Emerging Insights:
The Agricultural Technology Adoption Initiative

#EvidenceSummit

J-PAL
ABDUL LATIF JAMEEL POVERTY ACTION LAB

atai AGRICULTURAL TECHNOLOGY ADOPTION INITIATIVE

BILL & MELINDA GATES foundation

UKaid
from the British people

Overview

- Introduction to the **Agricultural Technology Adoption Initiative (ATAI)**

- Emerging Insights on **Financial Services** for Smallholders:
  - Morning Panel: “Financial Services for Smallholders in Volatile Contexts”

- Emerging Insights on **Delivering Information** to Smallholders:
  - Afternoon Panel: “Adoption and Impacts of Improved Crop Varieties”
  - Precision Agriculture for Development

atai AGRICULTURAL TECHNOLOGY ADOPTION INITIATIVE

Motivation

2 billion people engage in smallholder farming. That's 500 million households, each on <10 hectares.

Globally, smallholders are the largest occupational segment of those living under $2 per day.

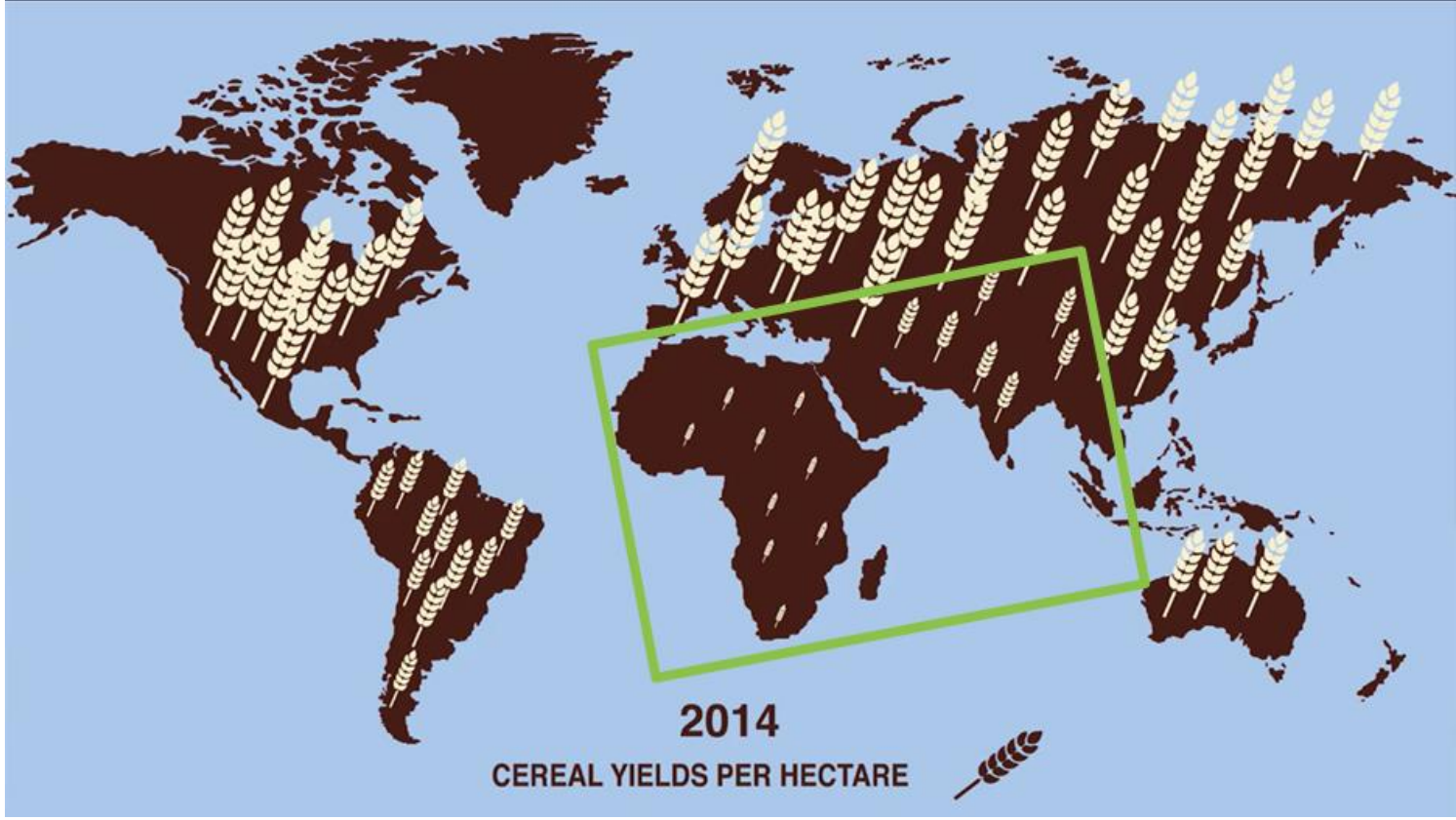
CGAP 2016

Credit: Mitch Harris

Motivation

Agricultural technologies exist that can

- boost productivity
- increase profits
- fortify the food supply

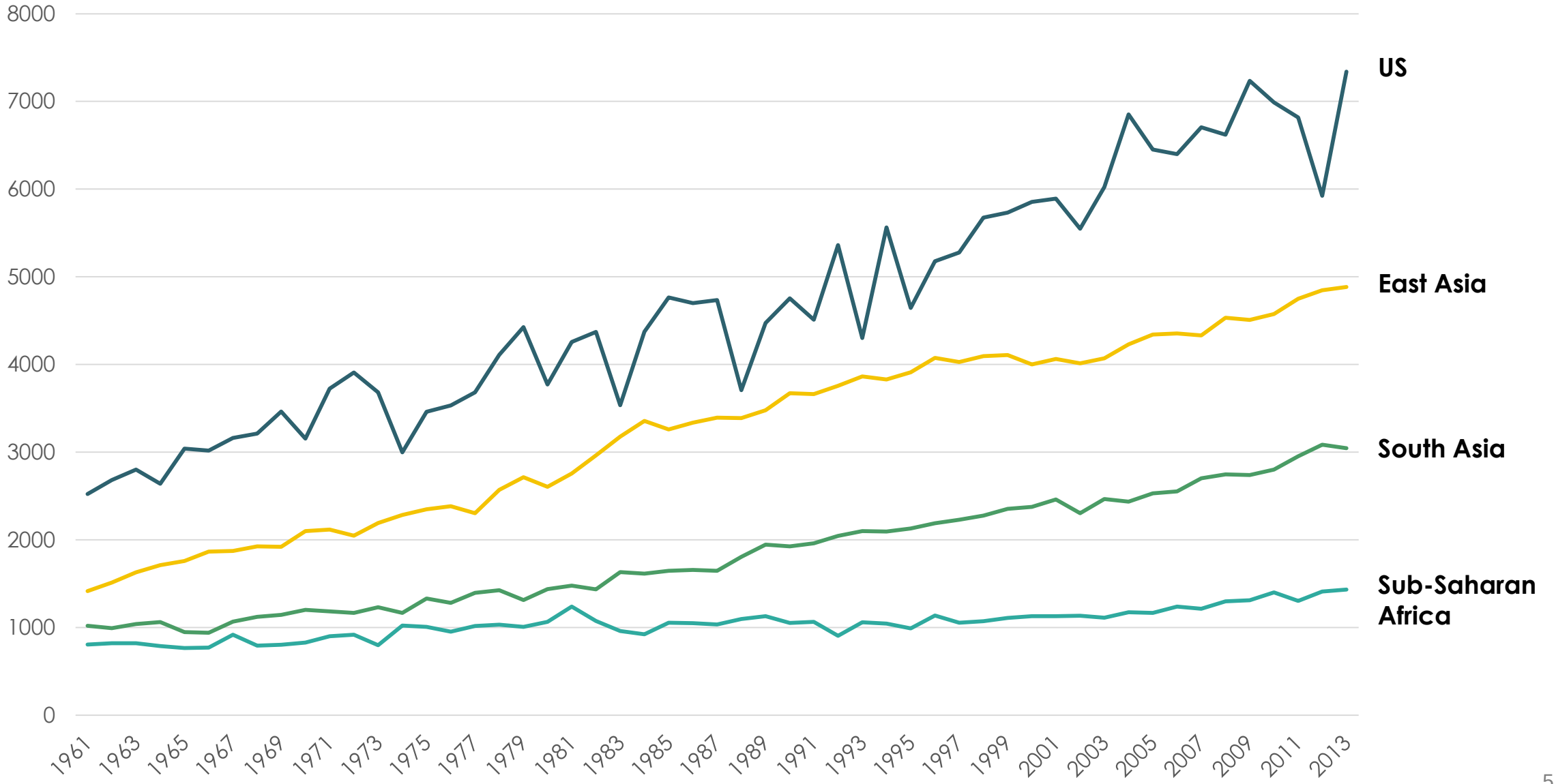


We've seen a "Green Revolution," yet agricultural productivity was not transformed everywhere.

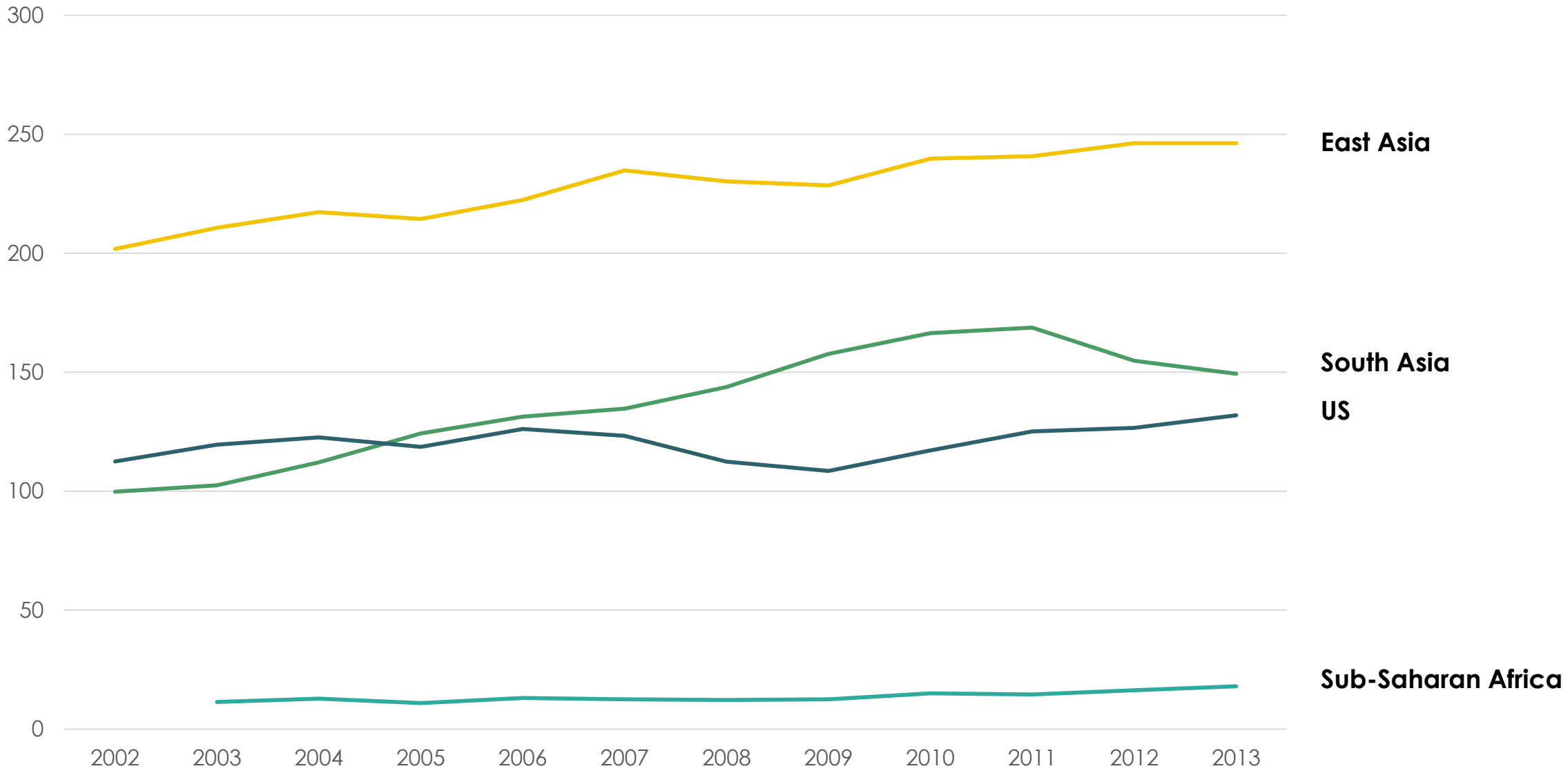
How can we improve smallholder farmers' profits and welfare?

