Agriculture in the Developing World

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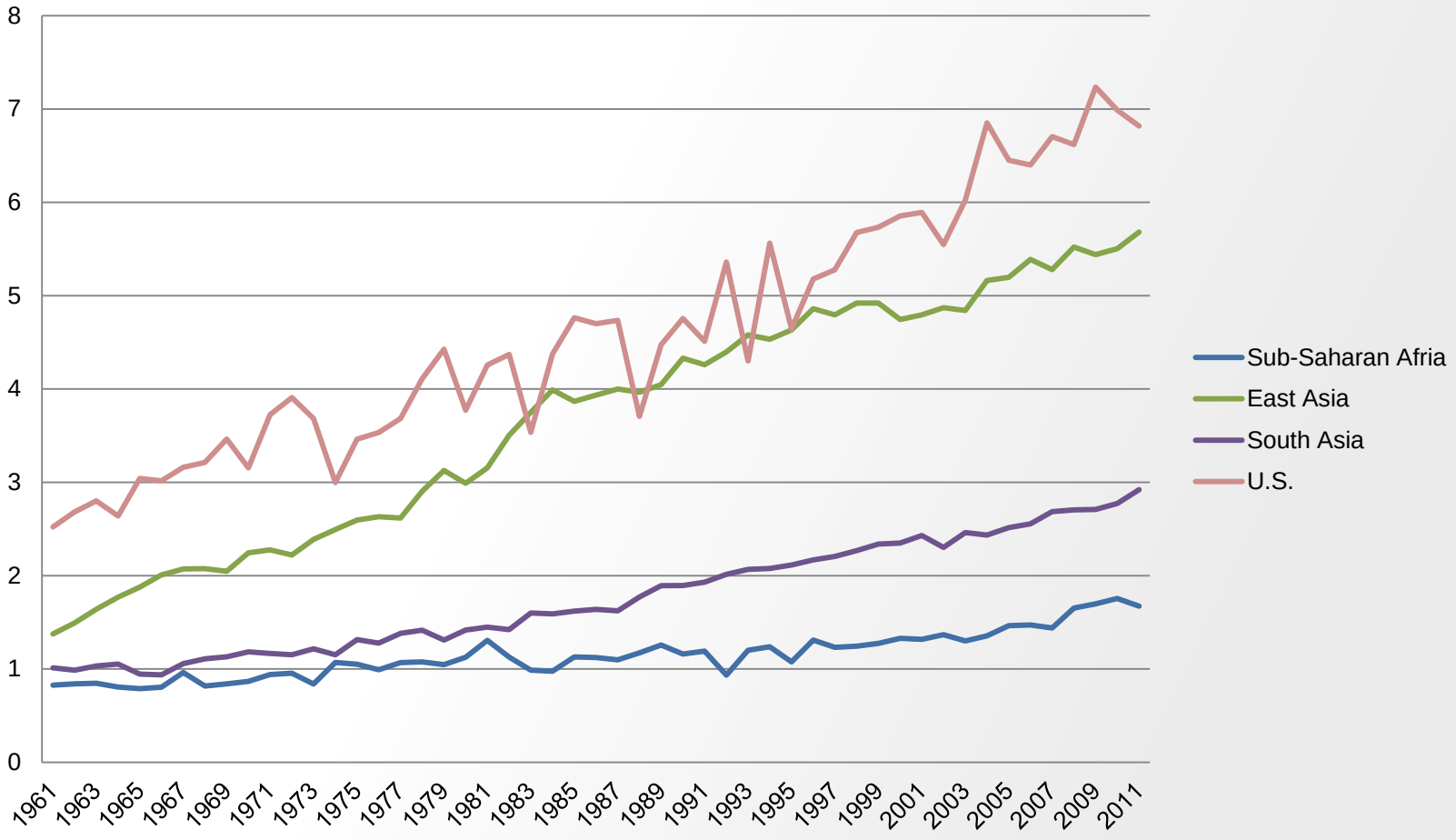
22 January 2016

