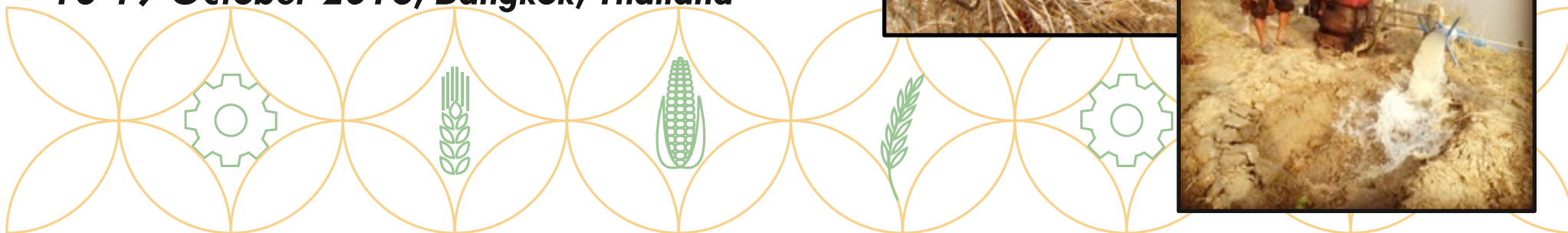# Cereal Systems Initiative for South Asia (CSISA) Program, Spurring a Transformation in Agriculture through Remote Sensing (STARS), and Climate Services for Resilient Development (CSRD)

Timothy J. Krupnik, Andrew McDonald, and many, many others

Towards better integration of R4D for improved food production systems in the coastal zone of Bangladesh.

*18-19 October 2016, Bangkok, Thailand*

In this presentation

1. Background – why are we doing this work?

2. Evolution of the Cereal Systems Initiative for South Asia (CSISA) program and associated projects

3. CSISA Phase III in Bangladesh

4. CSISA-Mechanization and Irrigation (CSISA-MI)

5. Spurring a Transformation in Agriculture through Remote Sensing (STARS) project

6. The new Climate Services for Resilient Development (CSRD) project

7. Looking forward – avenues for enhanced collaboration

Background and justification

Each dot = 50,000 people living under $1 day^{-1}

Mottaleb et al. 2016 J. Rural. Dev.
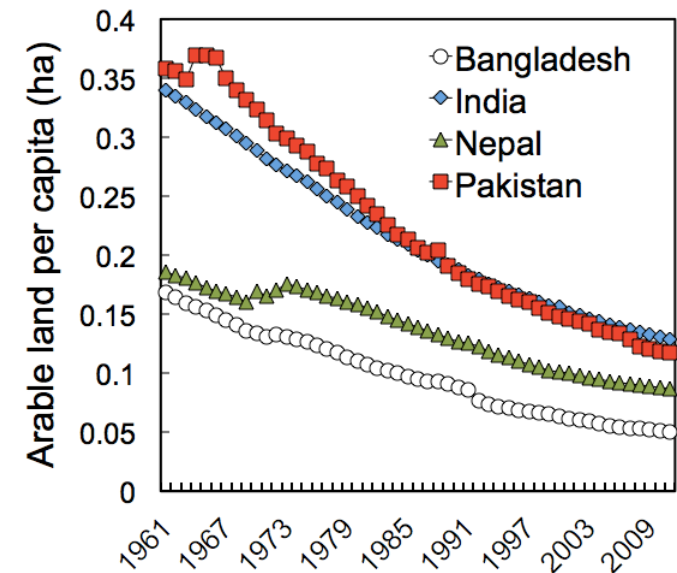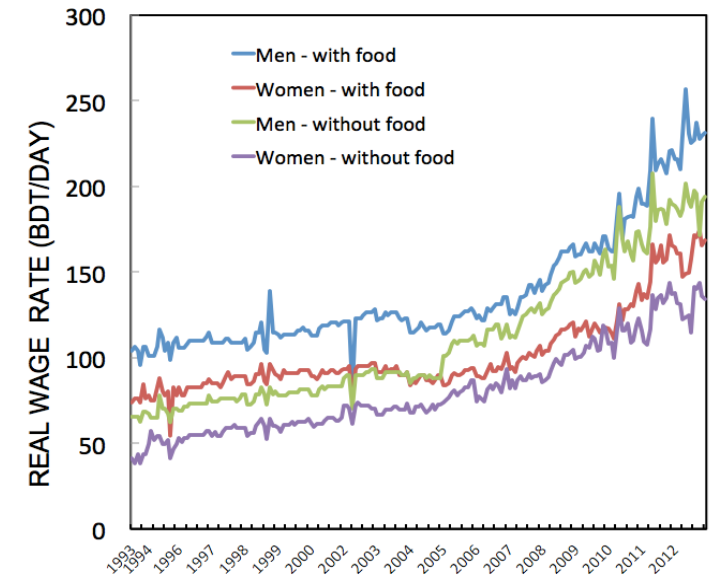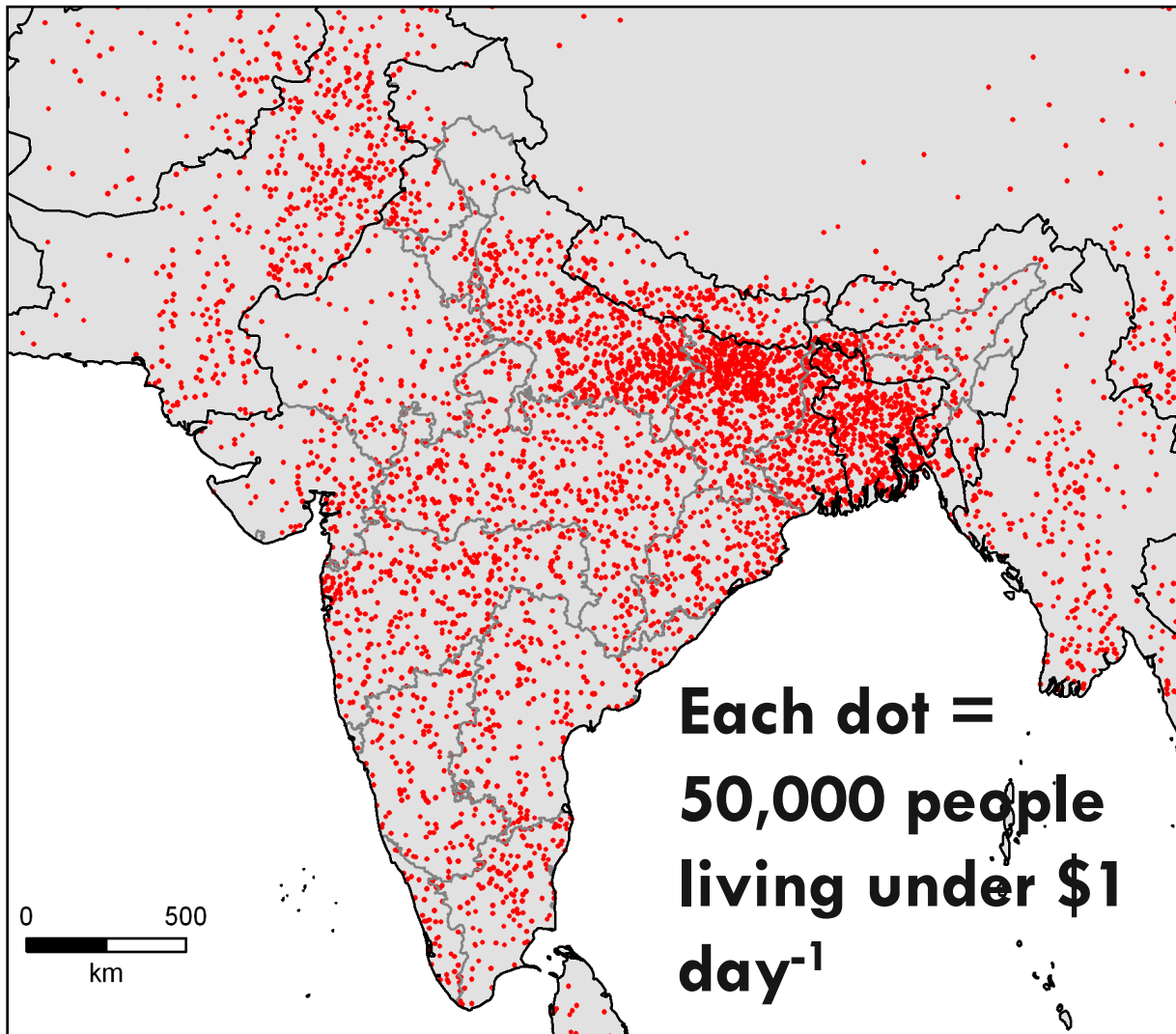
Some constraints agricultural productivity in coastal Bangladesh

Resource degradation and lack of optimization

But huge scope for improvements (MoA and FAO 2012)

Poor coordination among research and development efforts

Competition, duplication, taking stock of lessons learned, lack of communication
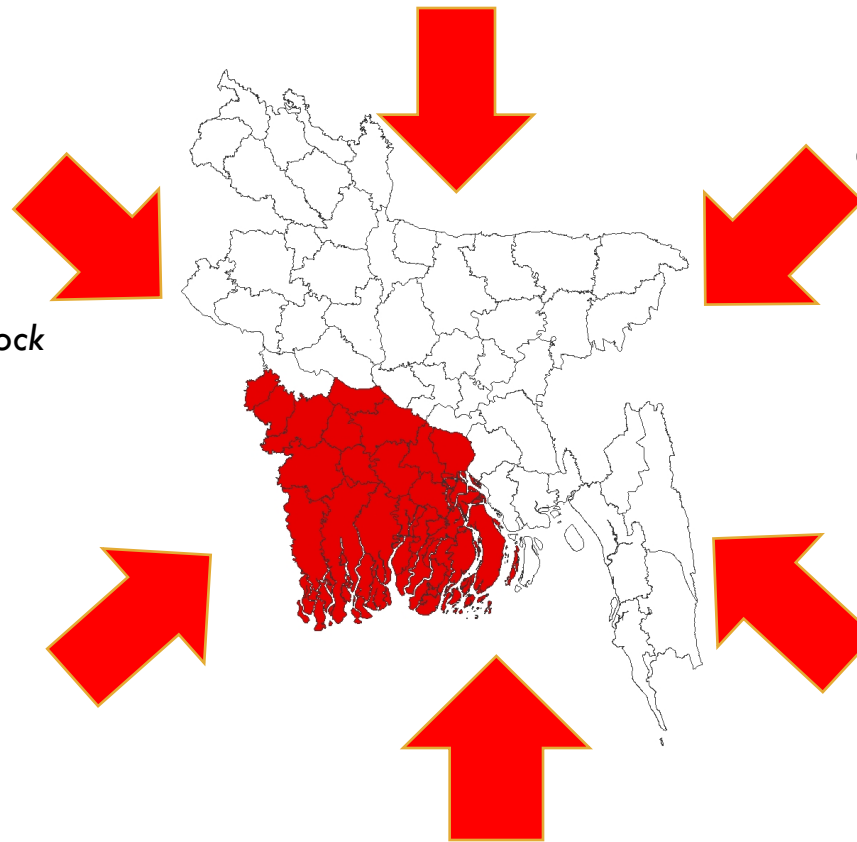
Climate change risks

Extreme weather, Increased salinity, drought risk, risk and adaptation bottlenecks

Growing energy and production costs

500% fuel increase in last 15 years (BBS 2003)

Low crop intensity

Lower than remainder of country (MoA and FAO 2012).