Data Source: World Development Indicators, FAO via the World Bank

Cereal Yields (kilograms/hectare arable land)



Fertilizer Use (kilograms/hectare arable land)



atai AGRICULTURAL TECHNOLOGY ADOPTION INITIATIVE

Q: What helps and what hinders smallholder farmers' **adoption** of technologies and access to markets?

Which approaches **impact** farmer profits and welfare?

A: *...well, let's tackle this scientifically*

- ➔ Review available evidence: identify key research needs since 2009
- ➔ Mobilize research networks: fund competitively-selected, high-quality randomized evaluations
- ➔ Share findings: inform policy for better development

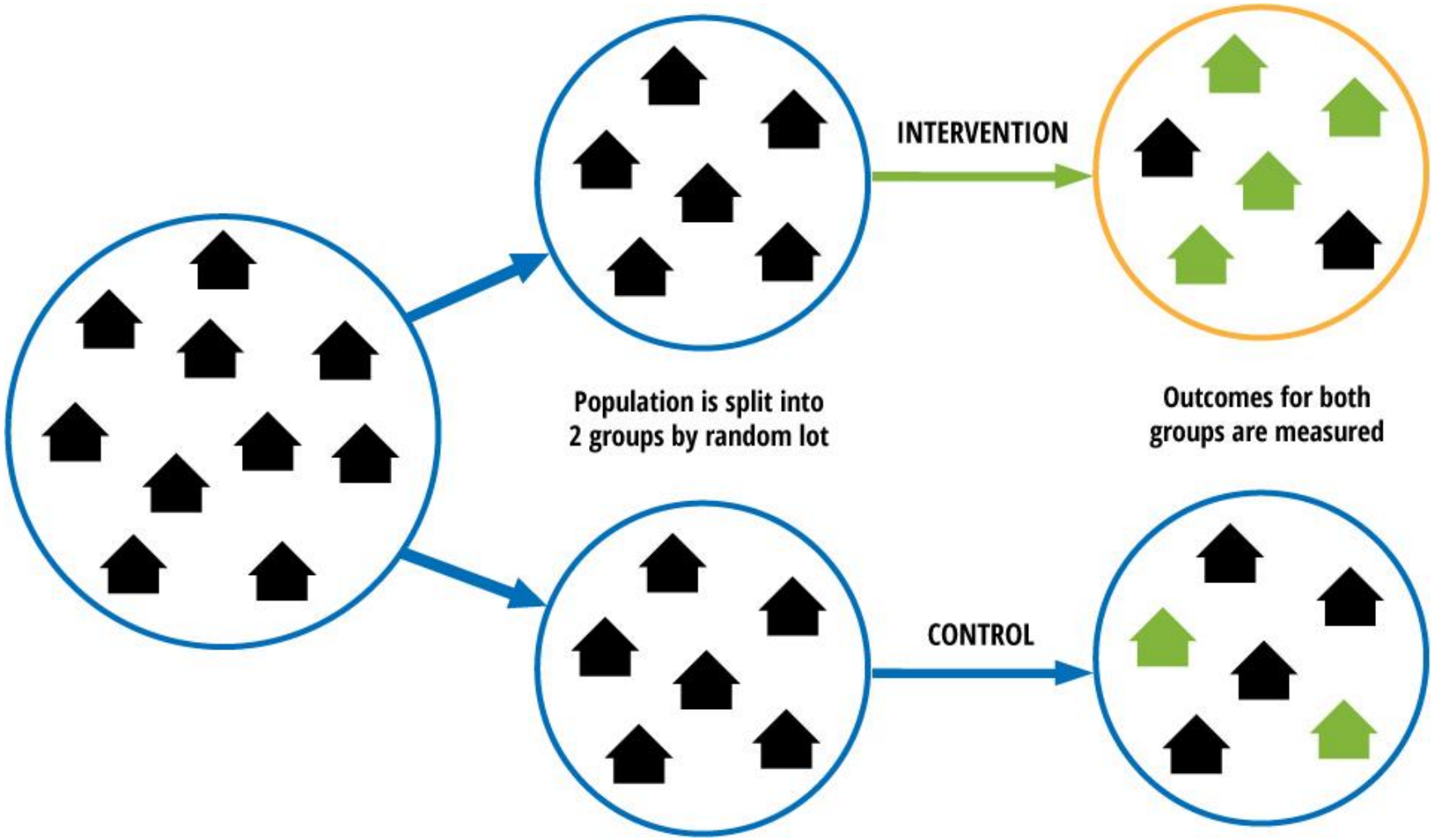
Why don’t farmers adopt technologies?