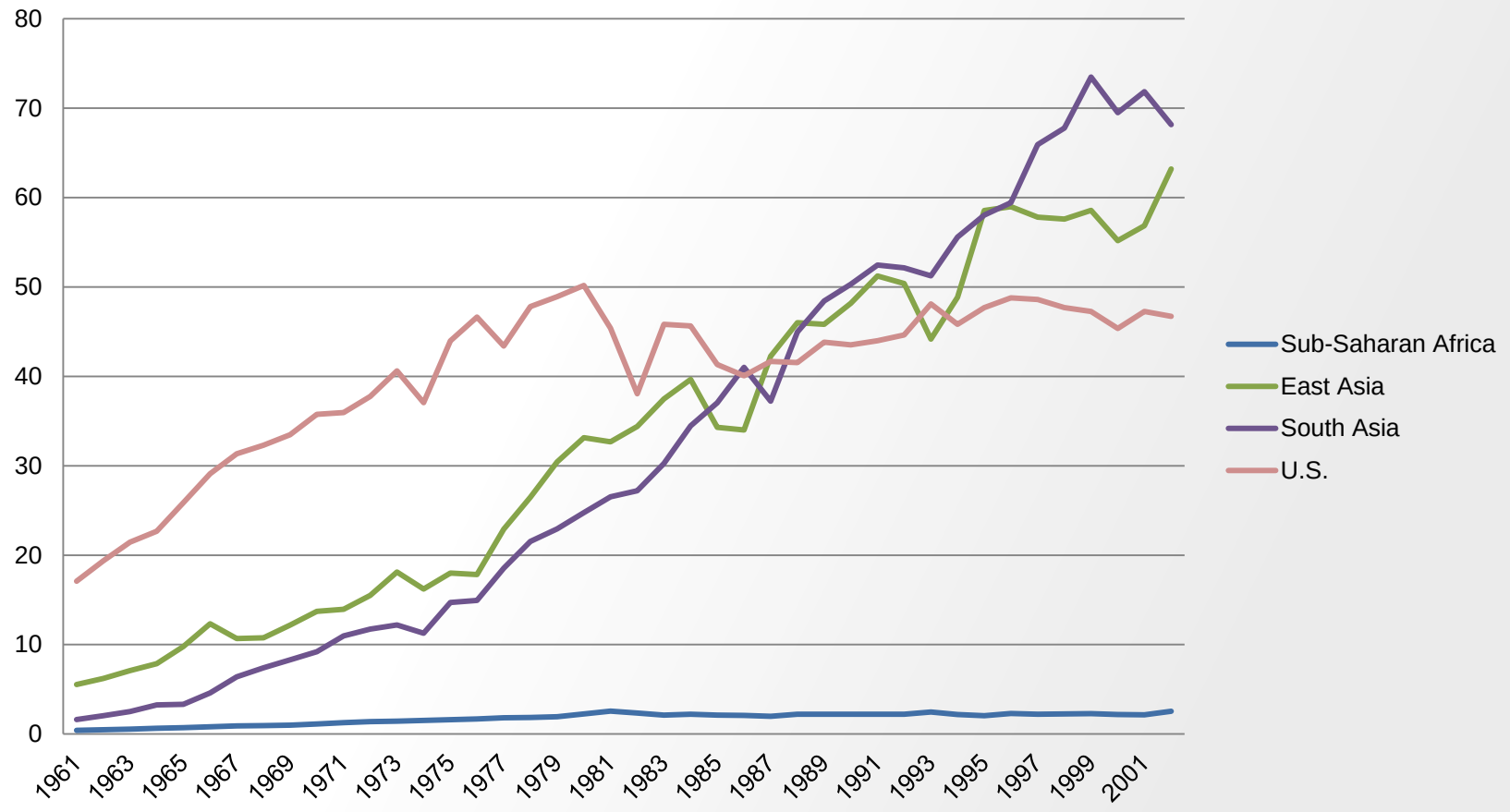
Overview

- Constraints in Agriculture
- Lessons I: Information
- Lessons II: Credit
- Lessons III: Risk
- Lessons IV: Input/Output Markets
- Conclusion

Cereal Yields (Metric Tons/Hectare)



Fertilizer Use (Metric Tons/Hectare)



What is hampering technology adoption?

Market Inefficiencies

1. Credit markets
2. Risk markets
3. Information
4. Input and output markets
5. Externalities
6. Labor markets
7. Land markets

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Profits vs. Yields

Governments and NGOs provide advice is designed to maximize **yield**, rather than maximize farmer profit

Farmer decisions are based on **profit**, not yield

Duflo et al 2008, Hanna et al 2013

Why do farmers need information?

- 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:
  1. That it **exists**
  2. Something **about its benefits and costs**
  3. How to **use it effectively**

How do farmers receive information?

- Government or NGO extension services
  - Test plots
  - Trainings
- Social learning
- Direct to farmers
  - Door-to-door
  - ICT

Extension does not change behavior

- Traditional extension has little effect
  - Test plots
  - Farmer field schools
  - Train and visit
  - Training seed farmers

Duflo et al 2008, Blair et al. 2013, Kondylis et al. 2014, Beaman et al. 2015, Duflo and Suri, forthcoming

Improving extension services

- Incentives may improve adoption
  - Extension officers
  - Lead farmers
- Feedback on extension may help
  - Improves satisfaction
  - Improves knowledge in certain circumstances

BenYishay and Mobarak 2013, Ben Yishay et al. 2015, Jones and Kondylis 2015, Masset and Haddad 2014

Social learning

- The messenger matters
  - A farmer is more likely to demand a new technology if a greater proportion of his/her network is demonstrating it
  - Lead farmers most closely resembling target farmers were more effective at promoting a new technology

Ben Yishay et al. 2015, Beaman et al. 2015, Tjernstrom 2015, BenYishay and Mobarak 2013, Tjernstrom 2015

What is working?

ICT

New crops

Behavioral barriers

ICT to reach farmers directly

- Interventions using mobile phones to provide information to farmers have been shown to increase adoption and improve yields

Cole and Fernando 2012, Casaburi et al. 2014

Mobile Phone-Based Agricultural Extension

- Gujarat, India
- 2011-2012
- Center for Microfinance
- Awaaz.De

Cole and Fernando 2012

Mobile Phone-Based Agricultural Extension

- High take up and use of mobile platform
- Switch to more effective pesticides
- Increased adoption of cumin
- Some evidence of increased yields in cotton and cumin

Cole and Fernando 2012, Cole and Fernando 2014

Group Discussion

- When has information been a key constraint to adoption in your projects?
- How was the information delivered?
- Was timing important to the information?
- Was the learning particularly difficult?

Summary: Information

- General extension is often ineffective
- Information given to farmers may be wrong
- Extension may be improved
  - Incentives
  - Feedback
  - Leveraging social networks
- Successes
  - ICT
  - New crops
  - Behavioral barriers

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Agricultural credit is different

- Traditional microfinance model is inappropriate
  - Immediate repayment
  - Group liability
  - Mostly women
- Few self-sustaining agricultural credit markets have emerged
  - Few agriculture-specific products
  - Low demand from farmers

Credit constraints in action

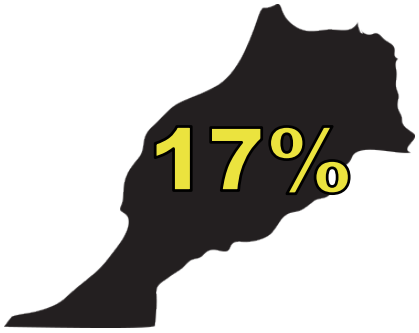
There is **no credit available**

Farmers **struggle to save income** from one harvest to the next

Farmers don't have **collateral** to back a loan

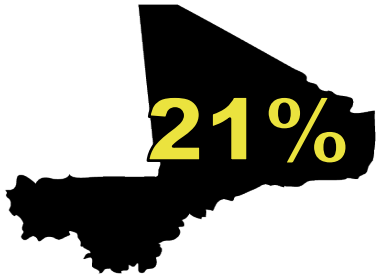
Farmers lack **financial literacy**

Take-up is low



Morocco: 17%, with no other lenders in the area

Sierra Leone: 25%, 50% lower than break-even rate



Mali: 21%, compared to full take-up of cash grants

Beaman et al. 2014; Casaburi et al 2014; Crepon et al 2015;

So how can we make credit work?