Limited knowledge of and commercial access to innovative technologies and markets

Putting Sustainable Intensification (SI) into practice in Bangladesh's cereal systems

SI: "Producing more output from the same area of land while reducing negative environmental impacts and increasing contributions to natural capital and the flow of ecological services" (Pretty 2008)
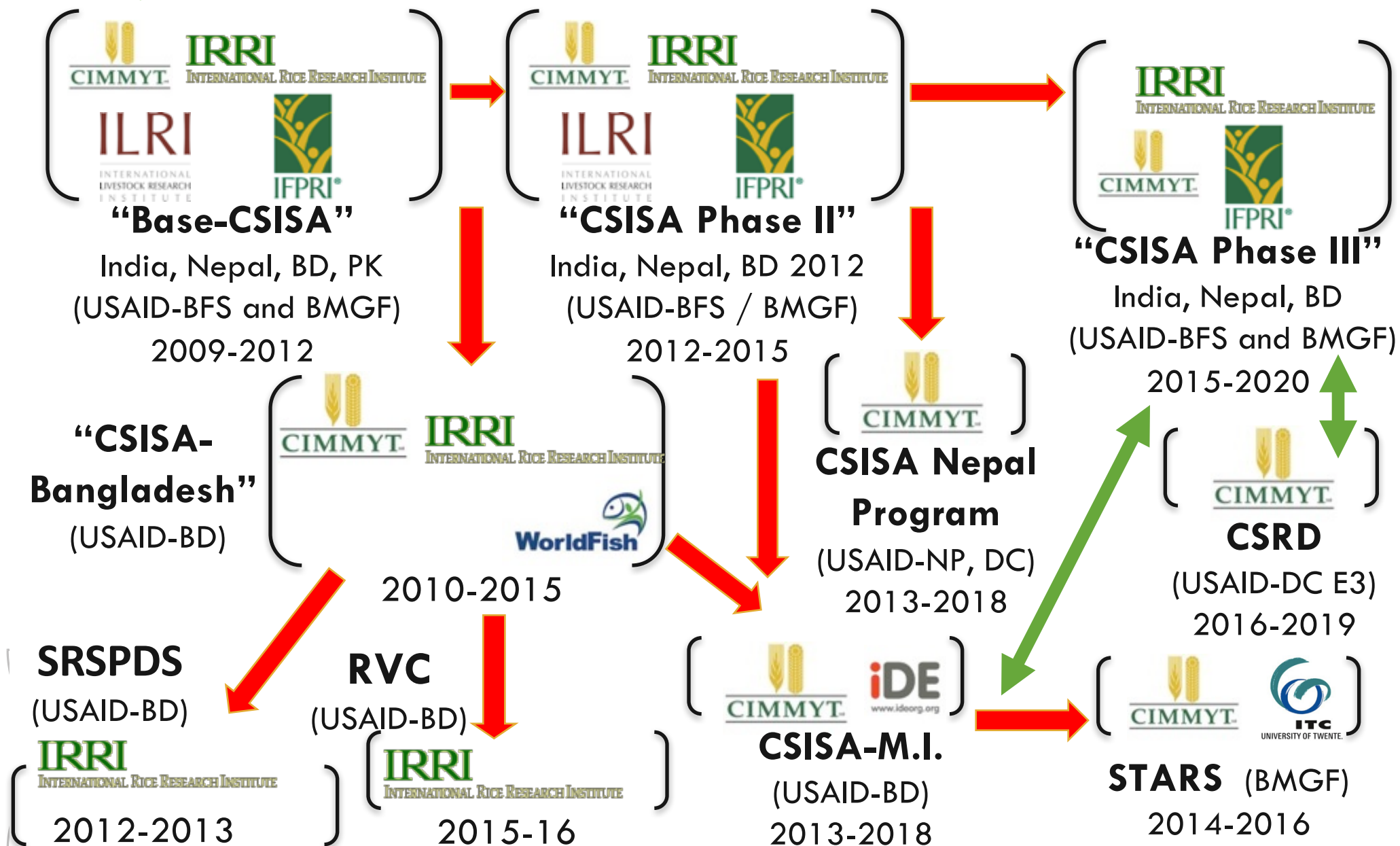

Genetic intensification

Land intensification

Technical intensification

Socioeconomic intensification

Evolution of the CSISA program and associated projects

"Base-CSISA"
India, Nepal, BD, PK
(USAID-BFS and BMGF)
2009-2012

"CSISA Phase II"
India, Nepal, BD 2012
(USAID-BFS / BMGF)
2012-2015

"CSISA Phase III"
India, Nepal, BD
(USAID-BFS and BMGF)
2015-2020

"CSISA-Bangladesh"
(USAID-BD)

2010-2015

CSISA Nepal Program
(USAID-NP, DC)
2013-2018

CSRD
(USAID-DC E3)
2016-2019

SRSPDS
(USAID-BD)

2012-2013

RVC
(USAID-BD)

2015-16

CSISA-M.I.
(USAID-BD)
2013-2018

STARS (BMGF)
2014-2016

Strengthening innovation systems through partnerships

- BARC
- BARI
- BRRI
- DAE
- BADC
- BMD
- SRDI
- BAU
- CEGIS
- IWM
- AFSIS
- BWDB

- WAGENINGEN Univ.
- FAO
- JUNATA ENGINEERING
- RFL
- ACI
- THE METAL LTD
- BSMRAU
- AIP/AIRN
- JCF
- ALIM INDUSTRIES
- CSIRO
- IPNI

- SDC
- BDS
- BIID
- WEP
- AEP
- BUET
- SRDI
- Georgia Tech Univ.
- iDE
- GJUS
- ICIMO
- Syngenta Foundation

CSISA Phase III in Bangladesh

Phase I:
'Packing the technology pipeline', demonstrations and training
(2009 – 2012)

Phase II:
Planning around common R4D impact pathways, support to intermediaries, continued demonstration and training
(2012 – 2015)

Phase III:
Specific, targeted research and scalable activities
(2015 – 2020)

CSISA Phase III in Bangladesh (2015-2020)

CSISA Hub Domain and Working Areas
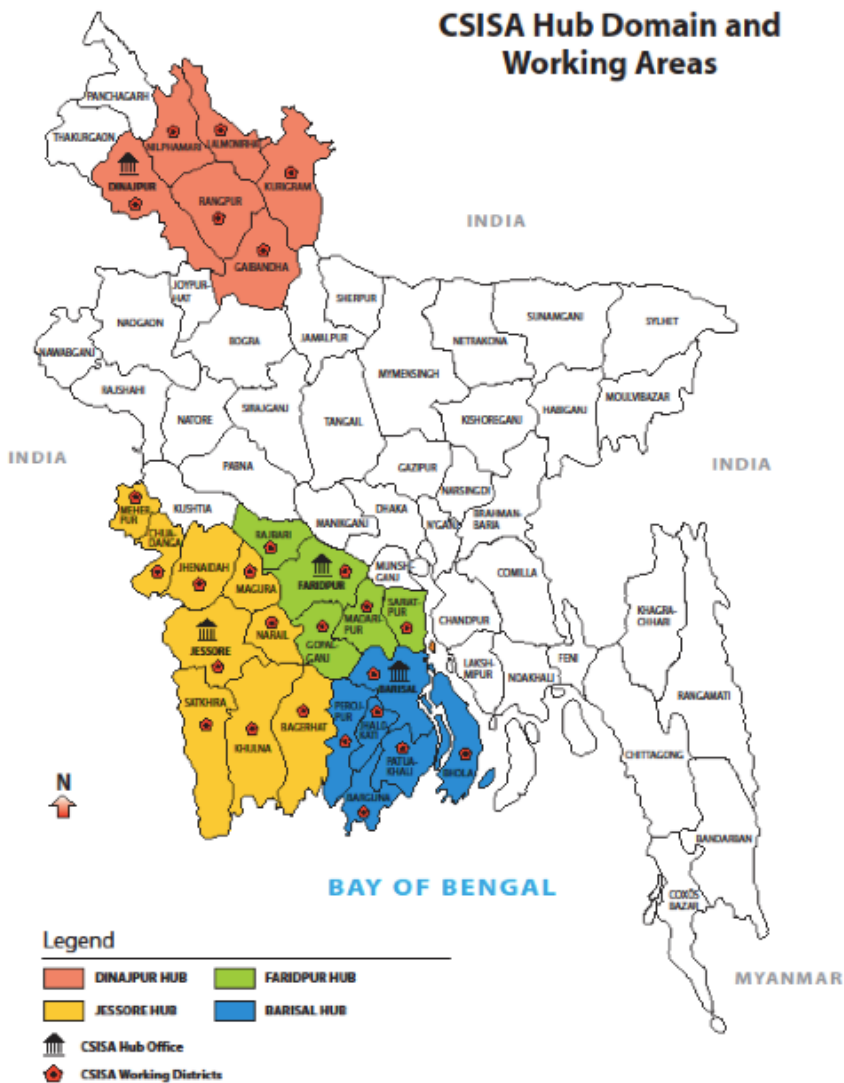
GOALS:

1. Widespread **adoption of resource-conserving practices** and services.

2. **Mainstream innovations** in national-, state- and district-level government.

3. Generate and disseminate new knowledge on **cropping system practices that can withstand climate change**.

4. **Improve the policy environment** to facilitate the adoption of SI approaches

5. Build **strategic partnerships that sustain and enhance the scale of benefits** accrued through improving cereal system productivity.

CSISA Phase III in Bangladesh

Catalyzing sustainable intensification at scale

Theme 1

Innovation towards impact

- Reducing risk for sustainable intensification
- Adding value to extension and agro-advisory systems

Theme 2

Systemic change towards impact (*partnerships and scaling pathways*)

- Inclusive growth around commercial pockets and neglected niches
- Participatory science and technology evaluations

Theme 3

Achieving impact at scale (*mainstreaming*)

- Growing the input and service economy
- Managing risk by coping with climate extremes

CSISA Hub Domain and Working Areas

Legend
- DINAJPUR HUB
- FARIDPUR HUB
- JESSORE HUB
- BARISAL HUB
- CSISA Hub Office
- CSISA Working Districts
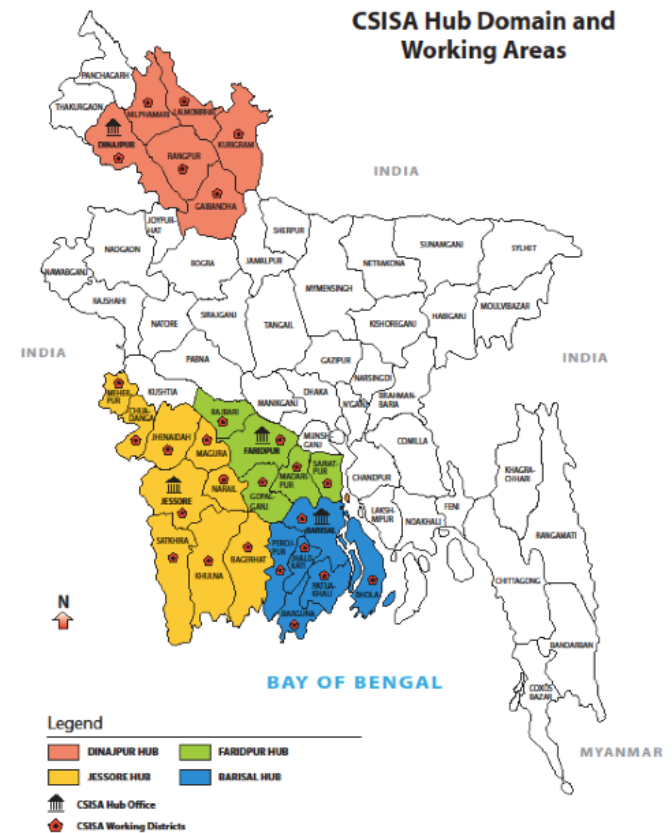
CSISA Phase III in Bangladesh

FOCUS ACTIVITIES:

1. Developing DSR service economy

2. Agronomic and variety recommendations to reduce the threat of wheat blast

3. Precision nutrient management and digital soil mapping

4. Healthy rice seedling awareness raising

5. Leveraging input dealers to deploy better-bet agronomic messaging

6. Rabi fallows development

7. Premium quality rice market linkages

8. NARES capacity building – focus on on-farm research methods and advanced statistics

9. Expanding integrated weed management in rice

10. Expanding commercial machinery supply chains for machinery in Rangpur district

11. Early wheat sowing to combat heat stress

Precision nutrient management (PNM) and digital soil mapping

Goals:

- Introduce and mainstream rapid spectral-based soil assessment methods to SRDI

- Update national databases and produce Bangladesh's first digital soil map

- Assess methods to scale-out PNM approaches
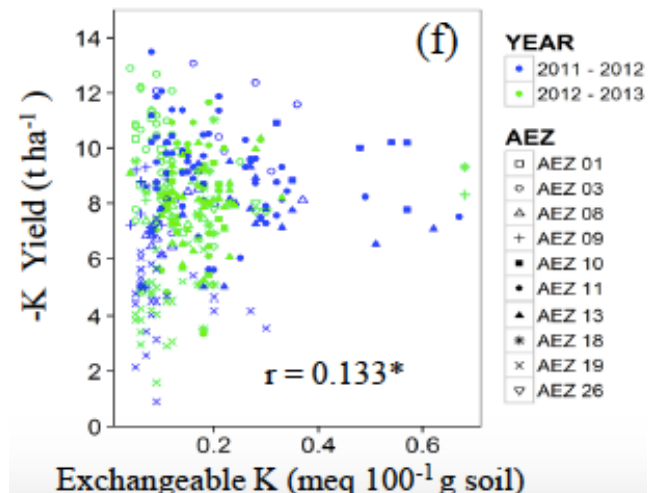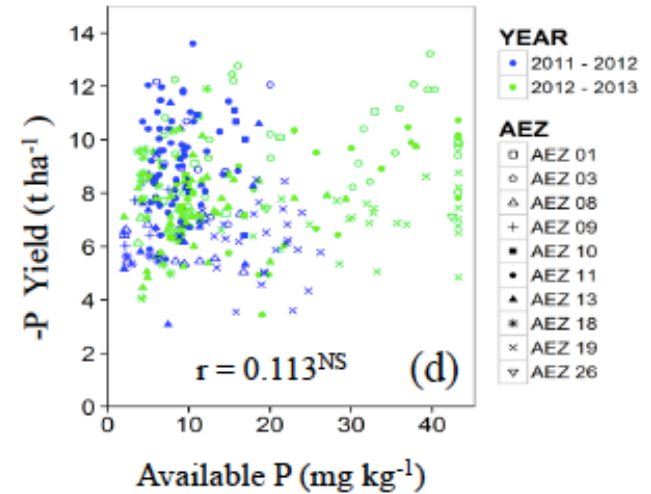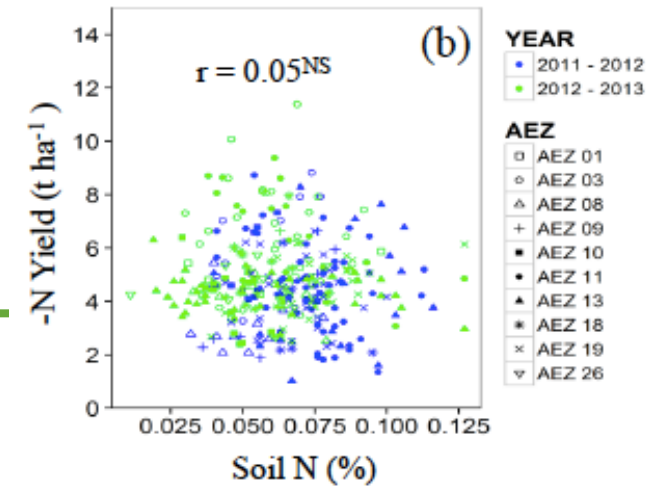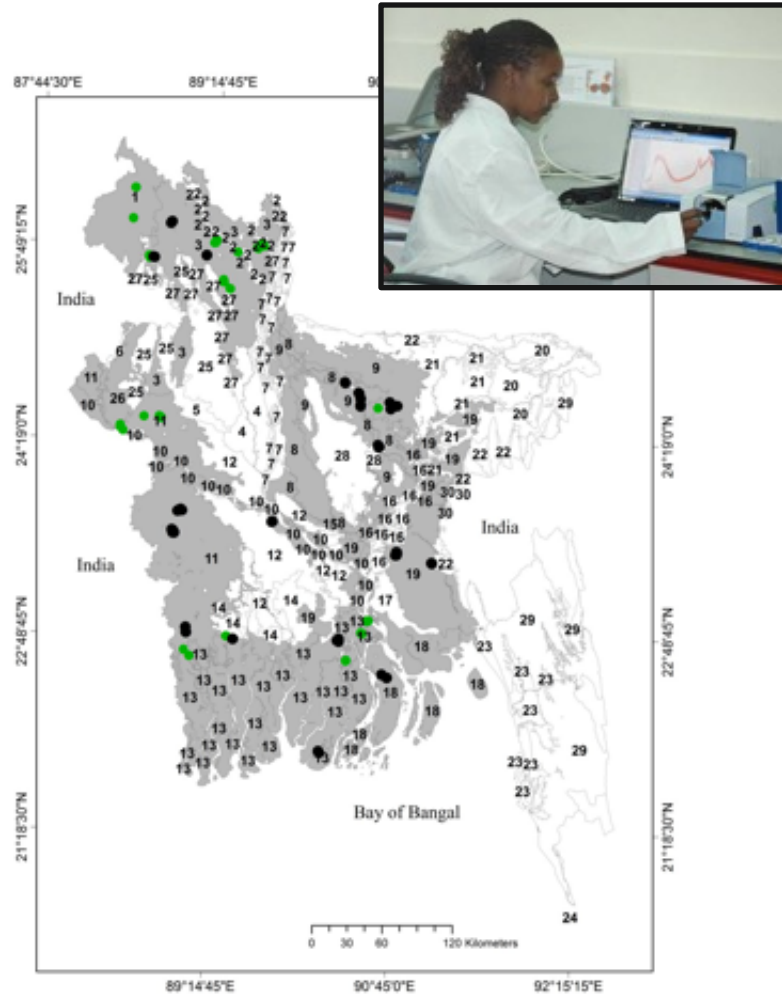
Ahmed et al. In revision: Eur. J. Agron.

Rabi season intensification
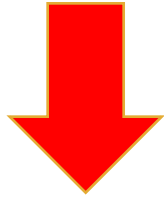
Master Plan for Agricultural Development
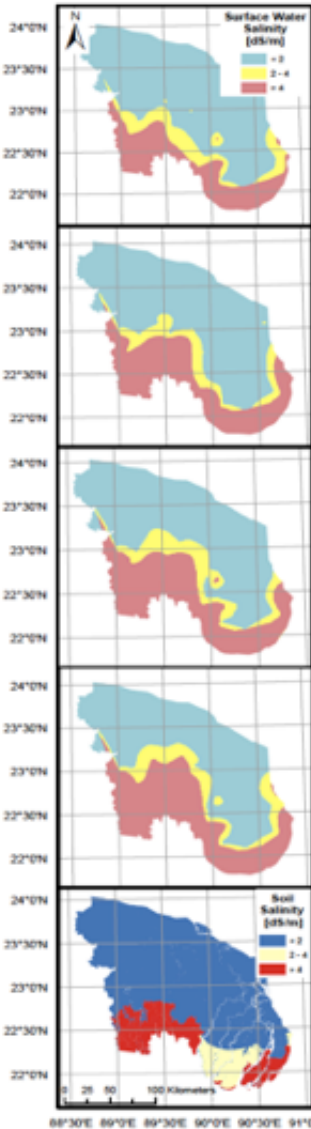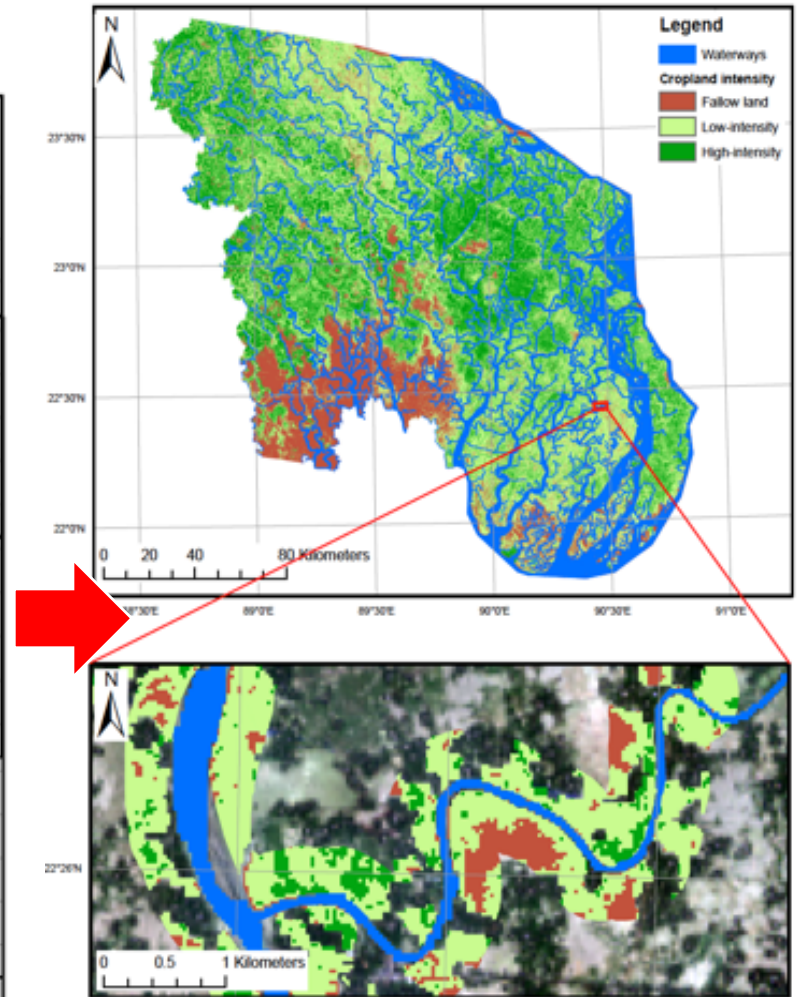## in the Southern Region of Bangladesh
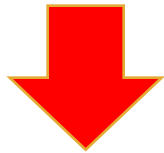
Targeting surface water irrigation in coastal Bangladesh

Remote sensing
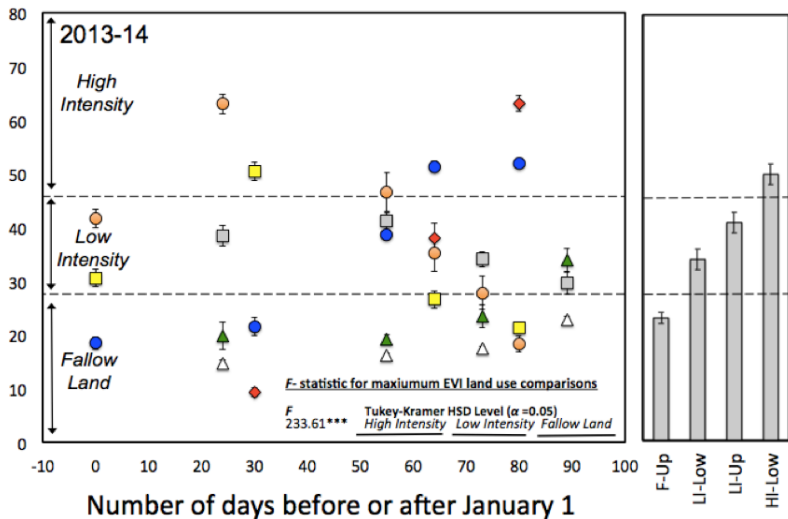
Time Series EVI of field crops

Salinity Analysis

43,271 km² study area: **125,000 ha suitable for decentralized** *rabi* **intensification + surface water irrigation**

Krupnik et al. 2016 - Land Use Policy

Targeting surface water irrigation in coastal Bangladesh

All data layers in open access in decision support tool format:

http://202.53.173.179/cimmyt/home.aspx

Science partnerships into impact

- Assisted USAID and BADC to mobilize a BDT $1.5 million investment for irrigation canal rehabilitation
- Locations result from remote sensing analysis
- 7 Upazillas in Barisal District – 72 km of canals rehabilitated
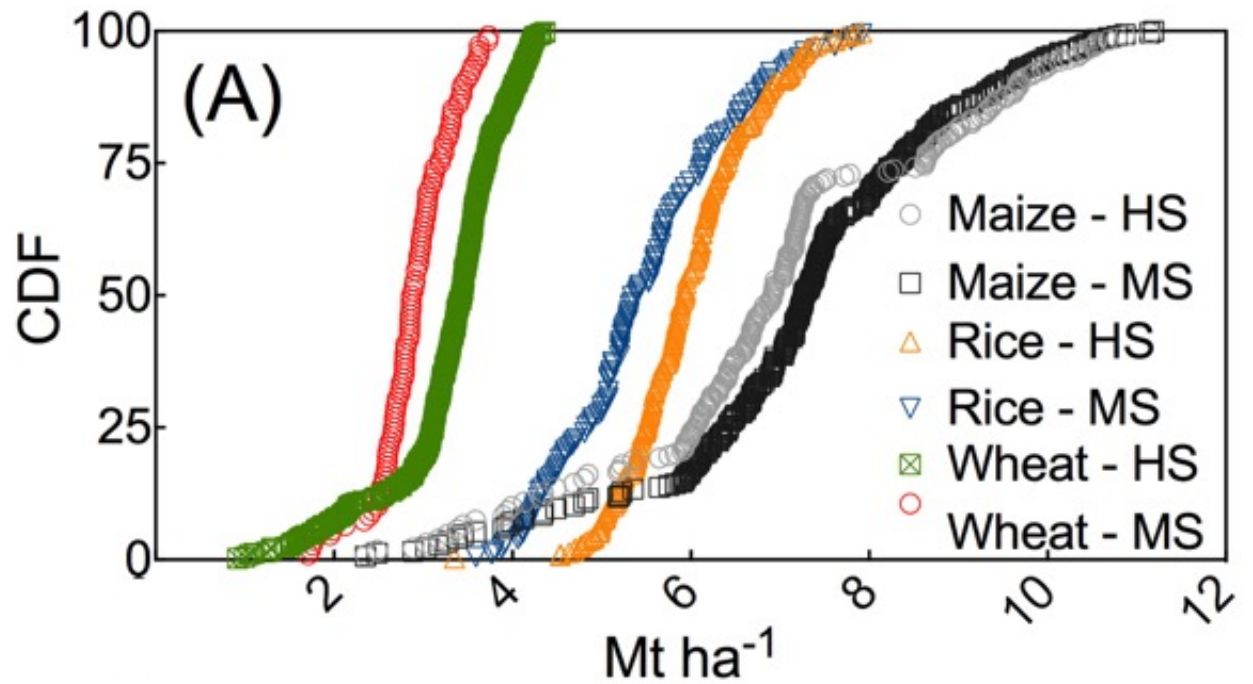- Now used for *rabi* season irrigation