“Constraints” that prevent or discourage agricultural tech adoption

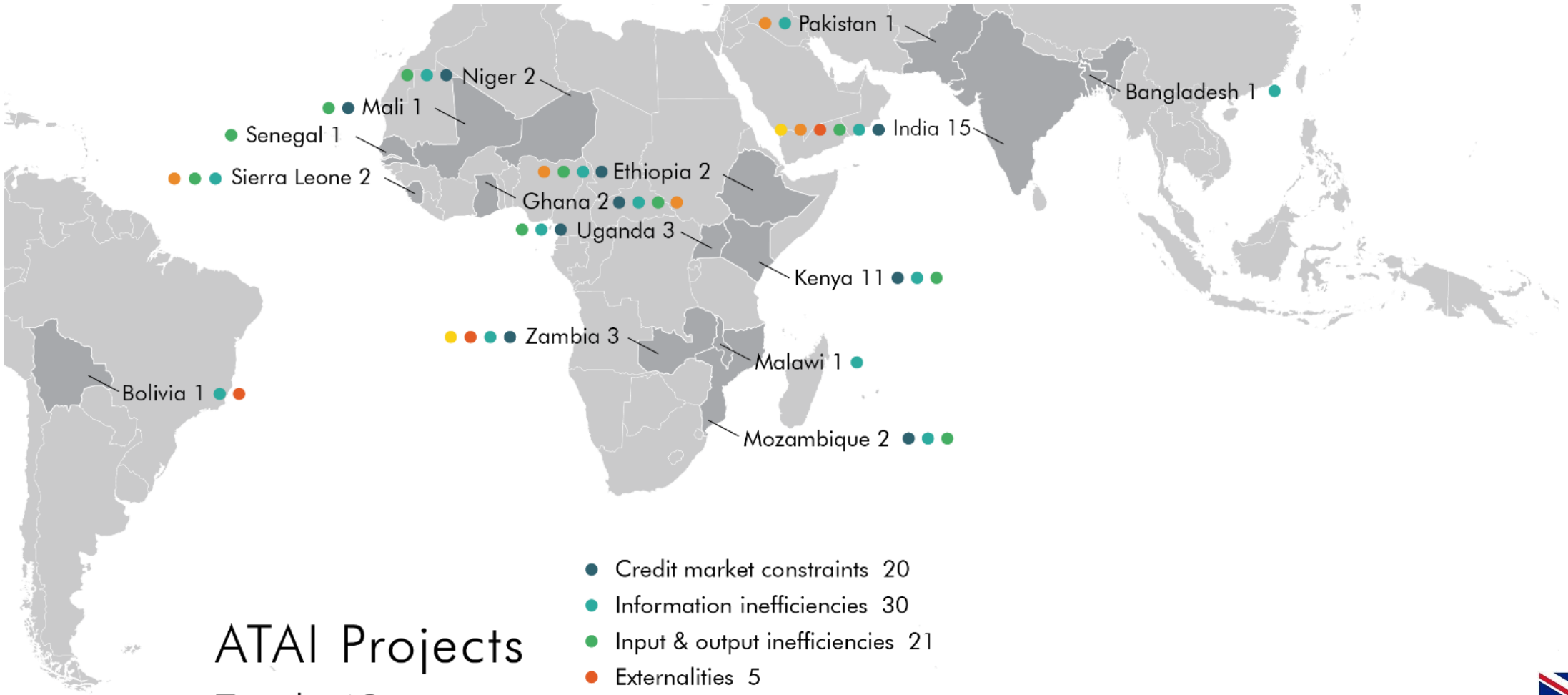
- **Credit and Savings**
  Not enough cash at the right times - how can I invest?
- **Risk**
  My yields might be diminished for uncontrollable reasons - why invest?
- **Information**
  What technologies could help me achieve which benefits?
  How would I change my investments and farming practices to reap the benefits?

Also constrained by land, labor, input and output markets, and externalities

Randomized evaluations provide the most rigorous estimate of program impact



atai AGRICULTURAL TECHNOLOGY ADOPTION INITIATIVE



ATAI Projects

Total: 48

- Credit market constraints 20
- Information inefficiencies 30
- Input & output inefficiencies 21
- Externalities 5
- Risk market inefficiencies 11
- Labor inefficiencies 5
- Land inefficiencies 0

BILL & MELINDA GATES foundation

UKaid
from the British people

Context: Financial Services for Smallholders

- Risk, credit and savings as **constraints** on technology adoption
- **Emerging Insights**: evidence on credit and risk for smallholders
- Research **case studies** during the morning panel:

  "Financial Services for Smallholders in Volatile Contexts"

How does risk constrain adoption?

- Smallholder agriculture is a risky activity with significant uncertainty
  - Weather and disease risks are aggregate, affecting all farmers in geographic area
  - Extreme weather events can destroy a large portion of harvest, increasingly likely given climate change

- Without any way to mitigate or insure risks, investment in crops or technologies appears to be an unsafe gamble
  - Higher-value crops may also be more sensitive to weather
  - Farmers make conservative production decisions to self-insure

A decade of evidence on weather index insurance (WII)

10 randomized evaluations in various contexts

- India, Ethiopia, Ghana, Malawi
- Differences in crops insured, conditions that triggered payout, etc.
- Examine effects of discounts, others encouragements to purchase insurance
- Where possible report effects on production decisions

BULLETIN

POLICY BULLETIN [FEBRUARY 2016]

J-PAL CEGA atai

MAKE IT RAIN

Weather index insurance protects farmers against losses from extreme weather and facilitates investment in their farms, but randomized evaluations in South Asia and sub-Saharan Africa have shown low demand for these products at market prices, suggesting the need for alternative approaches.