- Supply side
  - Reduce risk for lenders
- Demand side
  - Flexible collateral arrangements
  - Provide products that account for seasonality in production cycle

Reducing risk for lenders

- Provide **improved information** about borrowers
  - Credit bureaus
  - Biometric identification (e.g. fingerprinting)

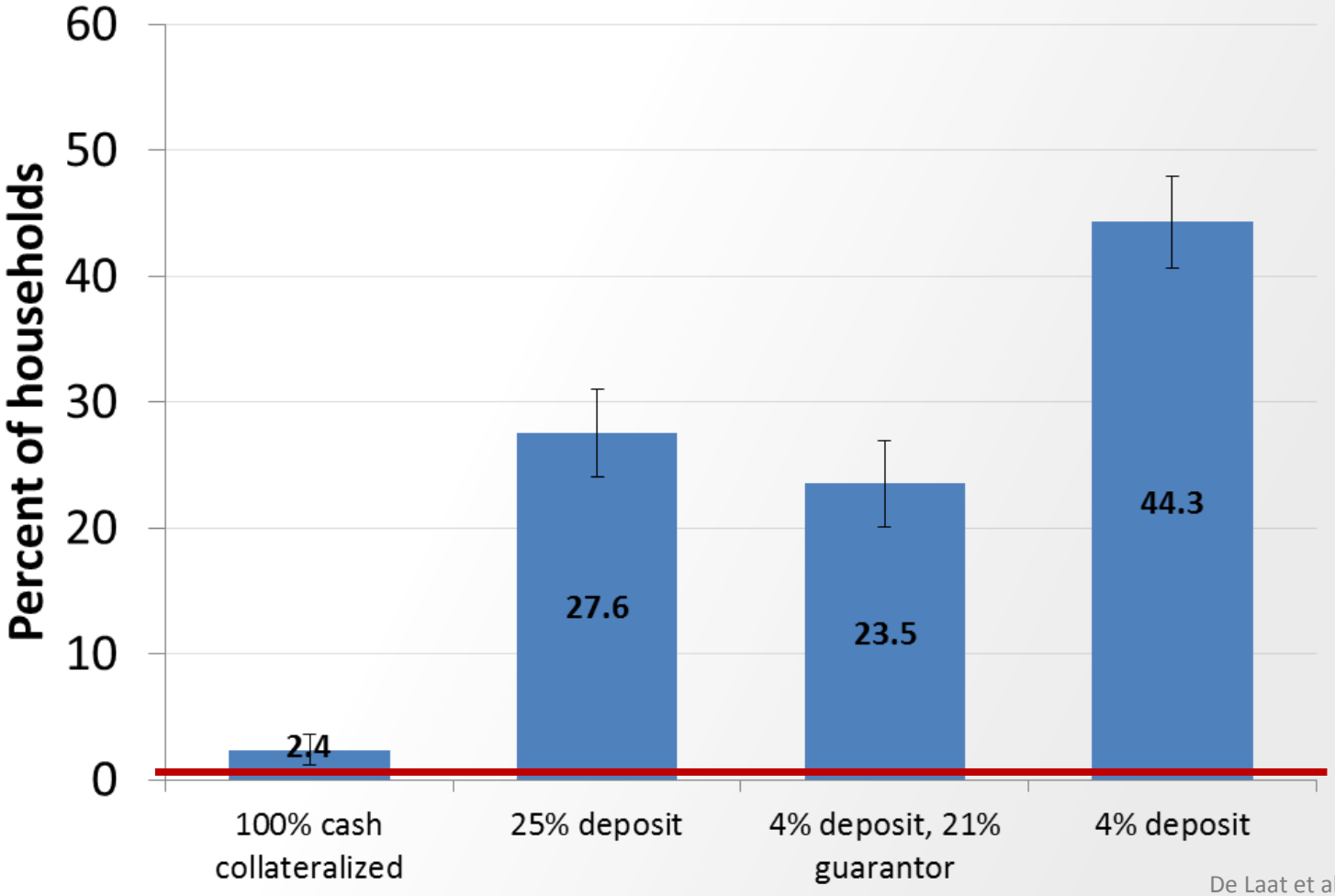
McIntosh & Wydick 2006, de Janvry et al. 2010, Gine et al. 2011

Flexible Collatoral Arrangements

- Rainwater harvesting tanks in Kenya for dairy farmers to collect water for cattle
- Variations in loan offers
  - Standard: 100% secured
  - 25% deposit, tank as collateral
  - 4% deposit, 21% pledge from guarantor, tank as collateral
  - 4% deposit, tank as collateral