Boro Rice (n = 553)

Wheat (n = 513)

Maize (n = 550)
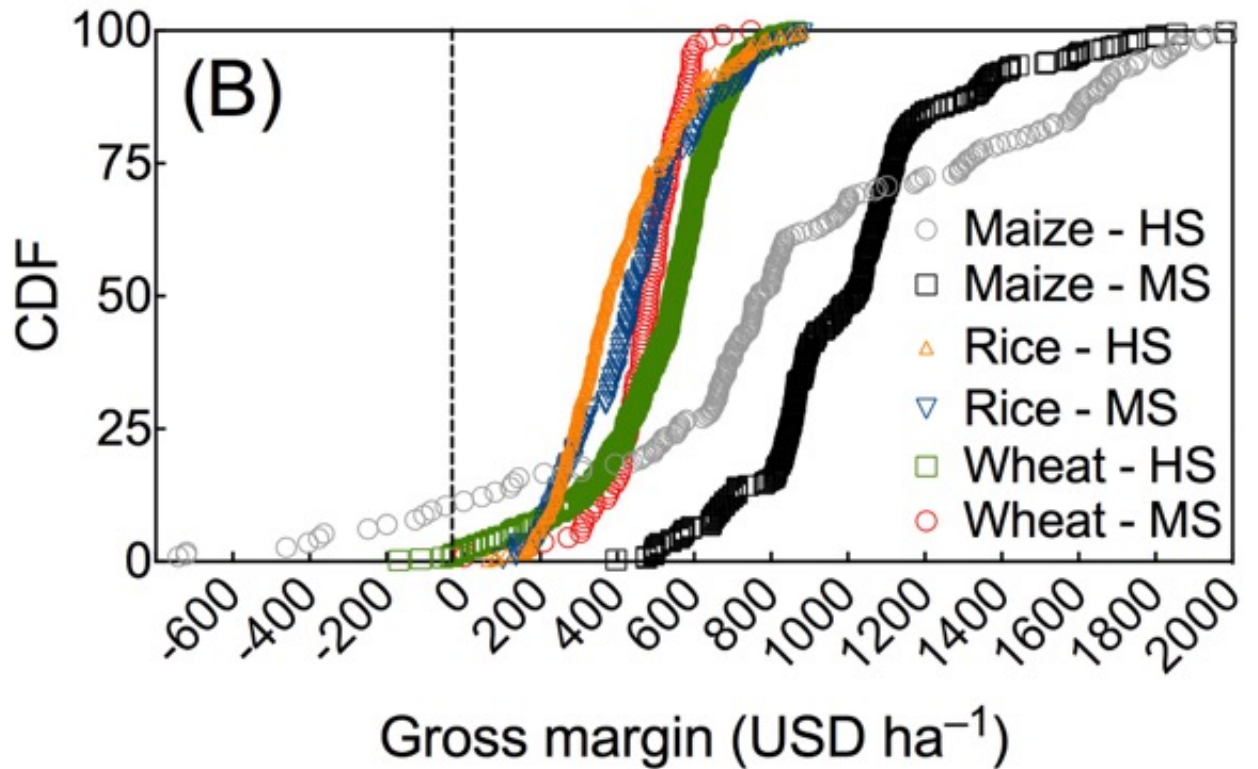
Targeting surface water irrigation in coastal Bangladesh
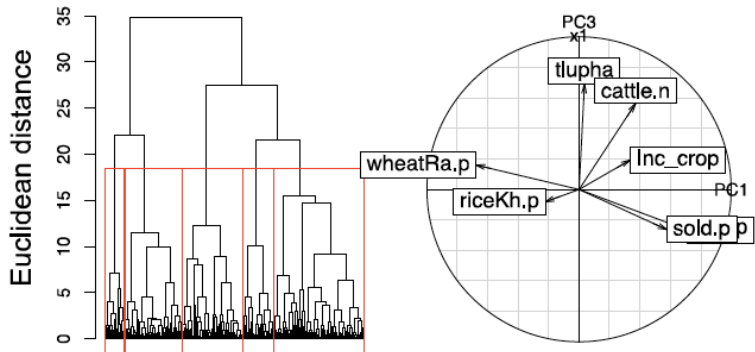

Maize (*n* = 550)

Wheat (*n* = 513)

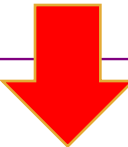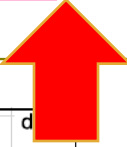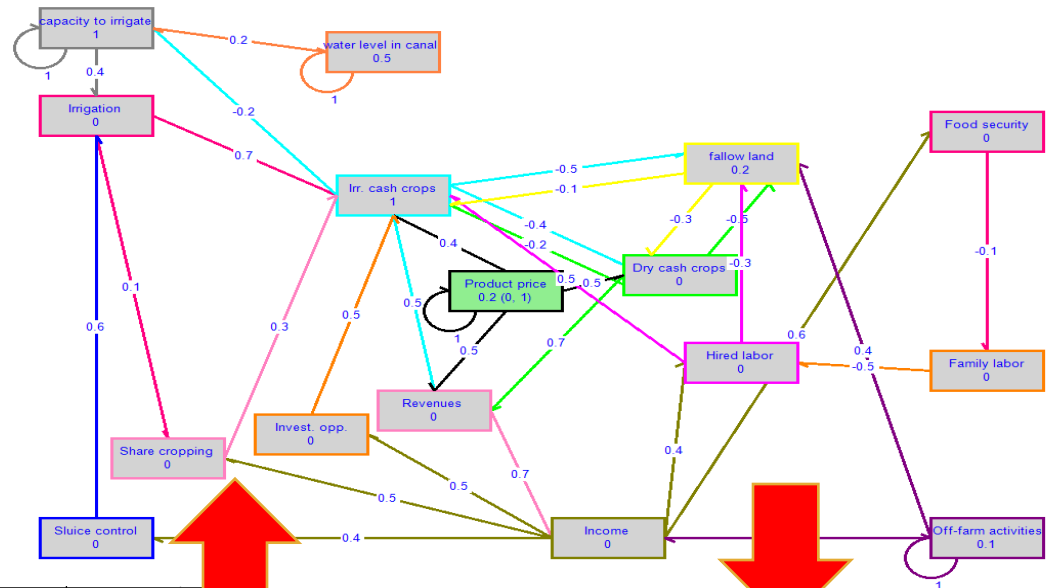Boro Rice (*n* = 553)

Krupnik et al. 2016 - Land Use Policy
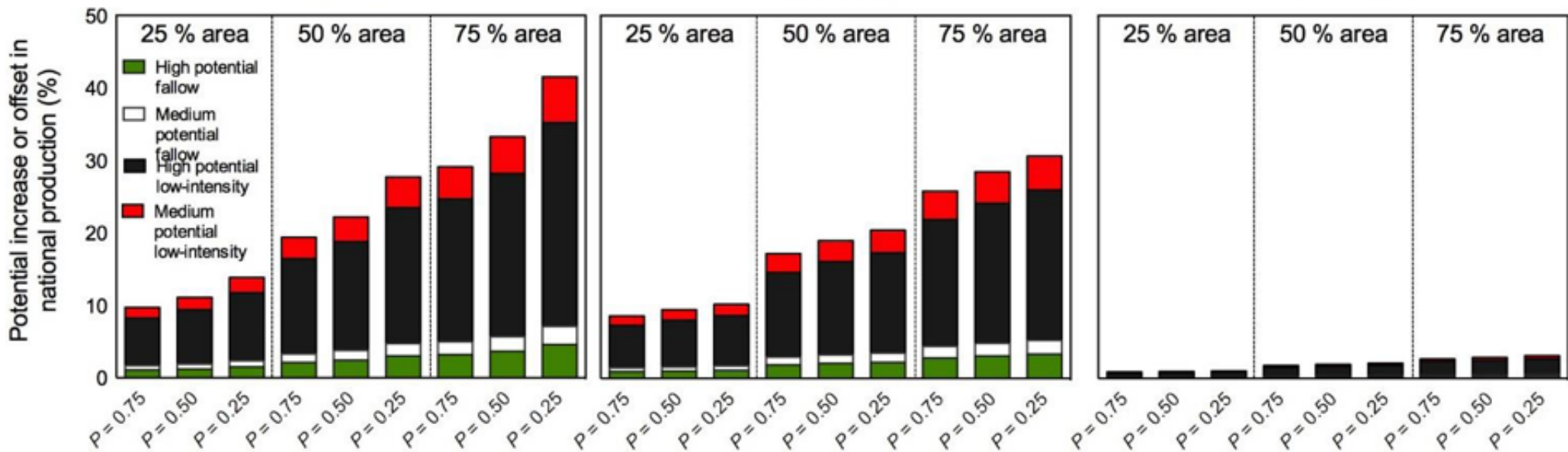
Farmers perceptions drive adoption behavior – and are relevant for prioritizing interventions

Farmers' motivations differ: typological analysis

Cognitive mapping: Relationship and intervention scenario analysis

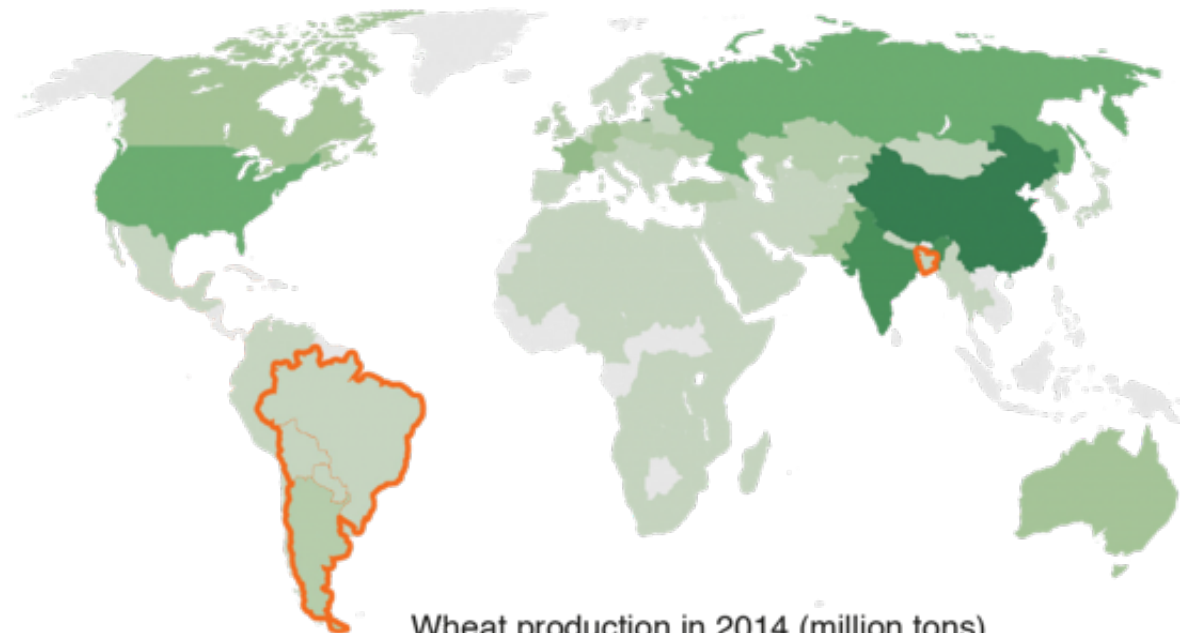*Aravindakshan, Sharin et al. (PhD & MSc. research)*