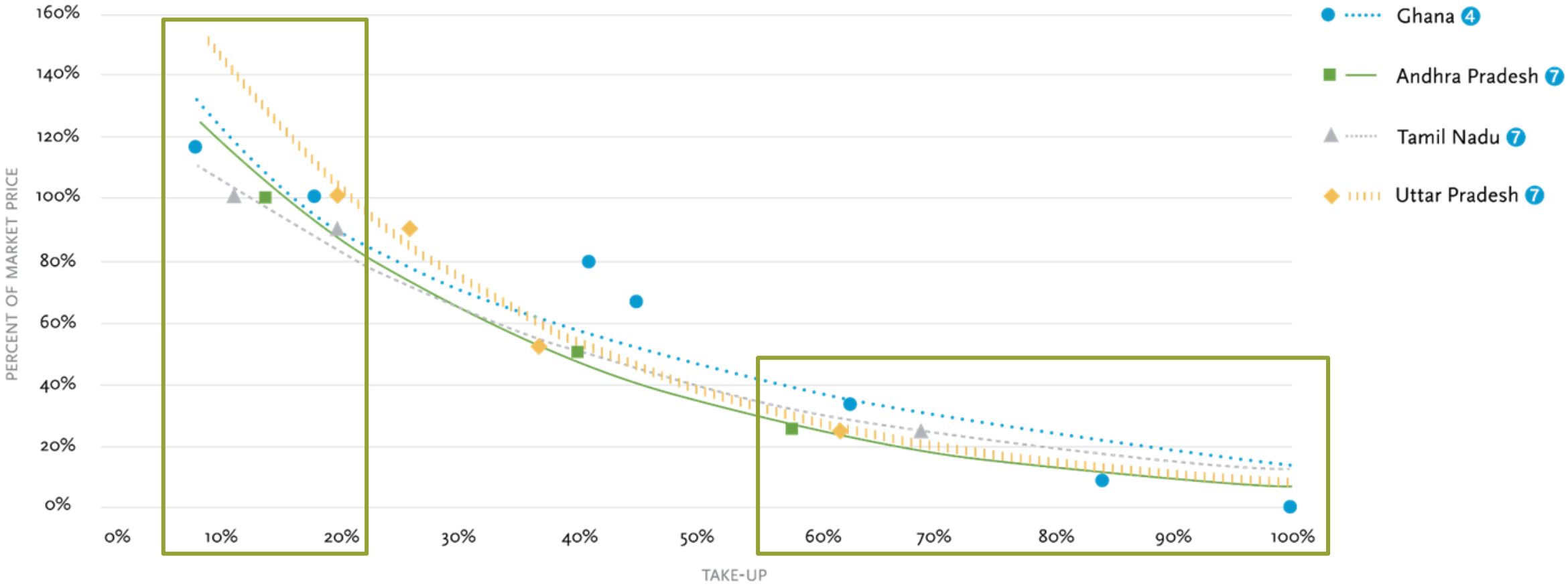
Floods, droughts, heat waves, cold spells, and other natural disasters are large sources of risk for farmers. For instance, in semiarid areas of India, 89 percent of farming households cited drought as the largest risk to agricultural production. Climate change may make weather patterns more extreme and unpredictable, further exposing already vulnerable smallholder farmers.

A drought, heat wave, or other disaster can lead to a poor harvest, leaving uninsured farming households with little income for the season. In order to cope with unpredictable weather, farmers often plant low-risk, low-return crops instead of investing in more profitable crops that are more sensitive to weather. In India, farmers may plant sorghum, a low-risk crop, instead of groundnut, a higher-risk cash crop. Furthermore, farmers wary of bad weather may hesitate to

ATAI "Make It Rain" 2016.

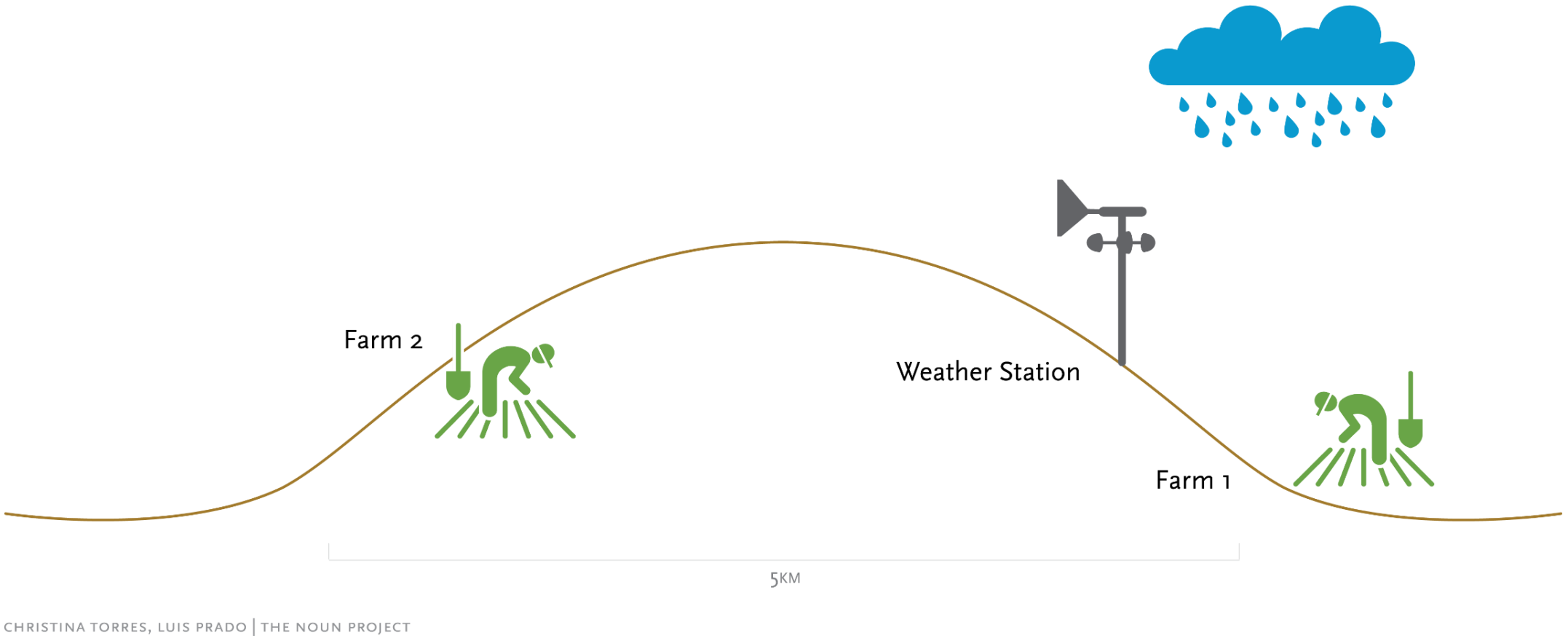
Limited demand for WII at commercial prices