De Laat et al. forthcoming

Increased take-up with no change in default



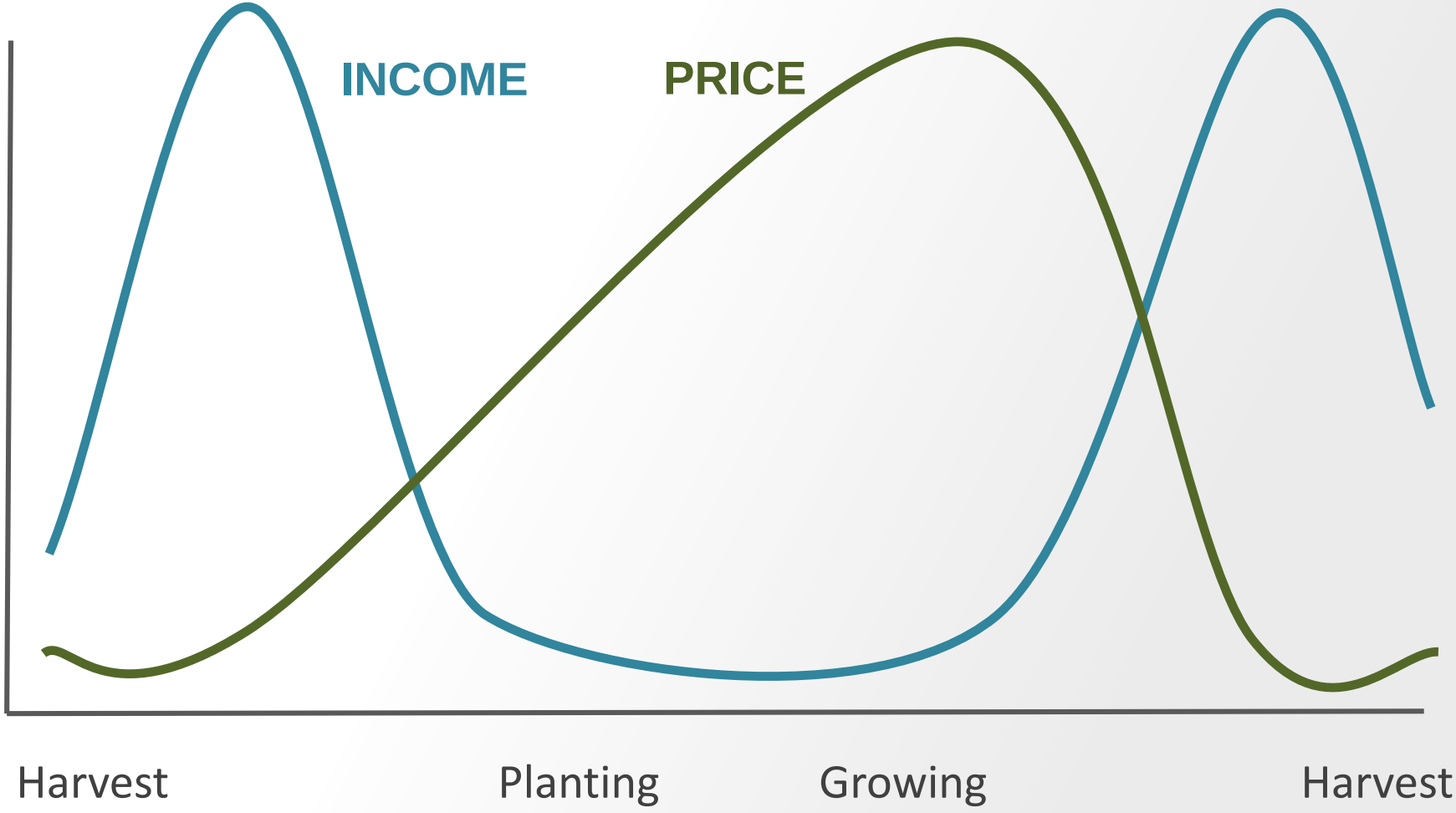
No default in all groups

De Laat et al. forthcoming

Designing products for seasonality

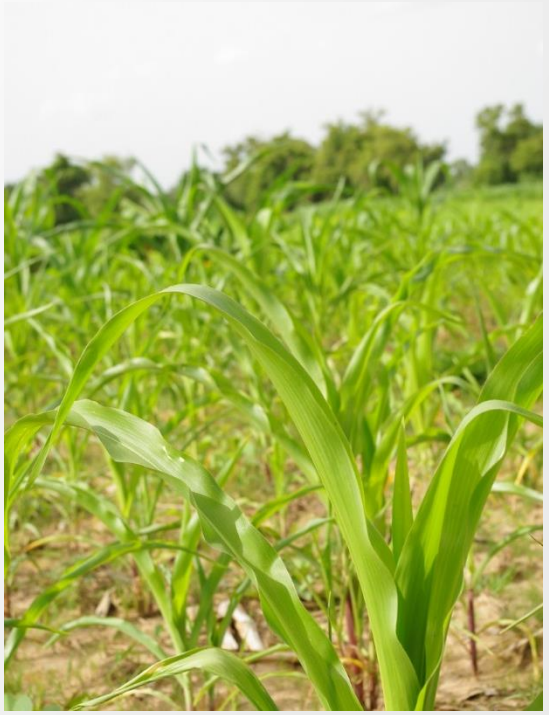
- Delaying **repayment** of loan until after harvest
- Loans for **consumption** during “hungry season”
- **Storage loans** to allow farmers to take advantage of price fluctuations
- **Savings products** to save from harvest until planting time

Seasonal cycles to production and prices



Harvest-time loans in Kenya

- Loans allowed farmers to:
  - Buy/keep maize at low prices
  - Store while prices rose
  - Sell later at higher prices
- Temporal arbitrage increased profits
  - Concentrated in areas where fewer farmers offered loans



Burke 2014

Credit can affect agricultural activity…

- Mali
  - Households offered loans **spent more** on fertilizer, insecticides
- Morocco
  - Loans used to **invest** in agriculture and husbandry (purchase cattle or sheep)
- Kenya
  - Farmers switched to **higher-value** export crops
- Malawi
  - Farmers allocated **more land** to paprika, a cash crop

Ashraf et al 2009; Beaman et al 2014; Crepon et al 2015; Yang et al 2012

…but inconclusive evidence on profits

- Mali
  - Cash grants **increased** farm profits; loans increased value of output but not profits
- Morocco
  - Agricultural income increased, other sources decreased
- Kenya
  - Temporal arbitrage **increased profits**
- Sierra Leone
  - Storage loans had **no effect** on profits

Beaman et al 2014; Crepon et al 2015; Burke 2014; Casaburi et al 2014

Maybe credit is not the binding constraint

- Compared cash grants, weather index insurance, or combination
  - Northern Ghana
- Investment and activity increased about equally in groups given cash and groups given insurance
  - When risk constraint relieved, farmers were able to find credit from other sources

Karlan et al 2013

Summary: Credit

- Farmers' credit needs are **different**
- Take-up is often **low**
- Promising interventions
  - **Reduce risk** for lenders
  - Use **flexible collateral**
  - Account for **seasonal distribution** of income
- Access to credit affects farm activities, but mixed evidence on profit
  - Other constraints may be binding