- Intervention scenario analysis
- Sequencing of interventions

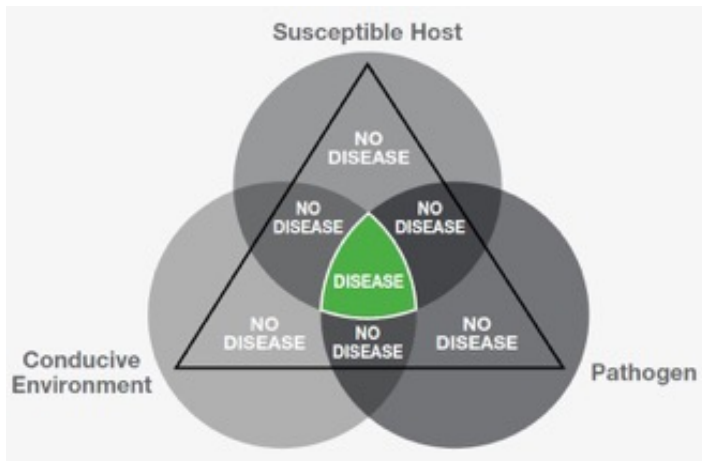# Wheat blast: Agronomy, surveillance, forecasting

- 2016: ASIA'S FIRST OUTBREAK OF *Magnaporthe oryzae*, pathotype *Triticum*

- 15,000 HA (16% NATIONAL AREA) AFFECTED WITH MEAN 25% YIELD LOSSES

- EPIDEMIOLOGY AND CONTROL LARGELY UNKNOWN

Susceptible Host

NO DISEASE

NO DISEASE NO DISEASE

DISEASE

Conducive Environment NO DISEASE NO DISEASE NO DISEASE Pathogen

Source: Kevin Robson, BASF, 2014

Wheat production in 2014 (million tons)

0 — 130

— Borders indicate countries where wheat blast has occurred

Wheat blast:
Agronomy, surveillance, forecasting

- AGRO-CLIMATOLOGY, MODELING AND FORECASTING EFFORTS (RS, MET., EXPERIMENTAL DATA)
- SURVEILLANCE AND ALTERNATE HOST SURVEYS (2016/17)
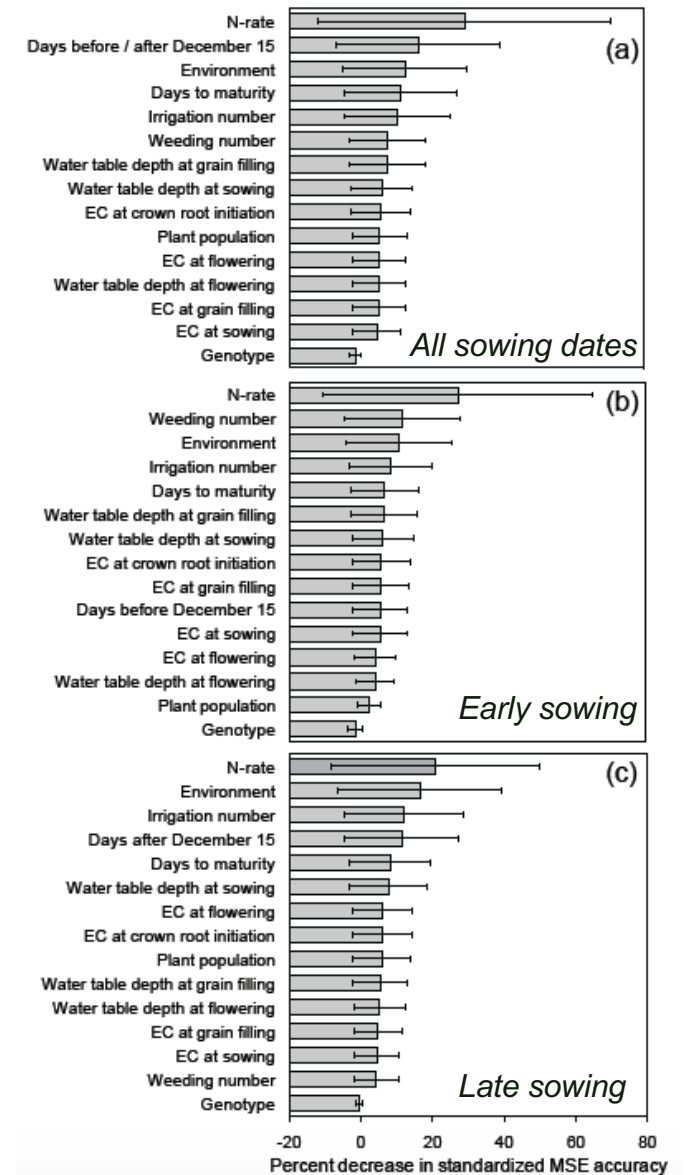- LARGE-SCALE AWARENESS RAISING WITH NATIONAL PARTNERS

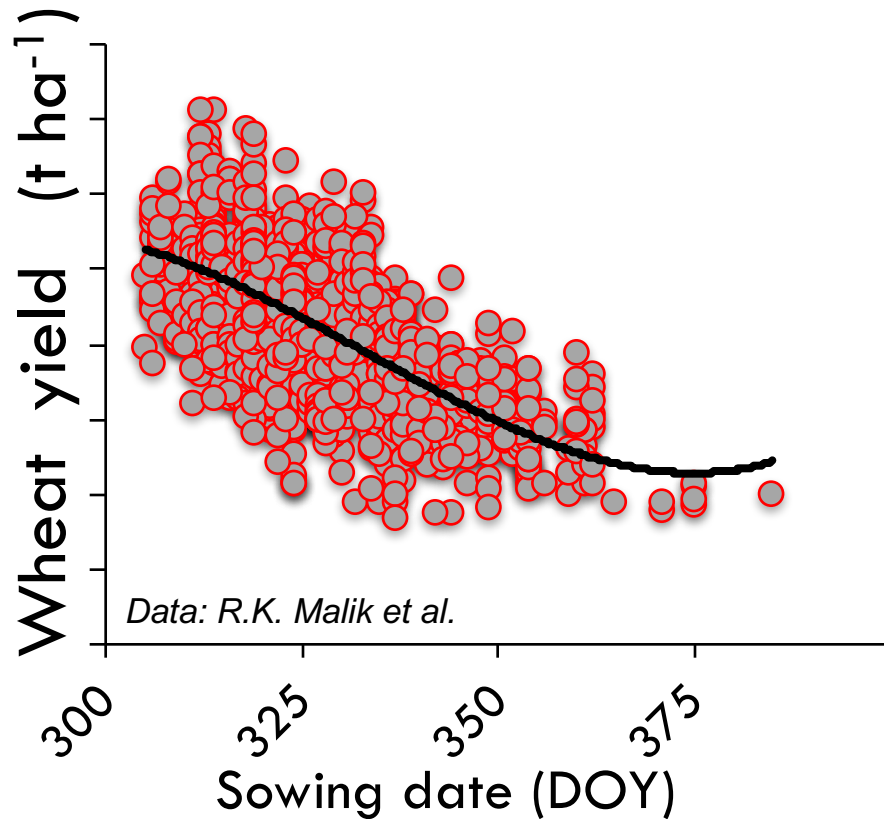# What constrains wheat production in coastal Bangladesh?

Krupnik et al. 2015 Agricultural Systems
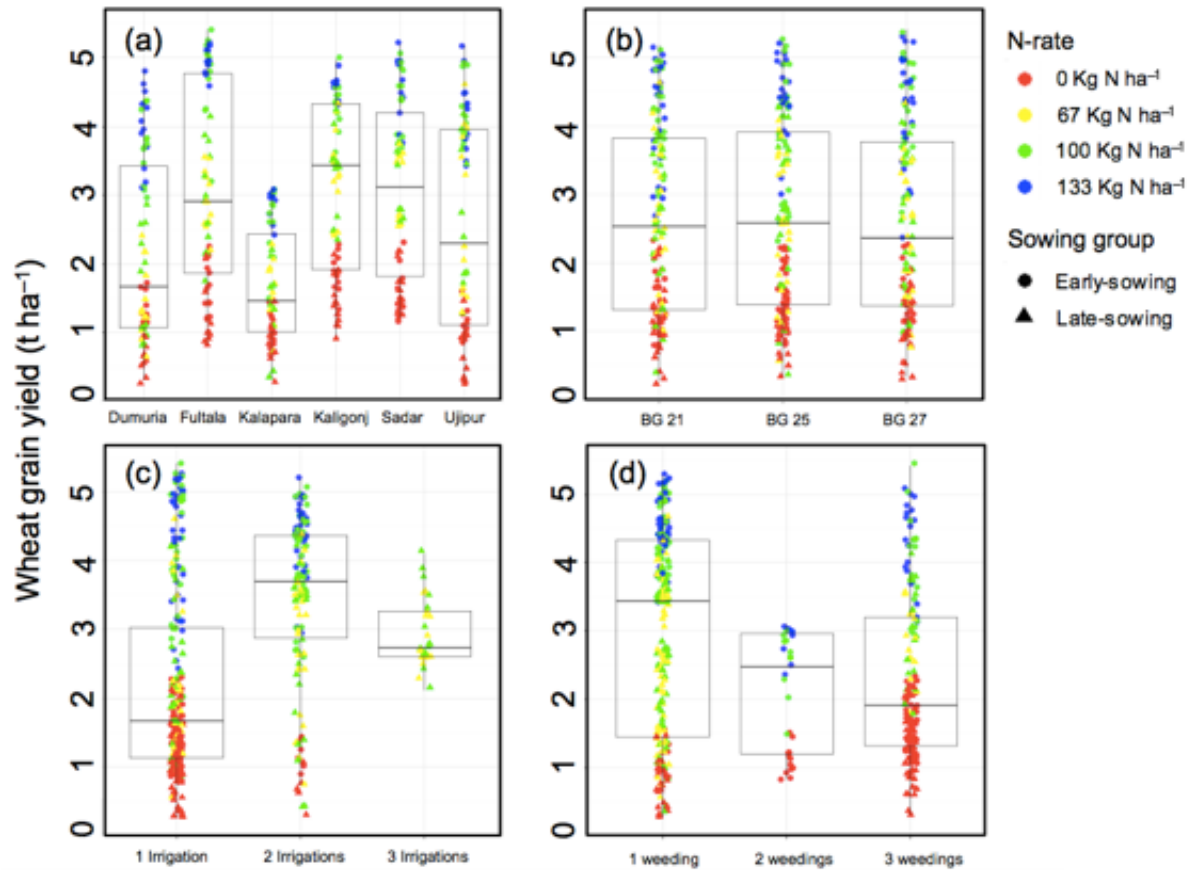
- What factors are most important in determining yield under late sowing ?
- 422 wheat fields – researcher backed but farmer managed

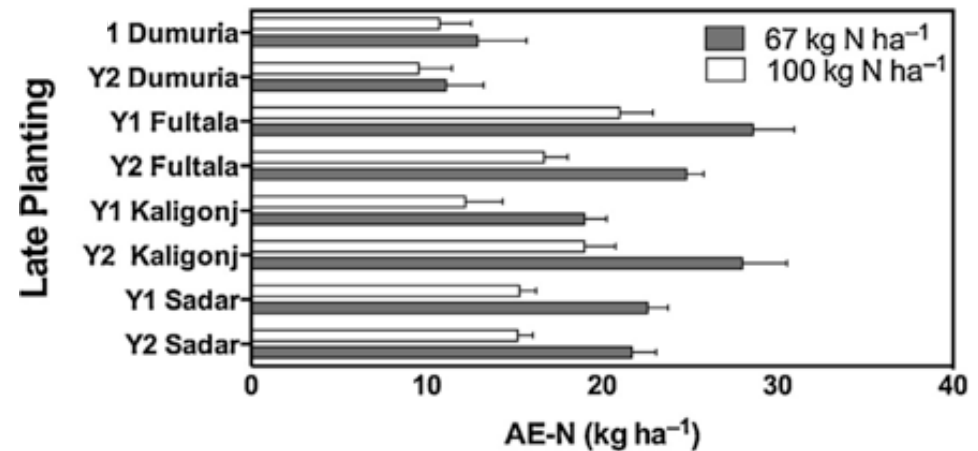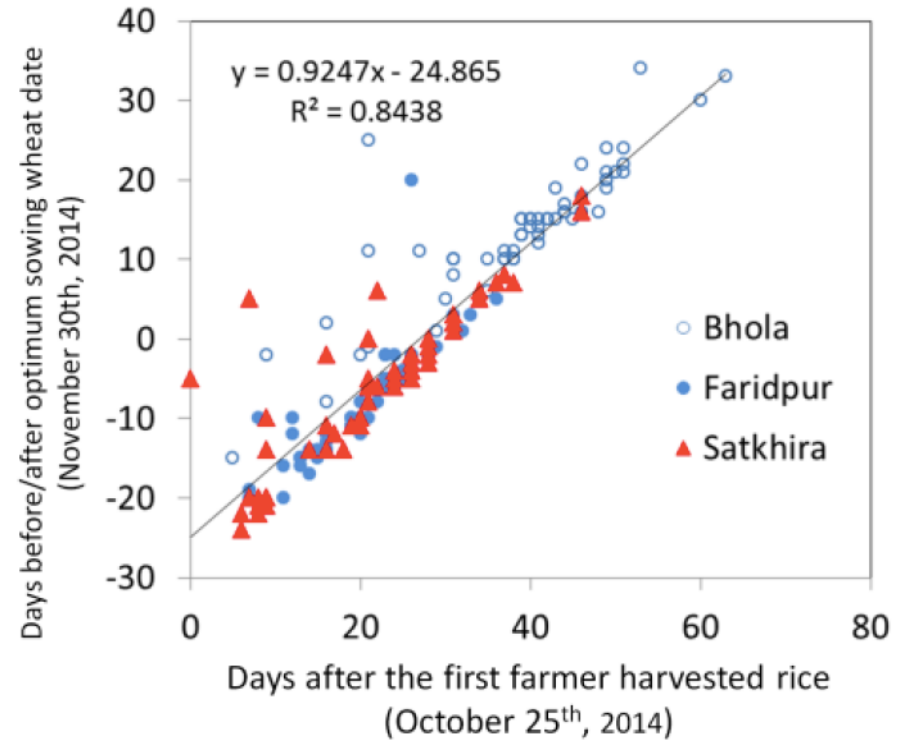# Early wheat sowing to combat heat stress (and blast)

CSISA

Wheat yield (t ha^{-1})

Sowing date (DOY)

Data: R.K. Malik et al.