- Take-up ranged from only 6-18% at market prices
- Though (very) large subsidies did increase demand



Gaurav et al 2011; Karlan et al 2013; Mobarak & Rosenzweig 2012

Major drawback to index insurance: basis risk



Also may be constrained by limited financial literacy or distrust

WII can protect against shocks, encourage investment

- **Mexico (CADENA)**: insured farmers plant more the year after a shock than non-insured farmers (de Janvry et al.)
- **Kenya (IBLI)**: insurance helps pastoralists avoid decapitalizing livestock in response to drought (Janzen & Carter)
- In **Andra Pradesh**, farmers with insurance are 6ppts more likely to plant cash crops (Cole et al.)
- In **three different states in India,** insured farmers used riskier, higher-yielding production technology (Mobarak et al.)
- In **Ghana**, index insurance induced farmers to plant more maize and use more fertilizer (Karlan et al.)

Worthwhile to consider product innovations that induce take-up at market prices

Weather Index Insurance and Credit in Ethiopia:

Dealing with drought and climate risks to food supply

Alexandros Sarrís
Professor in the Department of Economics
University of Athens

Credit constraints in action

There is no credit available

Farmers struggle to save income from one harvest to the next

Farmers don’t have collateral to back a loan

Farmers often lack financial literacy

*Risk mitigation is critical, can be even more binding

Credit is also lacking for smallholders

- Farmers' credit needs are different from urban microcredit customers
  - **Risks** of potentially unavoidable default are high, and shared among farmers (e.g. all face the same drought year)
  - **Profits** in farming are low without complementary investments
  - **Timing** of most loans are poorly timed to fit seasonal production cycles and price fluctuations
- Take-up of traditional credit products is often low

→ Few financing providers are available, and suitable products rarely offered

So how can we make credit work where it's needed?

Reduce risk for lenders (supply)

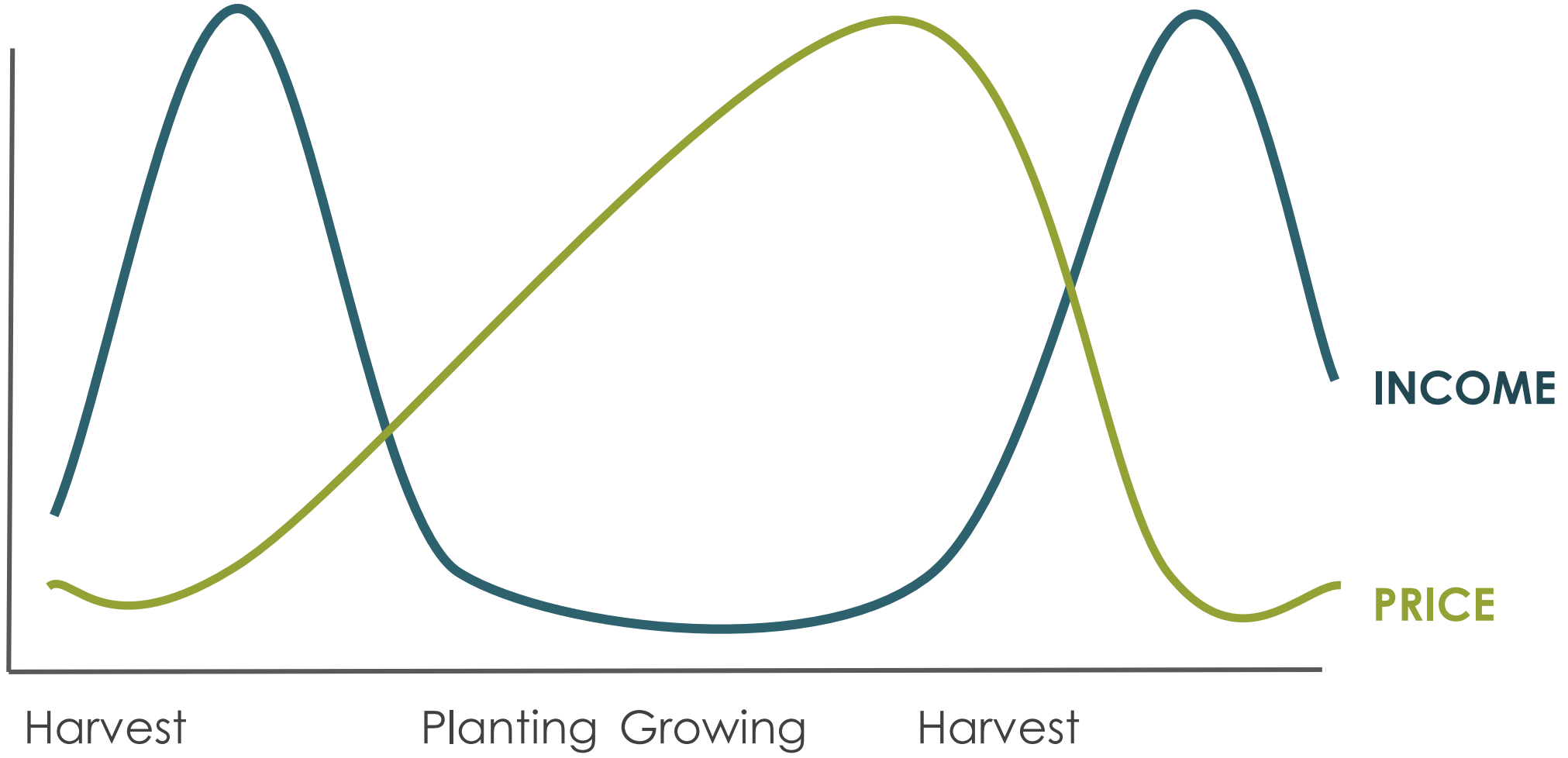
- improved information about borrowers (e.g. credit bureaus, biometric identification)
- new channels may help connect farmers to markets and lending institutions (e.g. digital financial services)