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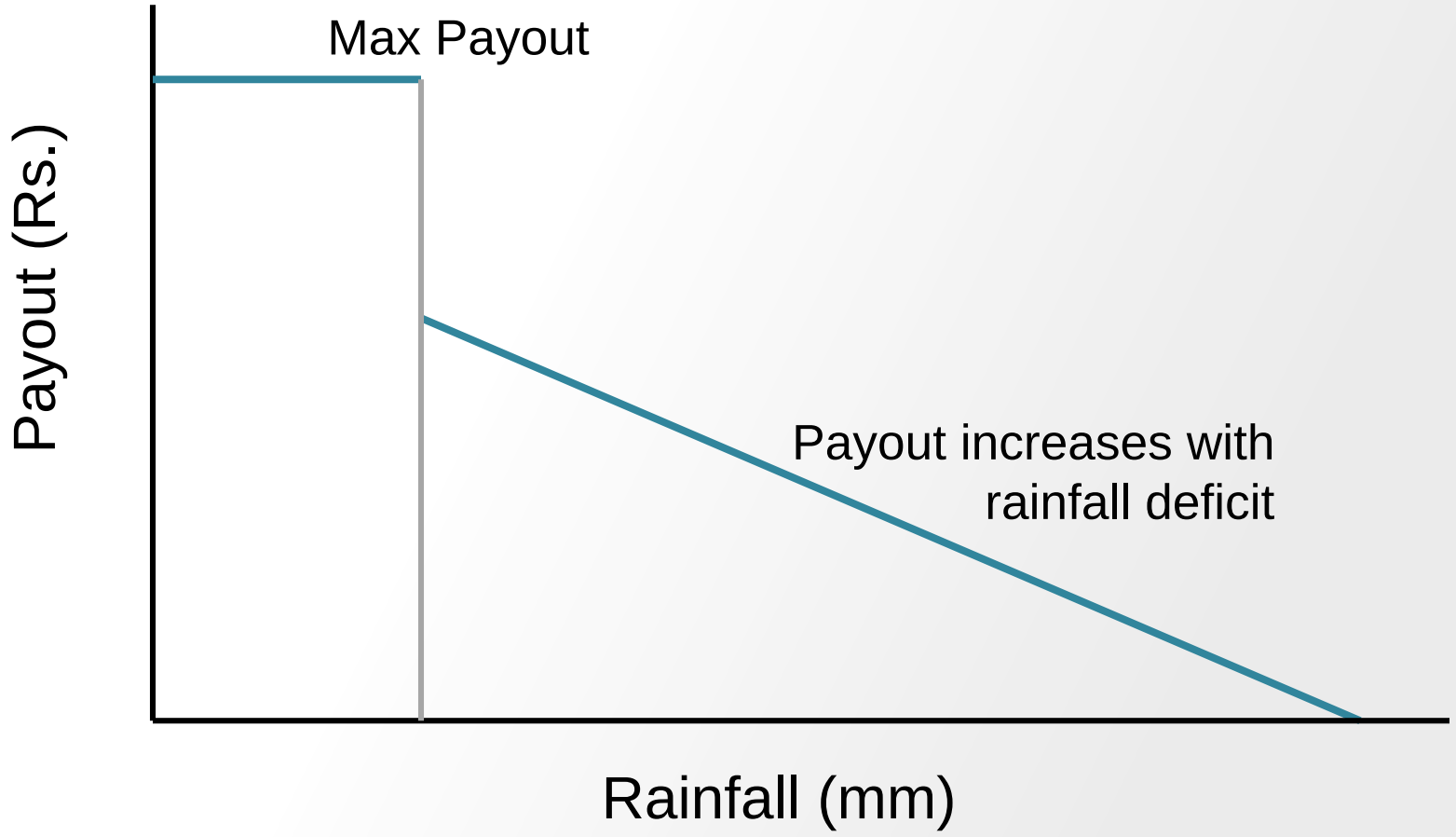
How does risk constrain adoption?

- Agriculture is inherently risky activity
  - Weather and disease risks are **aggregate**, affecting all farmers in geographic area
- Farmers may lose large portion of harvest to extreme weather event
- 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
- Exacerbated by **risk aversion** and **ambiguity aversion**

Protect farmers through formal insurance

- Agricultural insurance to hedge risk ubiquitous in developed countries
  - Large number of small farmers, poor regulatory environments make most traditional products **ill-suited** to smallholders
- Weather index insurance as innovation to insure smallholders
  - Payouts made on observable variable (e.g. rainfall)
  - Avoids some **disadvantages** of conventional insurance: lengthy claims process, adverse selection, moral hazard
  - But has **basis risk**: official observation does not accurately predict farmers' losses

Stylized index insurance payout schedule



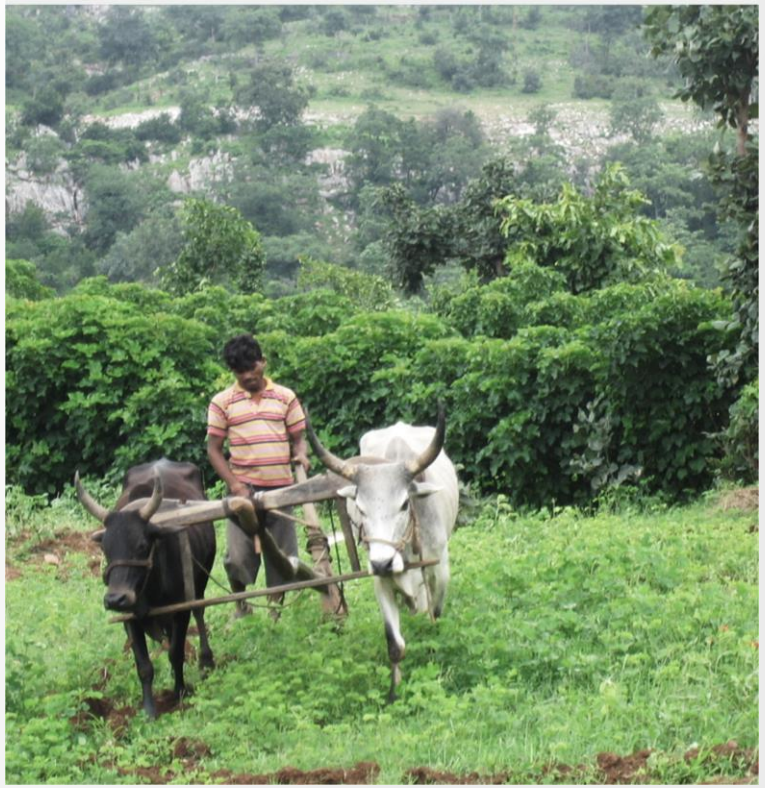
High commercial prices limit demand

- Take-up 6-18% at market prices
  - Those who purchase insure small portion of land
- Few examples of commercial weather index insurance products
  - Most insurers receive large subsidies or technical assistance
  - Subsidized, compulsory Weather Based Crop Insurance Scheme in India
- But (very) **large subsidies** increased demand
  - India: over 60% of farmers purchased insurance with 75% discount

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

Marketing, training had limited effects

- In series of experiments in Gujarat and Andhra Pradesh researchers tested:
  - Demand for insurance under a number of marketing techniques
  - Effect of financial literacy training
  - Demand for insurance over several seasons