$y = 0.9247x - 24.865$
$R^2 = 0.8438$

Days before/after optimum sowing wheat date (November 30th, 2014)

Days after the first farmer harvested rice (October 25th, 2014)

○ Bhola
● Faridpur
▲ Satkhira

Goal: Move sowing 5+ days earlier

Short duration rice │ Tillage options, including

aggregating farmers' demand │ Genotype

Mechanized rice harvest │ Drainage │ Credit

Time- and environment-specific N rates

Late Planting

1 Dumuria
Y2 Dumuria
Y1 Fultala
Y2 Fultala
Y1 Kaligonj
Y2 Kaligonj
Y1 Sadar
Y2 Sadar

■ 67 kg N ha^{-1}
□ 100 kg N ha^{-1}

AE-N (kg ha^{-1})

Krupnik et al. 2015 Field Crops Research

Ahmed et al. 2016 GFS conference

CSISA – Mechanization and Irrigation (2013-2018)

CSISA – Mechanization and Irrigation
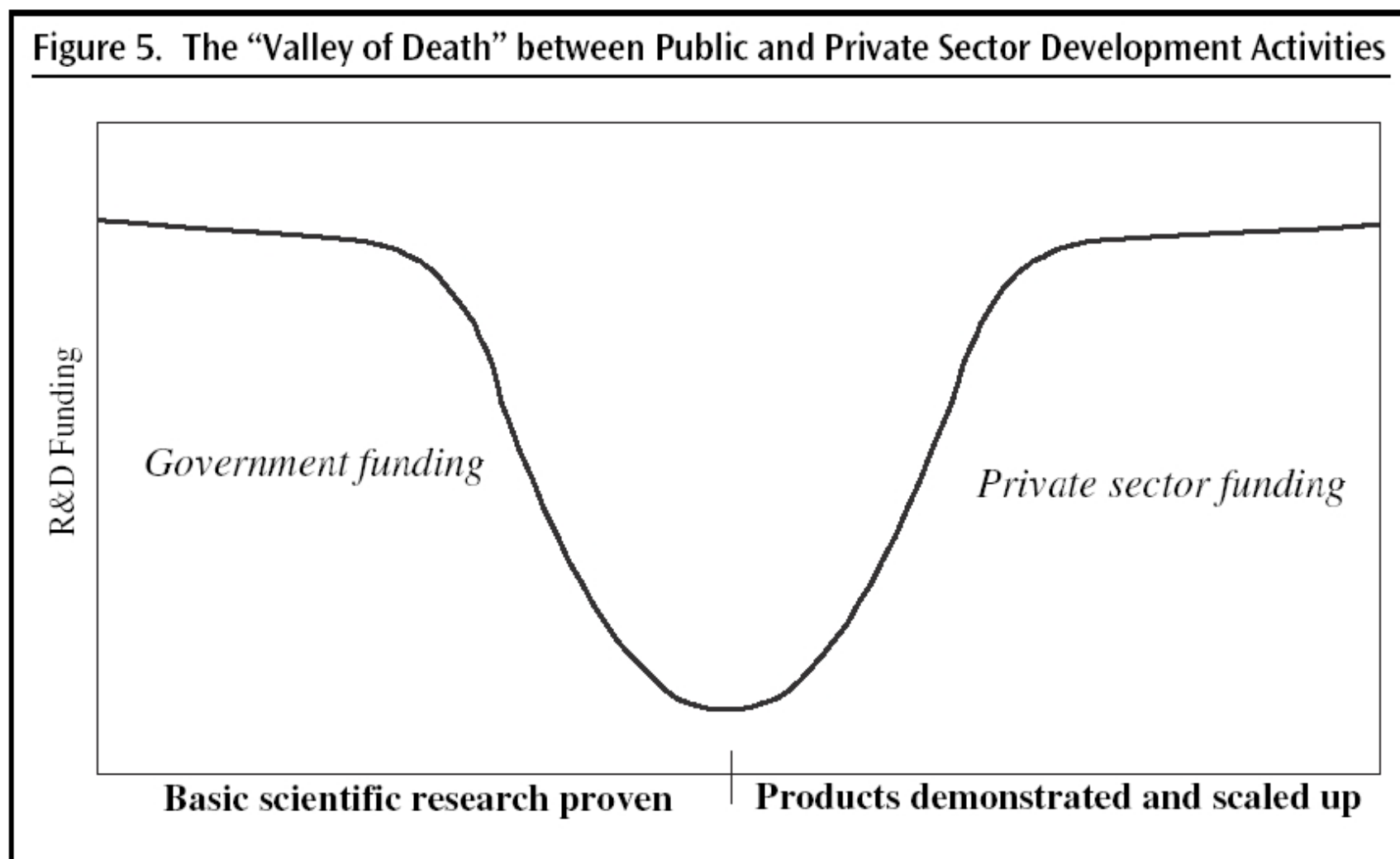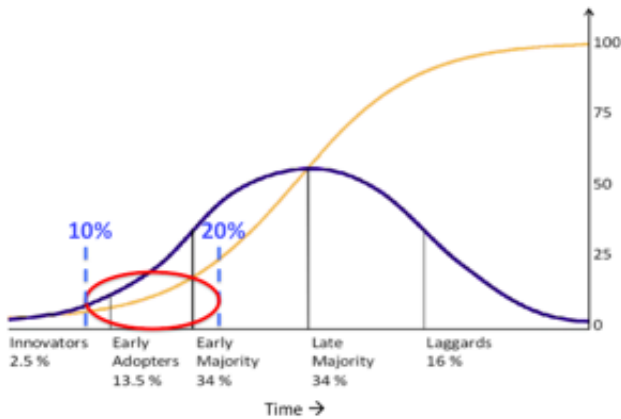
- OVERCOMING THE 'VALLEY OF DEATH' IN GETTING INNOVATIONS TO SCALE

Figure 5. The "Valley of Death" between Public and Private Sector Development Activities

R&D Funding

Government funding

Private sector funding

Basic scientific research proven | Products demonstrated and scaled up

CONSUMPTION SPREADS FASTER TODAY

CSISA – Mechanization and Irrigation

Technology adoption

10% · 20%

100 · 75 · 50 · 25 · 0

Innovators 2.5 % · Early Adopters 13.5 % · Early Majority 34 % · Late Majority 34 % · Laggards 16 %

Time →

Opportunity & constraints identified

Technology verification (NARES)

On-farm technology validation

Advertising

Block demos

Training

Business models implemented

Early adopters

~15%

Private sector investment expands

Spontaneous adoption

Product diversification and new innovations

Trigger · **Uptake** · **Sector Growth**

| Consumer insights | R 4 D | Piloting & demo | Commercialization |

CSISA – Mechanization and Irrigation

SO1: Intensify cropping in S. Bangladesh through surface water irrigation

SO2: Boost broad-based access to agricultural mechanization services

SO3: Public-private partnerships to support mech. in S. Bangladesh

CSISA – Mechanization and Irrigation

No more business as usual
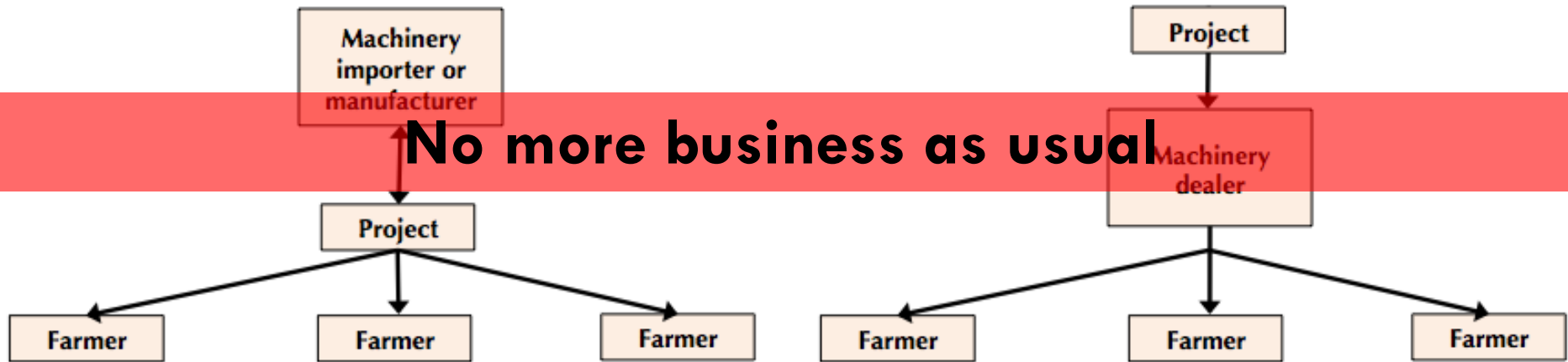
- Public-private partnerships, concentration on local agricultural machinery service providers to reach scale