Provide products better designed for farmers' context (demand)

- account for farmers' collateral constraints (e.g. asset collateralization, crops held in storage)
- account for seasonal distribution of farmer income

De Janvry 2010; Gine et al. 2010;; De Laat et al. fort hcoming; Fink et al. 2014; Casaburi et al. 2014; Basu & Wong 2012; Burke 2014; Matsumoto et al. 2013; Beaman et al. 2014; Duflo et al. 2008

Seasonal cycles to production and prices



Designing products for seasonality

- Delaying repayment of loan until after harvest
- **Loans for consumption during “hungry season”**
- **Storage loans allow farmers to take advantage of price fluctuations**
- Savings products to save from harvest until planting time

Seasonal Food and Cash Loans:

Easing the hungry season in Zambia

Felix Masiye
Head of the Department of Economics at the University of Zambia

Providing loans and storage at harvest time:

Supporting smallholder farmers in Kenya facing price volatility and isolated markets

Edward Miguel
Faculty Director,
Center for Effective Global Action,
UC Berkeley

Context: Adoption and Impacts of Improved Inputs

- The role of information in the adoption of improved inputs and practices

- Research case studies during the afternoon panel:

  "Adoption and Impacts of Improved Crop Varieties"

- Precision Agriculture for Development

Why do farmers need information?

- Learning about a new agricultural technology is a fundamentally hard learning problem
- Information helps famers assess novel technologies, their risk profile and potential profitability
- If a farmer is to use a new technology effectively they need to know:
  - That it **exists**
  - Something **about its benefits and costs**
  - How to **use it effectively**

How to improve agricultural extension?

- Leverage social networks to get information to harder-to-reach farmers
  - A farmer is more likely to demand a new technology if a greater proportion of his/her network is demonstrating it
  - Intensity of exposure may be more important than equity
- Choose the messenger wisely
  - Contract field extension officers from within communities
  - Lead farmers most closely resembling target farmers were more effective at promoting a new technology
- Incentivize agents based on the levels of adoption among farmers

Beaman et al. 2015; BenYishay and Mobarak 2015, Ben Yishay et al. 2015, Jones and Kondylis 2015, Tjernstrom 2015

How to improve agricultural extension?

- Use ICT to reach many farmers, where they are, at more frequent intervals, with information suited to their specific context
- Include opportunities for feedback
- Identify systems and simple tools with timing and behavioral barriers in mind

Duflo et al. 2011, Duflo et al. forthcoming, Casaburi et al. 2014 , Cole and Fernando 2014, Hanna et al. 2012, Islam 2014, Masset and Haddad 2014

Adoption and consumption of Quality Protein Maize in Ethiopia:

Identifying mechanisms to support child nutrition with CIMMYT's NuME project

Hugo De Groote
Principal Scientist and Agricultural Economist
International Maize and Wheat Improvement Center (CIMMYT) in Kenya

Adoption of Maize Technology Bundles:

Implications for Productivity and Food Security

Tim Njagi
Research Fellow,
Tegemeo Institute

Precision Agriculture for Development (PAD)