Cole et al 2013; Gaurav et al 2011; Cole et al 2014

Marketing, training had limited effects

- Relatively low take-up with flyer and video marketing techniques
  - 24-29 percent (with various discounts)
  - No differences by content (NGO endorsement, positive v. negative framing of payouts, individual v. group benefits)
- Financial literacy training had **small effect**
  - Expensive compared to product price, profit margin
- Demand for insurance increased when there were payouts in a household's village in the previous year
  - Learn from experience, gain trust in product over time

Cole et al 2013; Gaurav et al 2011; Cole et al 2014

Insured farmers changed production

- When given free insurance, farmers took on greater production risks
  - In Andhra Pradesh, farmers who received insurance were 6pp more likely to plant **cash crops**
  - In Ghana, farmers increased the share of land planted to maize, **fertilizer use**

Cole et al 2014; Karlan et al 2013; Mobarak & Rosenzweig 2014

Group Discussion

- Financial products have suffer from limited adoption
- How important are financial products in your programs?
- Do you focus on credit, savings, insurance?
- What are your thoughts on improving the usefulness of financial products for farmers in Africa?

An alternative: Risk-mitigating crops

- Agricultural R&D on varieties that tolerate flood, drought, salinity
  - Increasingly important with **climate change**
- Swarna-Sub1 is a flood-tolerant rice variety
  - No yield penalty in normal conditions
  - Researchers tested effect in **real-life conditions** in Odisha, India

Dar et al 2015

Farmers given Swarna-Sub1 invested more

- Farmers given Swarna-Sub1 had higher yields in 2011 floods
- Farmers **invested more** in their farms
  - Cultivated more land
  - Applied more fertilizer
  - Switched to more effective, but higher-labor techniques
- Scale-up would benefit **marginalized populations** the most, as they are more likely to hold flood-prone land
  - IRRI has already distributed stress-tolerant seeds to over 10 million farmers in India

Dar et al 2015

Summary: Risk

- Risk is a constraint for smallholder farmers
  - Especially weather risk
- **Low demand** for weather index insurance as commercial product
  - Price, distrust, lack of financial literacy, basis risk
- Alternatives to help farmers manage risk
  - Rethink insurance: provide subsidized policies as cash transfer or sell to institutions
  - Promising preliminary results on **risk-mitigating crops**

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Input and output market inefficiencies

Farmers may be unable or unwilling to adopt new technology due to barriers within:

Input Markets

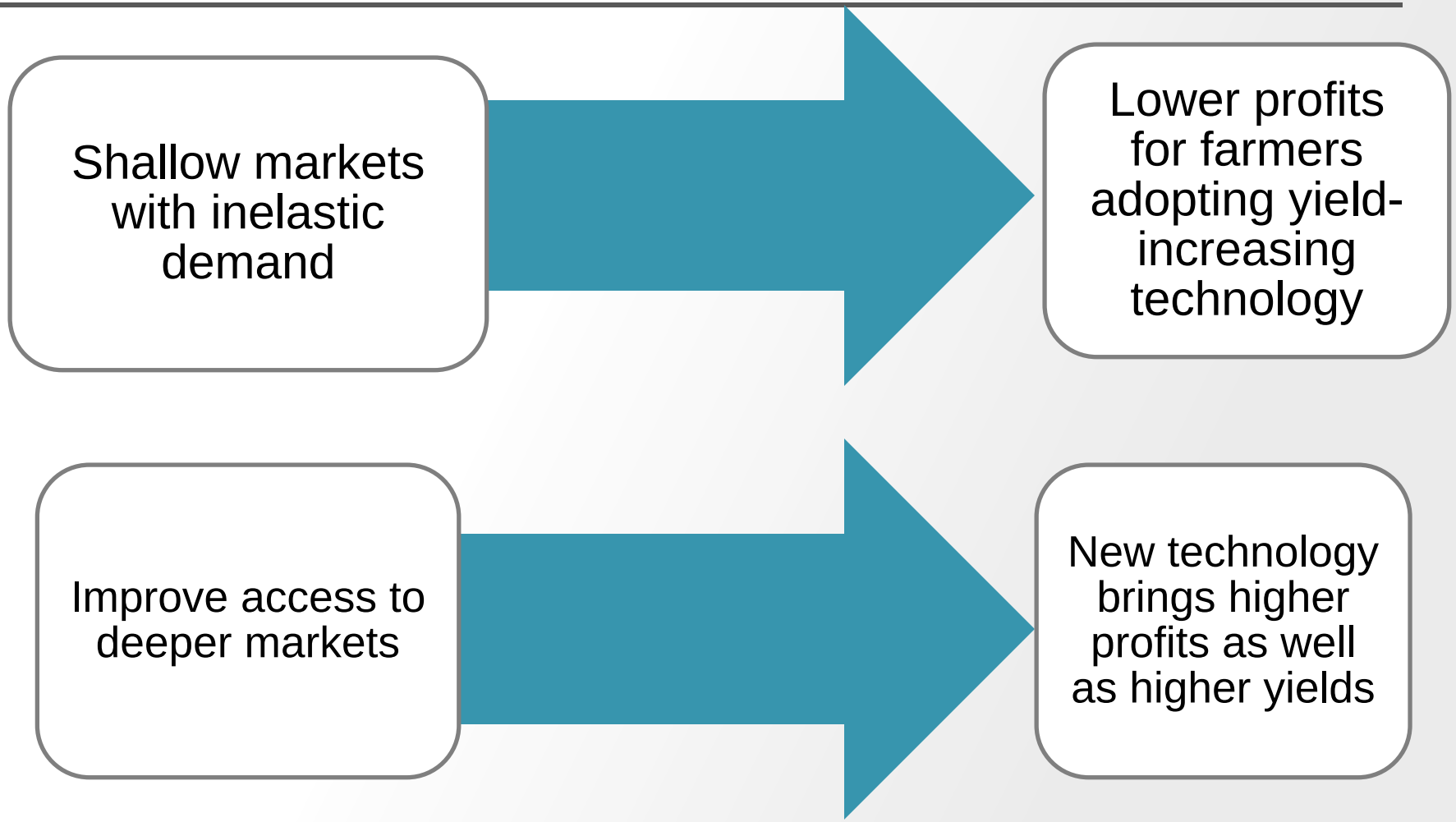
- Missing or incomplete supply chains
- Unprofitably high input prices

OR

Output Markets

- Lack of access to additional markets
- Low prices for yields, including high quality crops