CSISA – Mechanization and Irrigation
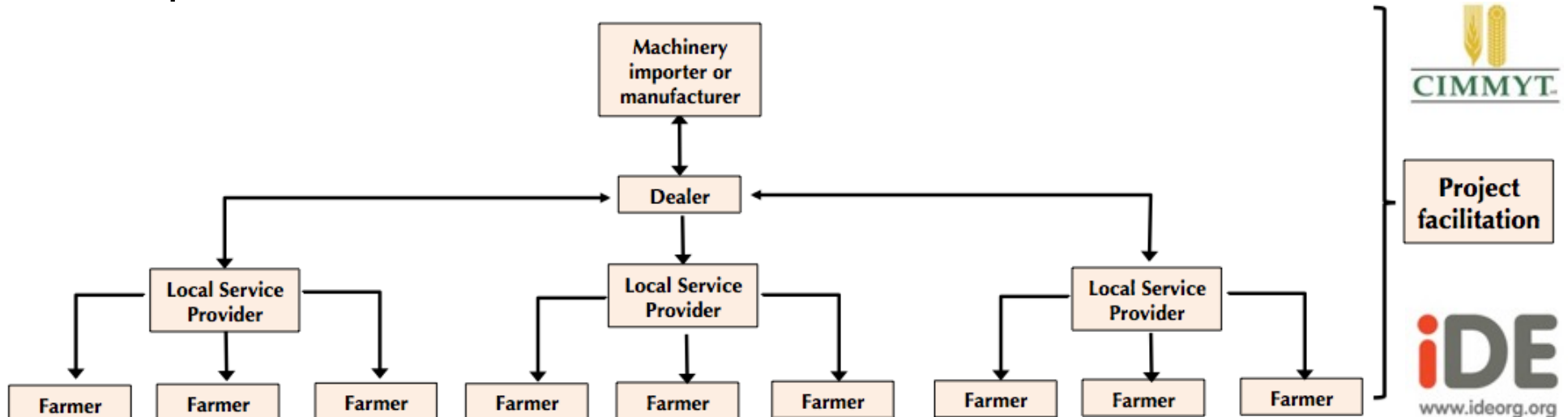
Axial flow pumps (AFPs) reduce energy requirements and costs for low-lift surface water irrigation
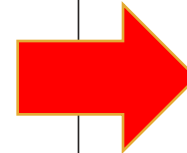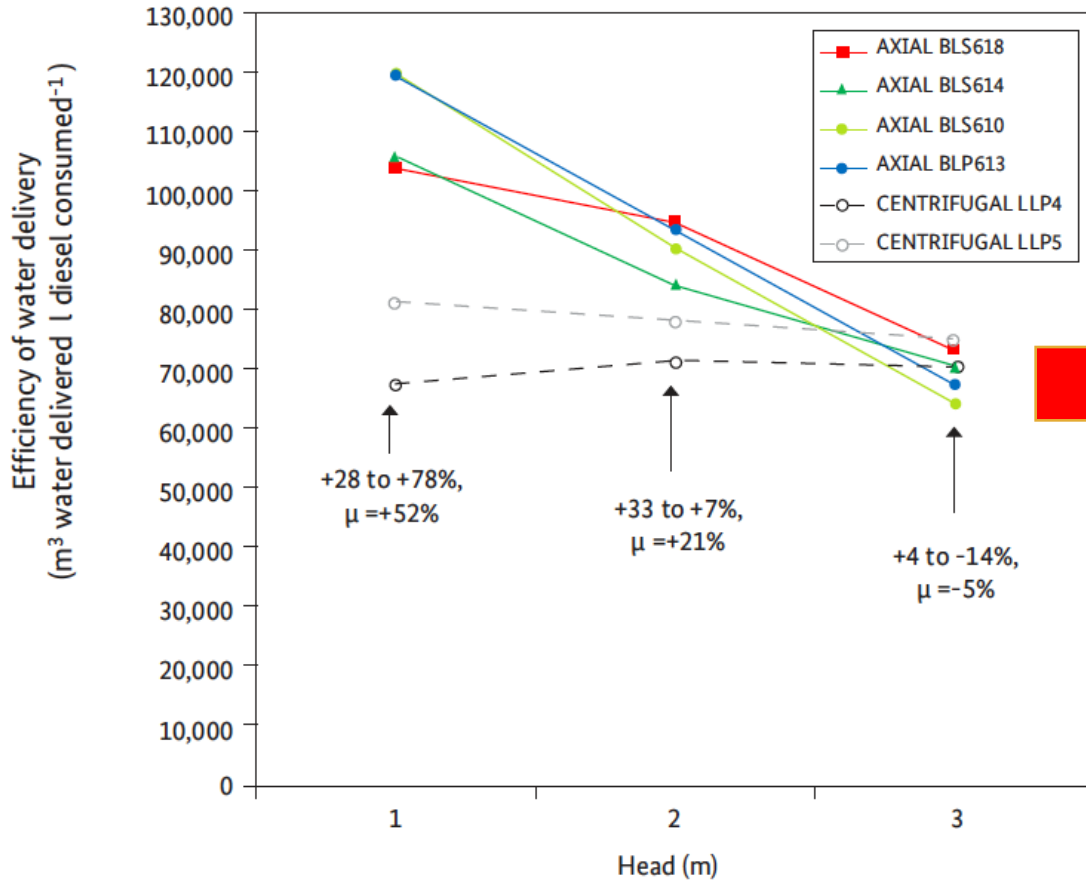
Private sector partners invest to broadly commercialize domestically made pumps

Krupnik et al. (2015) Irrigation and Drainage

CSISA – Mechanization and Irrigation

Market intelligence:
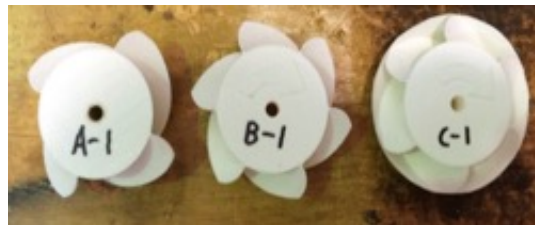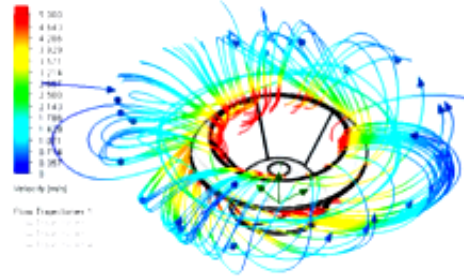
PTOS performance under farmers' mgt. (wheat)

Facilitating BARI, university student, and private sector collaboration

PTOS – Strip tillage blades
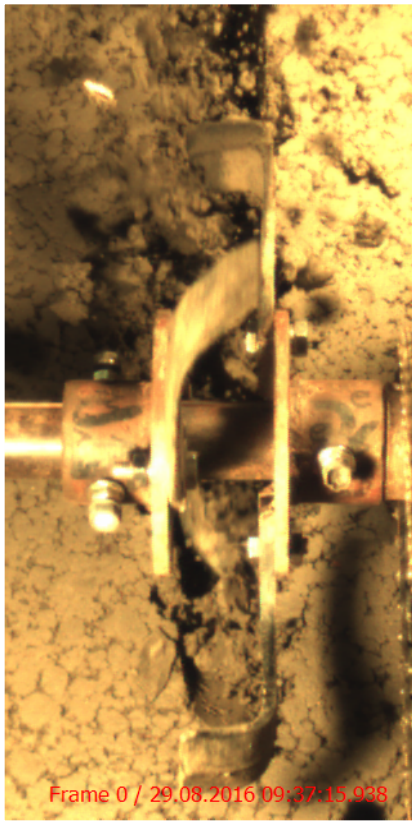
Towards Deshi axial flow pump design

3-D printing, modeling

Prototyping at Georgia Tech
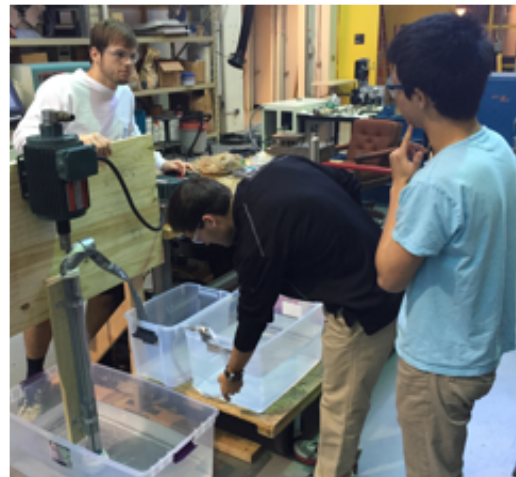
Best impellers built by companies, tested and refined at BARI
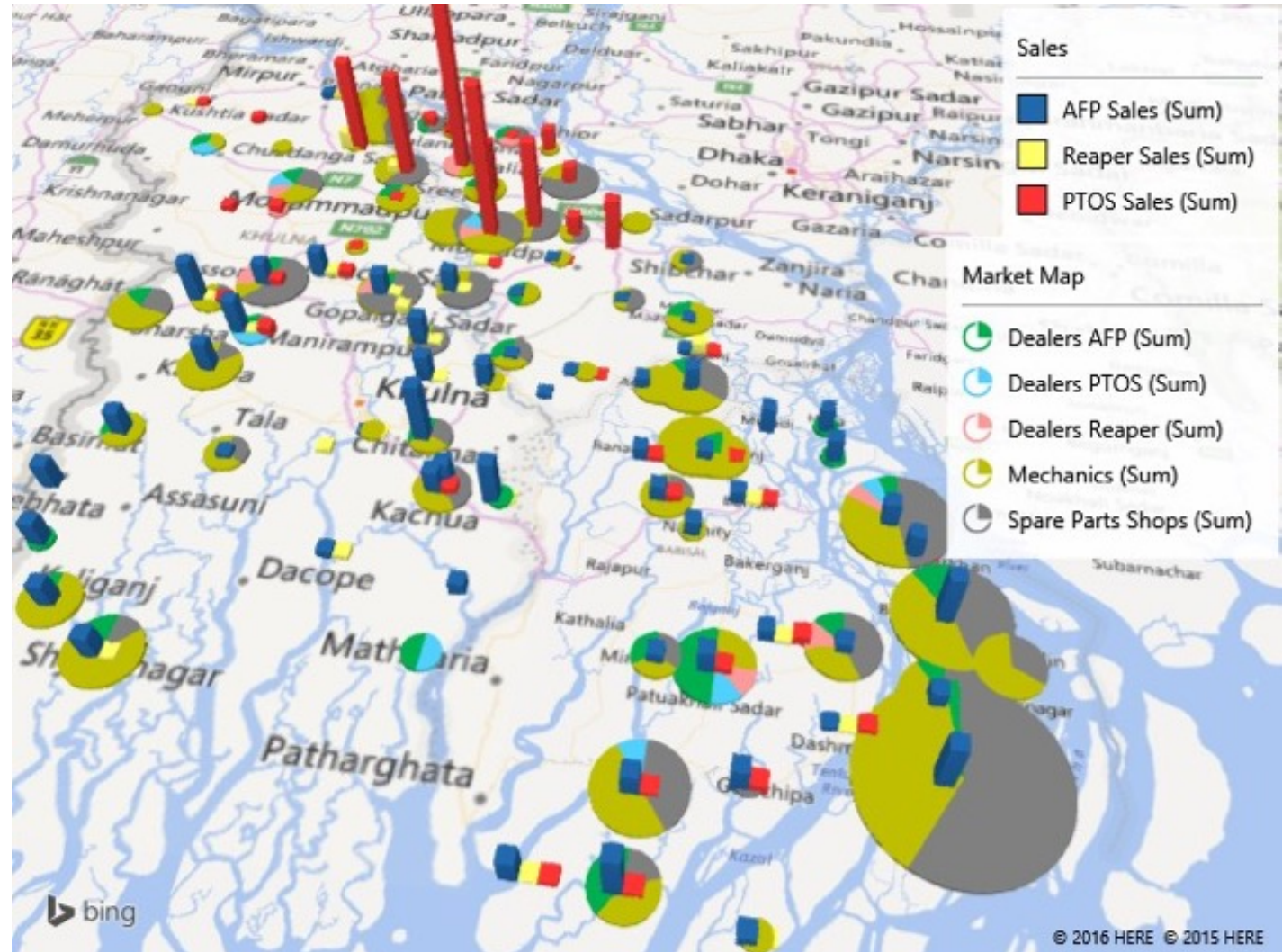
CSISA – Mechanization and Irrigation

Achievements
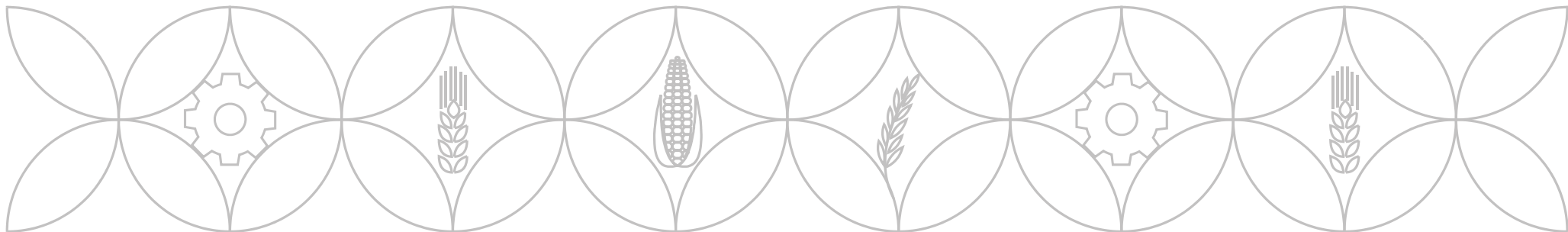
CSISA – Mechanization and Irrigation

- > $1.75 million of private sector investment
- 800 pumps, 550 PTOS and reapers sold
- Domestic pump production
- >29,000 + ha
- >1,200 service providers
- >40,000 + farmers serviced

Spurring a transformation in agriculture through remote sensing (STARS, 2014-2016)