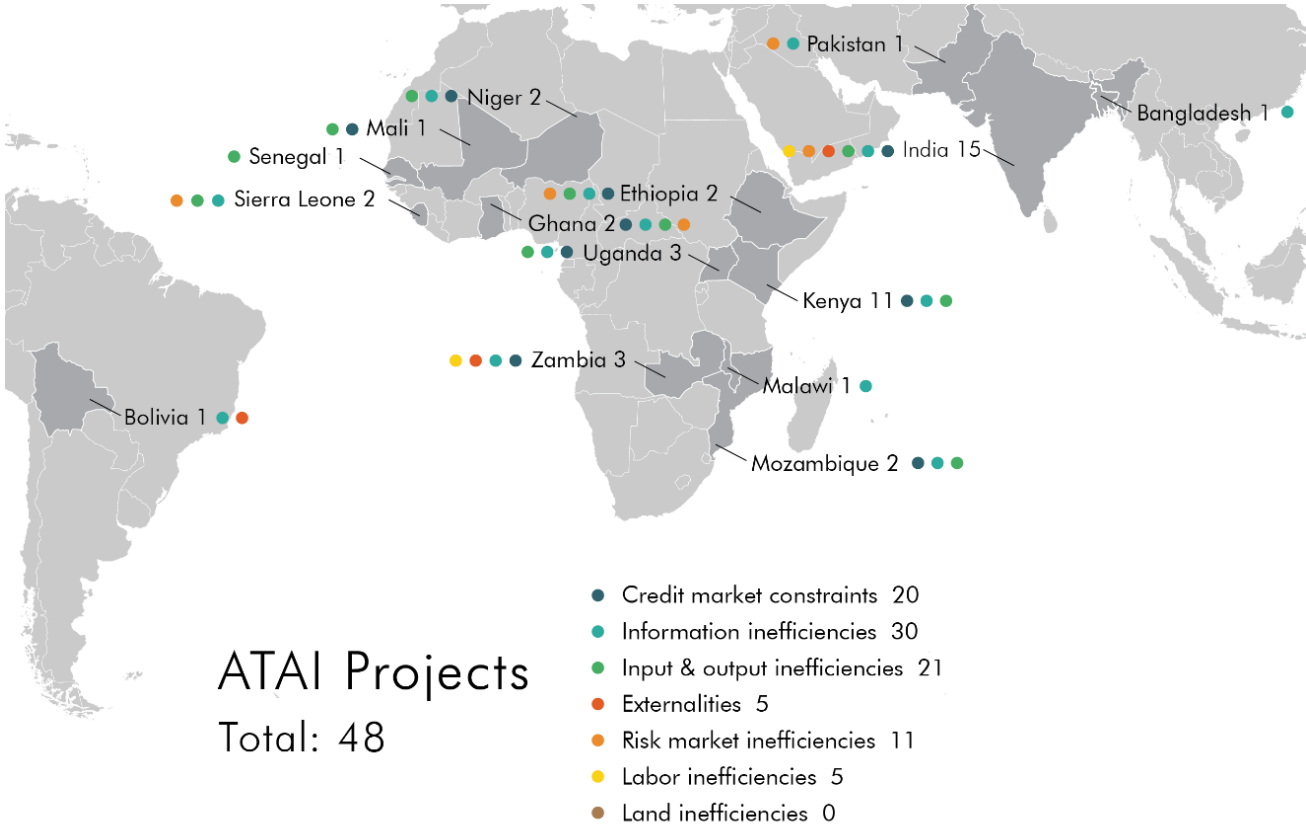
Carolina Corral
Kenya Country Director, PAD

Credit: USAID

atai AGRICULTURAL TECHNOLOGY ADOPTION INITIATIVE

Join Us

- Evidence dissemination events
- Emerging Insights policy briefs
- Research publications
- Matchmaking
- Customized trainings
- Find resources at atai-research.org



CEGA

J-PAL ABDUL LATIF JAMEEL POVERTY ACTION LAB

BILL & MELINDA GATES foundation

UKaid from the British people

Credit & Savings

- Access to capital can affect ag activity, yet credit take up is generally low
- Lack of credit is unlikely *the* primary constraint to agricultural investment
  - Address risk -- credit alone unlikely to increase ag tech adoption
- Some strategies have increased liquidity
  - Improved information about borrowers (credit bureaus, biometric IDs)
  - Flexible collateral arrangements (asset-collateralization), using crops as collateral (harvest inventory credit schemes) or savings (storage solutions)
  - Accounting for farmers' seasonal distribution of income (allow repayment after harvest, and/or help farmers save for inputs needed at planting time -- can increase purchase of inputs)
  - Labels or commitment devices to allocate resources for certain times

Evidence from 18 studies

Risk

- Risk mitigation approaches can impact yields and farmer welfare
- Weather index insurance can increase investment/risk-taking in production decisions, but has limited commercial viability (low demand at market prices)
  - Linking credit with insurance: mixed results, low demand
  - Demand for insurance increases when farmers observe payouts over time
  - Improving financial literacy and understanding of an insurance product increases take-up, but the cost of the training is much higher than the full cost of premiums.

New risk-mitigating crop varieties provide a promising alternative to insurance when targeting individual farmers' risk, and can produce higher yields

Evidence from 13 studies

Information

- Agricultural extension is most common approach, but use is low.
  - Sometimes ineffective because they promote something unprofitable (look beyond yields to profits)
  - If on a profitable practice, can be helpful to overcome behavioral biases (e.g. procrastination)
- Adapting the pedagogical model can impact agricultural activity.
  - Easily accessible or more tailored to specific farmers at a given moment
  - More likely to follow advice from someone similar to them or from multiple people in their network.
  - Extension agents (trainers) are more effective when incentivized
- Training can be effective and important to adopt novel tech (e.g. improved seeds)
- Evidence from 13 studies

Input & Output Markets

Providing price information

- In isolation: unlikely to affect incomes or price levels, lack sufficient bargaining power given high transport and other costs.
- To intermediaries or producers with direct access to markets: market prices converge, producers may benefit.

Questions:

- Is lacking infrastructure a primary barrier? (ag commodities markets, WTP)
- Can enforceable contracts improve supply chains? (access, economies of scale, financial services, etc.)
- Does crop quality information transmit through value chains? (producers or intermediaries rewarded?)

Evidence from 5 studies (multiple in the field now)

Financial Services for Smallholders in Volatile Contexts

Weather Index Insurance and Credit in Ethiopia
Alexandros Sarris

.....

Seasonal Food and Cash Loans in Zambia
Felix Masiye

.....

Harvest time loans and storage in Kenya
Edward Miguel

CEGA #EvidenceSummit

Adoption and Impacts of Improved Crop Varieties

Quality Protein Maize for Child Nutrition in Ethiopia
Hugo De Groote

Adoption of Maize Technology Bundles in Kenya
Tim Njagi

Precision Agriculture for Development
Carolina Corral

CEGA #EvidenceSummit

Looking Forward:
Priorities for Agricultural Policy and Research in East Africa

#EvidenceSummit

J-PAL
ABDUL LATIF JAMEEL POVERTY ACTION LAB

atai AGRICULTURAL TECHNOLOGY ADOPTION INITIATIVE

BILL & MELINDA GATES foundation

UKaid
from the British people