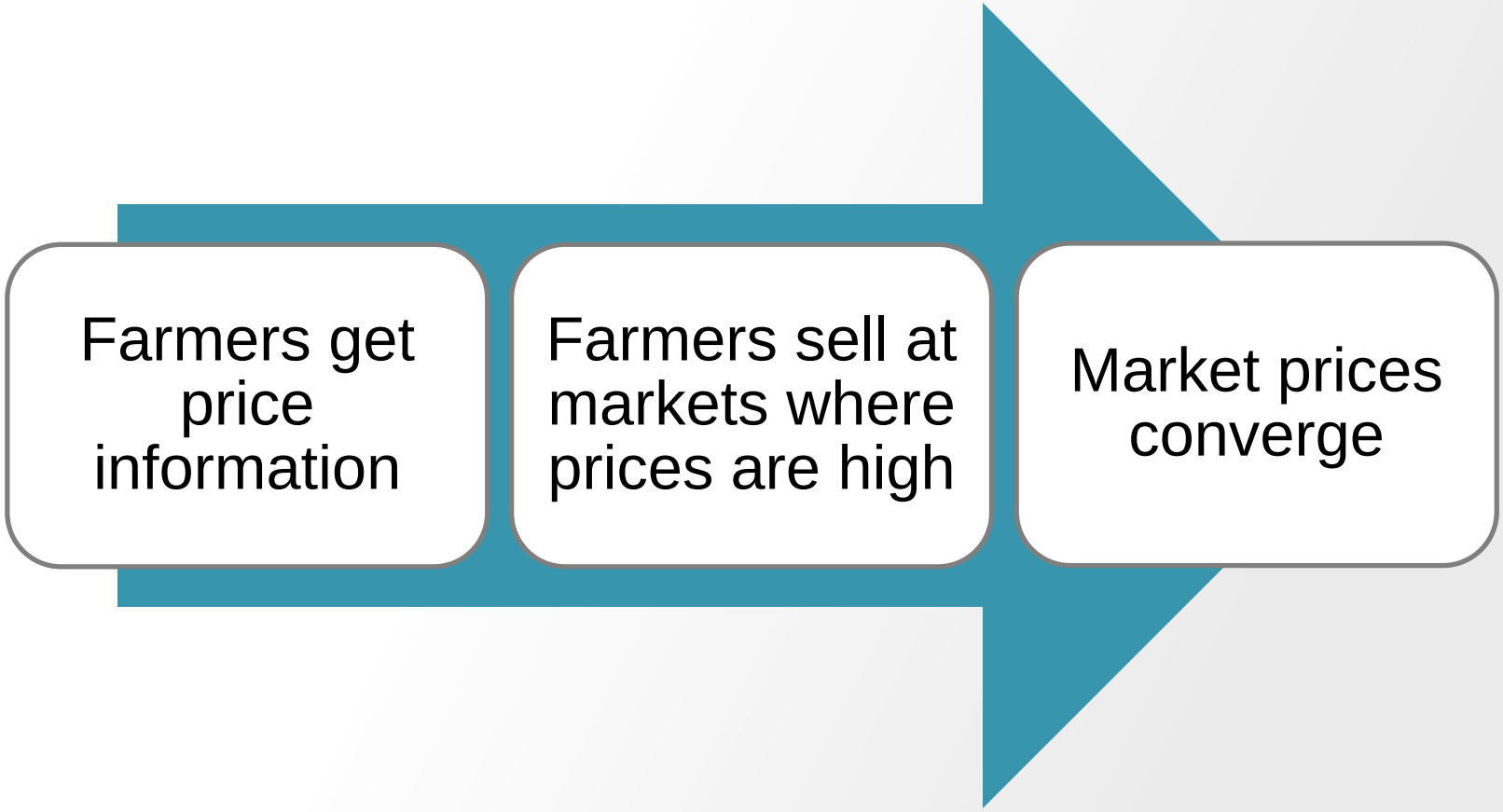
Effects of market structure



Group Discussion

- What are some ways to improve the functioning of input and output markets?
- What have you seen in markets that reduce the likelihood that farmers will adopt new technologies?

Theory of price information



Price information to farmers

- Limited effect on prices
- Farmers may change behavior
- No gain on average for farmers

Goyal 2010, Minten & Fafchamps 2012, Mookherjee et al 2013

Price information to others

- Price information is actionable
  - Traders
  - Fishermen
- Reductions in price dispersion
- Potential improvement in profits

Aker 2010, Jensen 2007

Price information and the market

- Farmers are unlikely to benefit from price information
- Members of value chains who can take action on the information can see benefits

Road Development in Sierra Leone

Road Development in Sierra Leone

Infrastructure: Road Development

Investment in roads lowers transportation costs and may increase access to and use of inputs

Summary: Input/Output Markets

- Price information has no positive effects on farmers, though other members of the value chain may benefit
- Infrastructure investment can decrease transport and input costs

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Take-aways

- The farmer's problem
  - Maximizing profit with limited labor, land, information, and capital within a restrictive market
- No silver bullets
  - Credit and insurance suffer from low uptake
  - Social networks not spreading information completely
- Silver lining
  - Mobile technology is a promising way to deliver timely information to farmers
  - Risk reduction can increase investment