- Application of remote (satellite) and proximal (drone) sensing to improve irrigation scheduling in southern Bangladesh
- Field-specific irrigation algorithm considering groundwater and salinity dynamics (wheat, maize, mung bean)
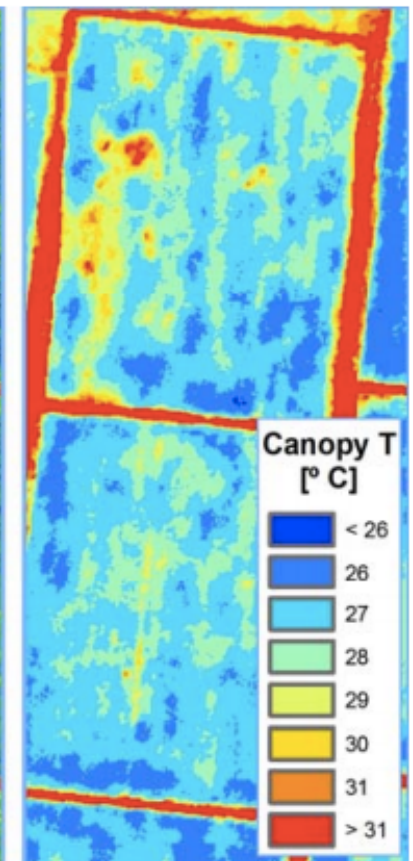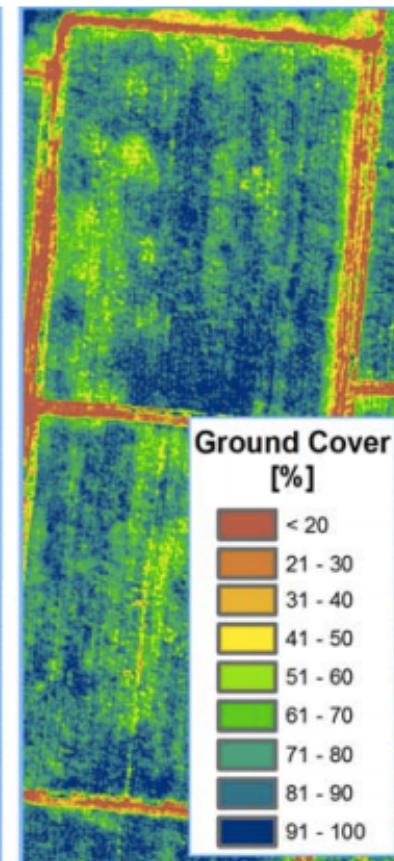
Spurring a transformation in agriculture through remote sensing (STARS)

- Program for Advanced Numerical Irrigation (PANI conceptual too – proof of concept)
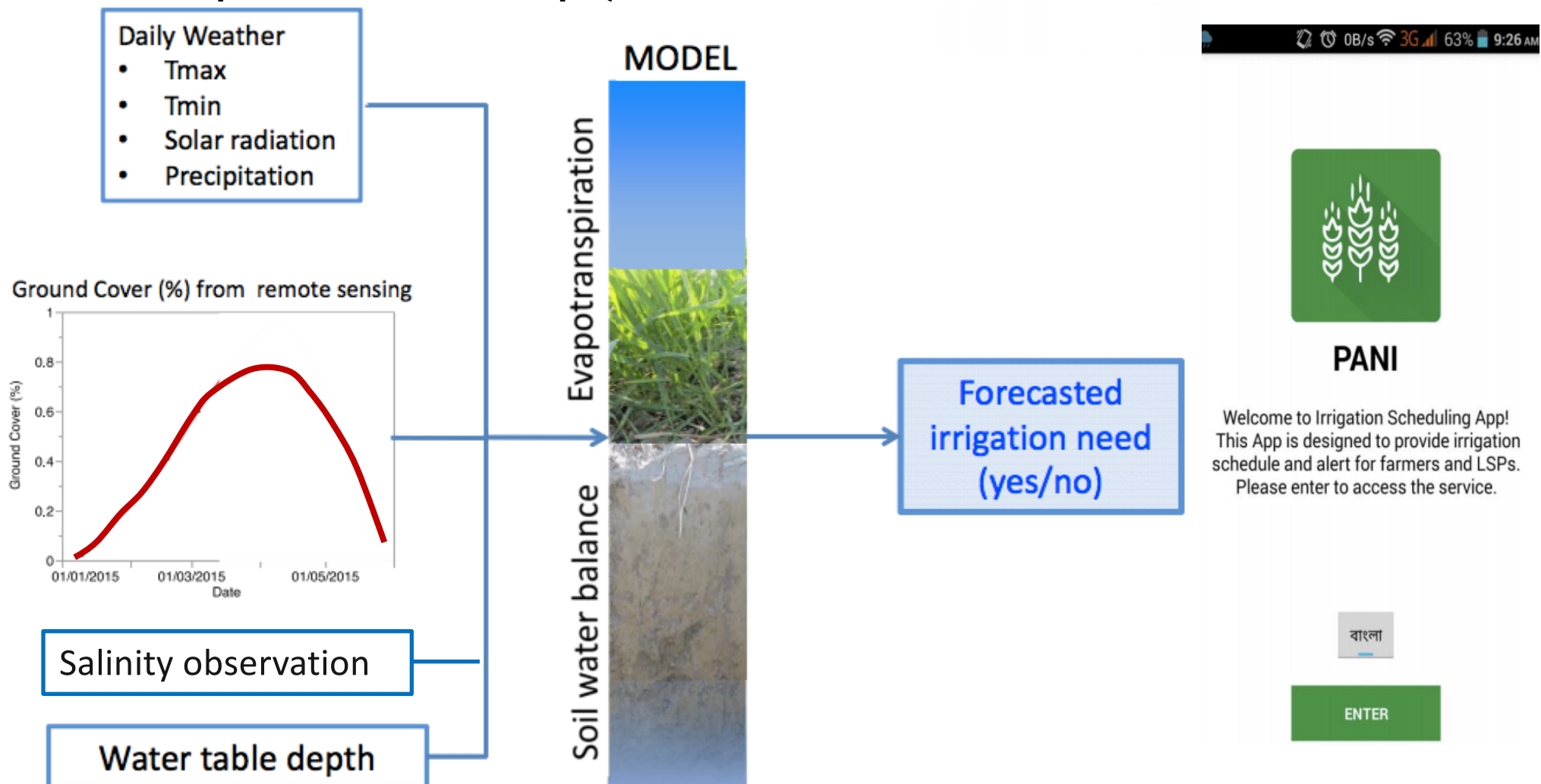
Spurring a transformation in agriculture through remote sensing (STARS)

- Multi-scale assessment of surface water irrigation feasibility
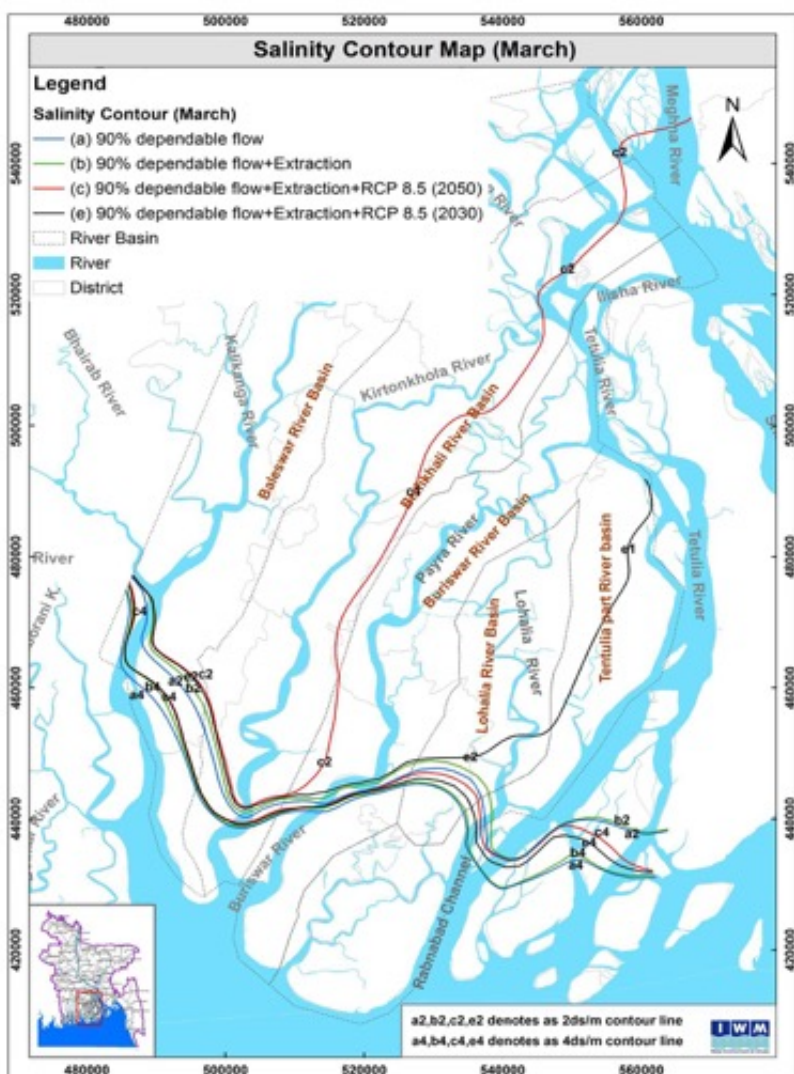
Macro-scale (region)

Meso-scale (actionable)

Climate services for resilient development (CSRD, 2016-2019)

Climate services for resilient development (CSRD)
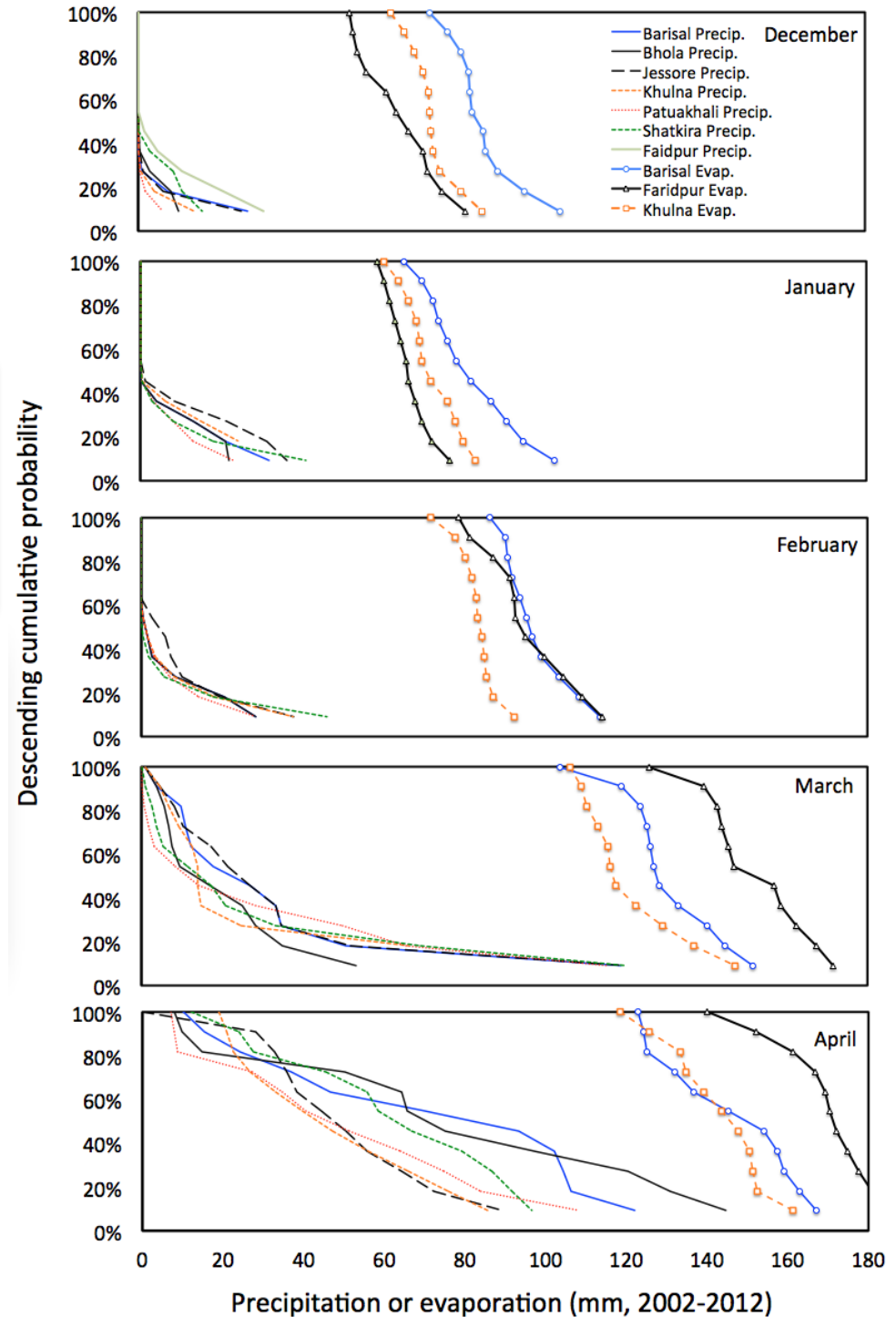
CSRD OBJECTIVES

Objective 1:
Impact-based national-scale decision tool platforms

Objective 2:
Collaborative development and refinement of South Asian regional-scale agro-climate decision support tools

Objective: 3
Coordination of CSRD partners

Looking forward: Where do we need to go?

- Research for long-term time horizons (preparing for 2030)

- SWOT analysis for ag. R4D in coastal Bangladesh?

- Prioritize: Seek synergy, avoid duplication (and competition!)

- More integration with development partners

- Interdisciplinary integration with social scientists!

Donors

Implementing Partners

Thank you! Questions? t.krupnik@cgiar.org