A spatial ex ante framework for guiding agronomic investments in Tanzania

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Africa's R&D & investments

Huge yield gaps in staples → where to invest?

Agronomic research

- Traditionally aspatial
- Agronomic returns over economic returns (profit and risk as evaluation criteria)

Targeting investments

- Fails to incorporate farmer-level decision making.
- Public and private

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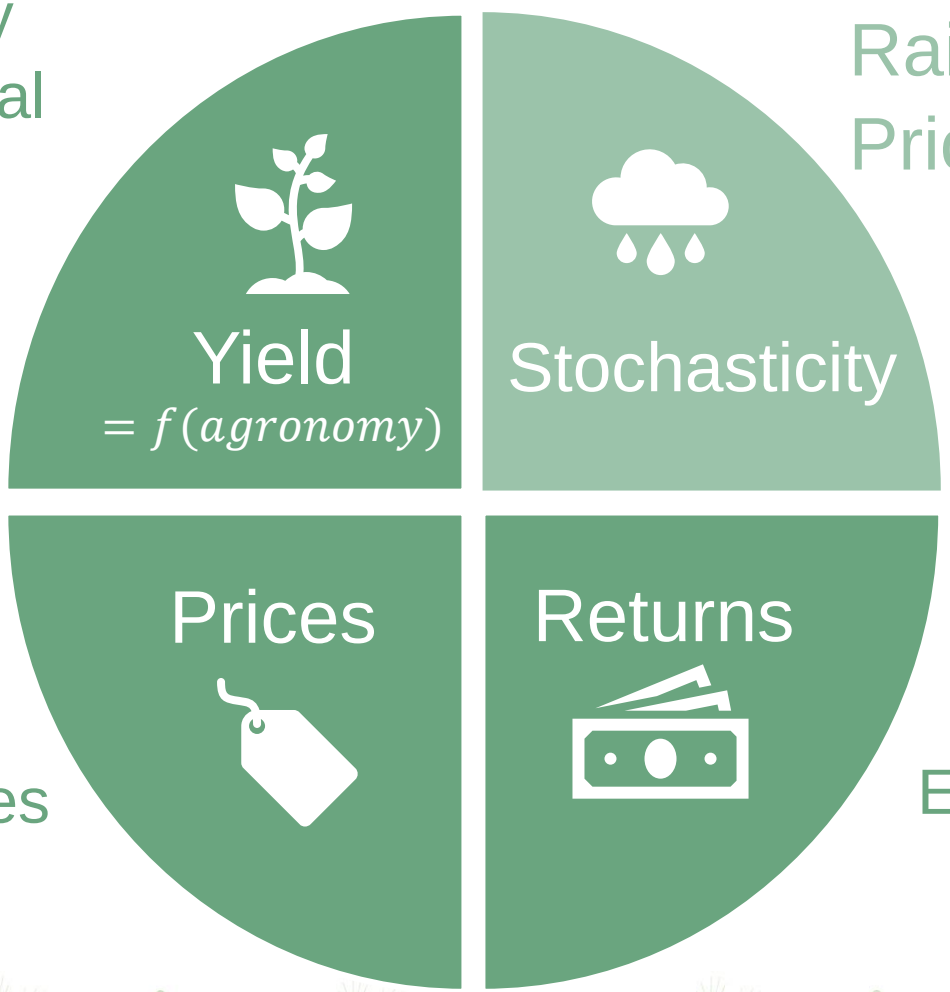
Objectives

- Have a geospatial framework to predict fertilizer profitability for maize systems in SSA.
- Determine the profitability of different fertilizers across space and provide feedback on finding potential optimal fertilization recommendations for different scales.
- Potential effects of a subsidy policy