Thank you

Contact

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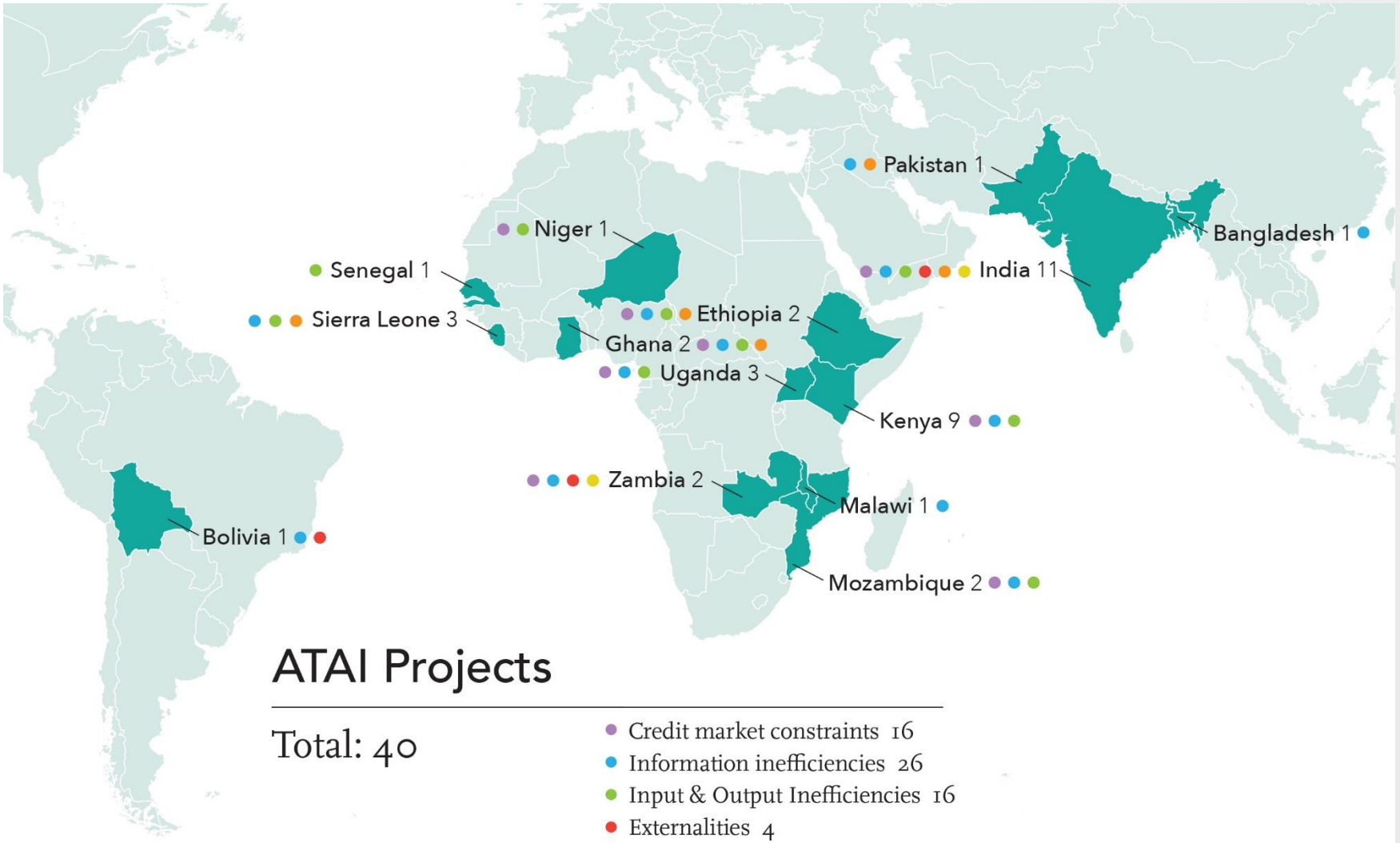

ATAI Projects

Total: 40

- Credit market constraints 16
- Information inefficiencies 26
- Input & Output Inefficiencies 16
- Externalities 4
- Risk market inefficiencies 9
- Labor inefficiencies 4
- Land inefficiencies 0

Basics

- J-PAL's first initiative, started in 2009
- Twelfth RFP to just opening
- Co-managed by CEGA
  - CEGA organizes RFP
  - J-PAL oversees awards and finance
  - Other activities are done jointly
- Funding
  - BMGF, DFID, an anonymous donor

ATAI Board

Officers

- Jeremy Magruder (UCB)
- Craig McIntosh* (UCSD)
- Tavneet Suri* (MIT)

Members

- David Ameyaw (AGRA)
- Richard Caldwell (BMGF)
- Shawn Cole (HBS)
- Alain de Janvry (UCB)
- Jon Robinson (UCSC)
- Kate Schneider (BMGF)

ATAI Secretariat

- Initiative Managers
  - Ben Jaques-Leslie (J-PAL)
- Initiative Staff
  - Leah Bridle (CEGA)
  - Anna Schickele (J-PAL)

Since the Start of ATAI

Category	Total
Farmers surveyed	108,814
Female farmers surveyed	47,819
Farmers whose behavior has changed	17,681
ATAI Awards	51
Unique ATAI projects	40
Countries with ATAI projects	14
Researchers on ATAI projects	89

Big Events

- Matchmaking I
  - Spring 2011, Washington, DC
- CGIAR Trainings
  - Winter and Spring 2012, Mexico City and Nairobi
- Matchmaking II
  - Winter and Spring 2013, Cambridge and Berkeley
- E2A: Evidence in Agriculture
  - Spring 2014, Berkeley
- SPIA Workshop
  - Winter 2015, Cambridge

Activities in 2015

Dissemination

- 3ie Delhi
- BMGF Learning Lunches in Seattle
- AGRA in Nairobi
- GDN Conference in Casablanca
- GFIA in Abu Dhabi
- ICT4Ag in DC
- USDA Presentation and Meeting
- *Upcoming:*
  - World Bank Seminar Series in DC
  - World Food Prize in Des Moines

Fundraising

- Awarded supplemental funding from BMGF
- Developing new proposal for grant in 2016
- Submitting proposal for research funding on credit

Research in Agriculture

What do you think?

Major Issues

Timeline of experiments

- Long crop cycles

Risk of bad events

- Weather and disease

Challenges in measurement

- Yield, land, and labor

Agriculture Policy Outreach

- Who are the key players?
- What are the major issues?

Organizations

CGIAR

- International Food Policy Research Institute (IFPRI)
- International Maize and Wheat Improvement Center (CYMMIT)
- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
- International Rice Research Institute (IRRI)

UN Organizations

- World Food Programme (WFP)
- Food and Agriculture Organization (FAO)

Organizations

Organizations in the United States	• USAID • USDA • Land grant universities
International Governments	• Ministries of Agriculture • Agricultural Research Centers

Organizations

Non-Profit Organizations

- CARE
- Save
- IGC
- BRAC
- One Acre Fund
- Cooperatives
- MFIs

For-Profit Organizations

- Unilever
- Mars
- Syngenta
- Mumias
- Fertilizer Companies

Major Issues

- Yields and farmer profit
- Technology use and sustainability
- Structural constraints
- Subsistence vs. cash crops
- Cooperative formation

J-PAL Agriculture Project Scaling

- Water tanks pilot in Rwanda
- IRRI distribution of flood- and drought-resistant rice in India
- Precision Agriculture for Development (PAD)