Spatial *ex ante* analytical framework

Agronomy
Biophysical context

Rainfall Climate
Price



Inputs
Farmgate prices
Markets

Expected returns

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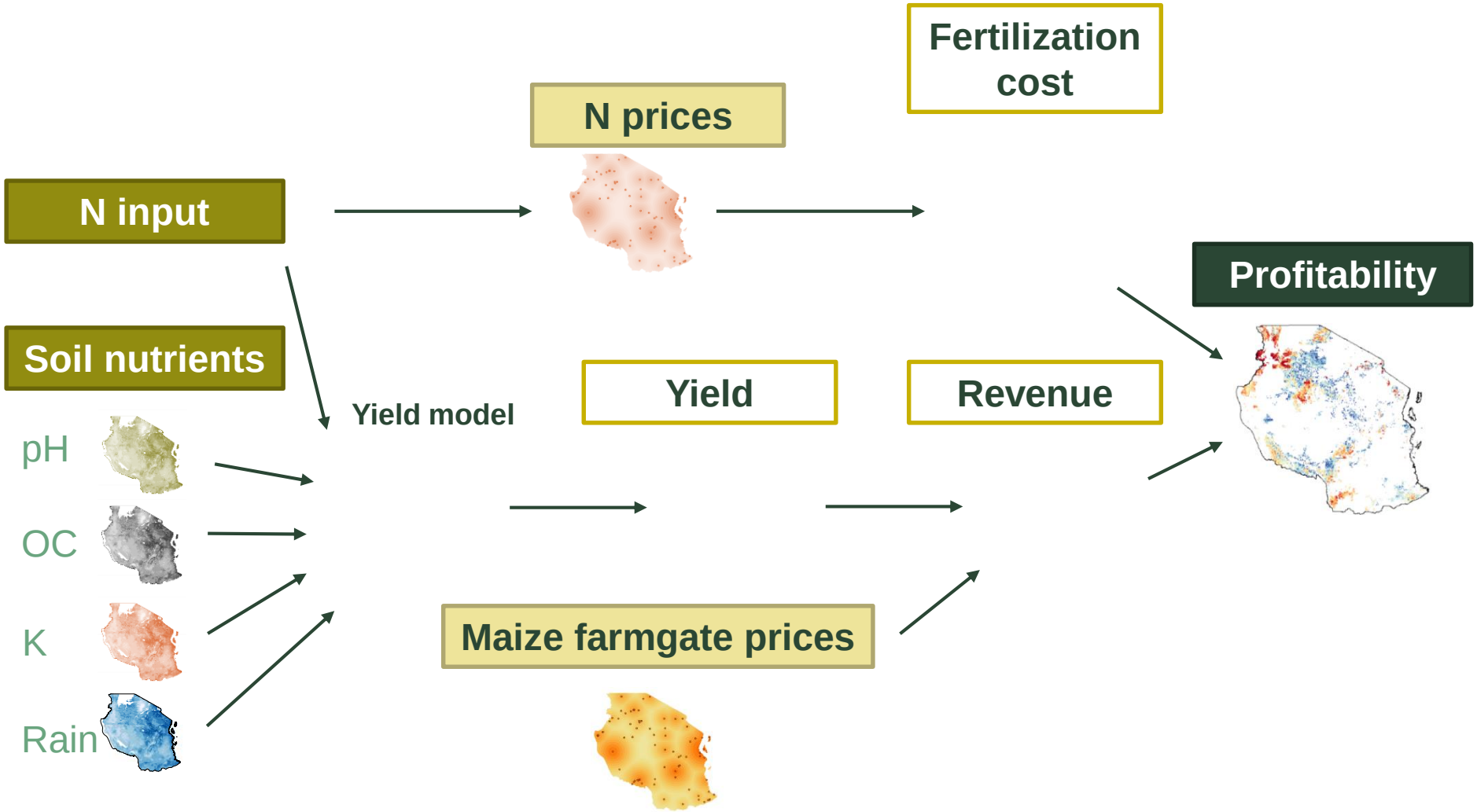

Fertilization cost
N prices
N input
Profitability
Soil nutrients
Yield
Revenue
Yield model
pH
OC
K
Rain
Maize farmgate prices

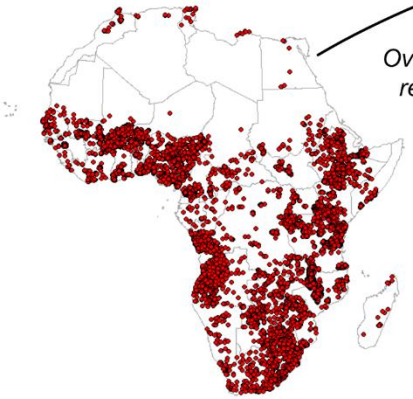
Yield: Soil Nutrients - AfricaSoils

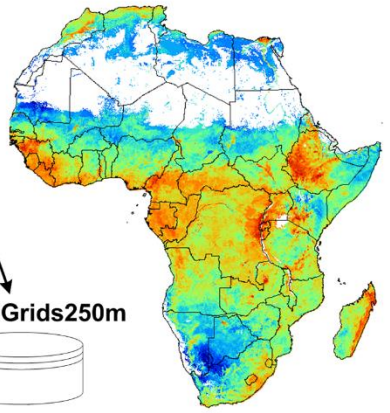
Soil covariates:

- MODIS and SRTM DEM land products,
- GlobeLand30 aggregated land cover data (30 m -> 250 m),
- SoilGrids1km (global models)

Fit models and generate predictions (random forests + kriging)

Overlay / generate a regression matrix





AfSoilGrids250m

Soil profiles and soil samples (model calibration data)

Share / distribute

- soil organic carbon,
- soil pH,
- sand, silt and clay fractions,
- coarse fragments,
- bulk density,
- cation-exchange capacity,
- total nitrogen,
- exchangeable acidity,
- Al content,
- exchangeable bases (Ca, K, Mg, Na),
- available water capacity
- ...

Collect new ground data (legacy data + new soil observations)

User community (extension workers, government agencies, agri-business)

africasoils.net

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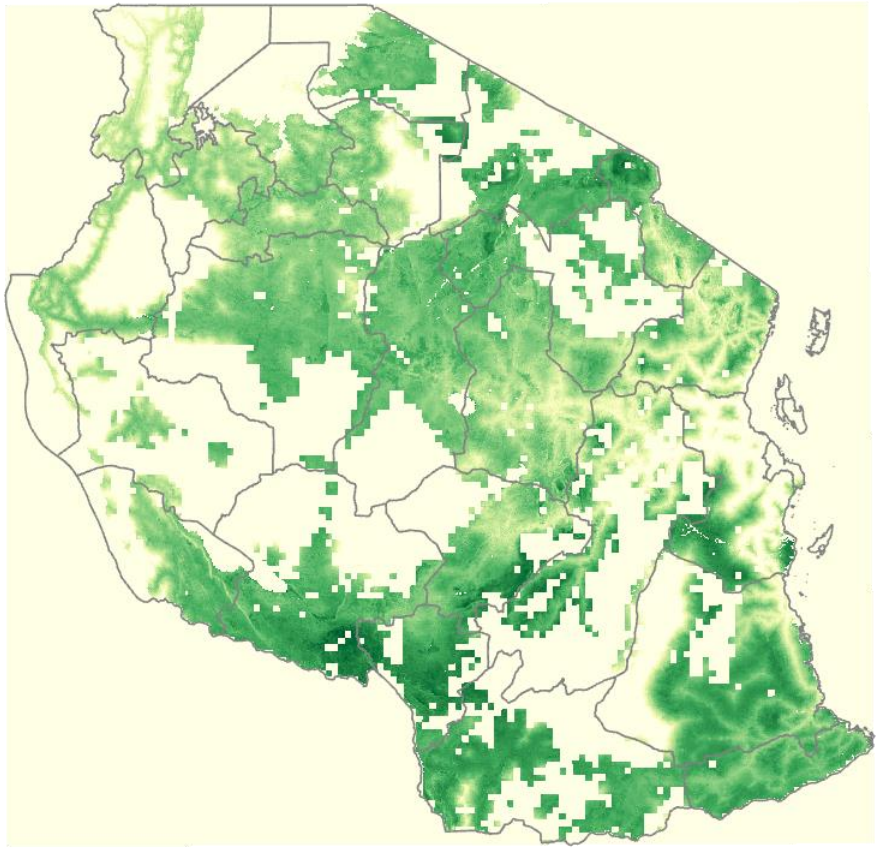
Yield: Regression model

- N applied
- Soil nutrients
- Rainfall
- Accessibility
- Management
- Household



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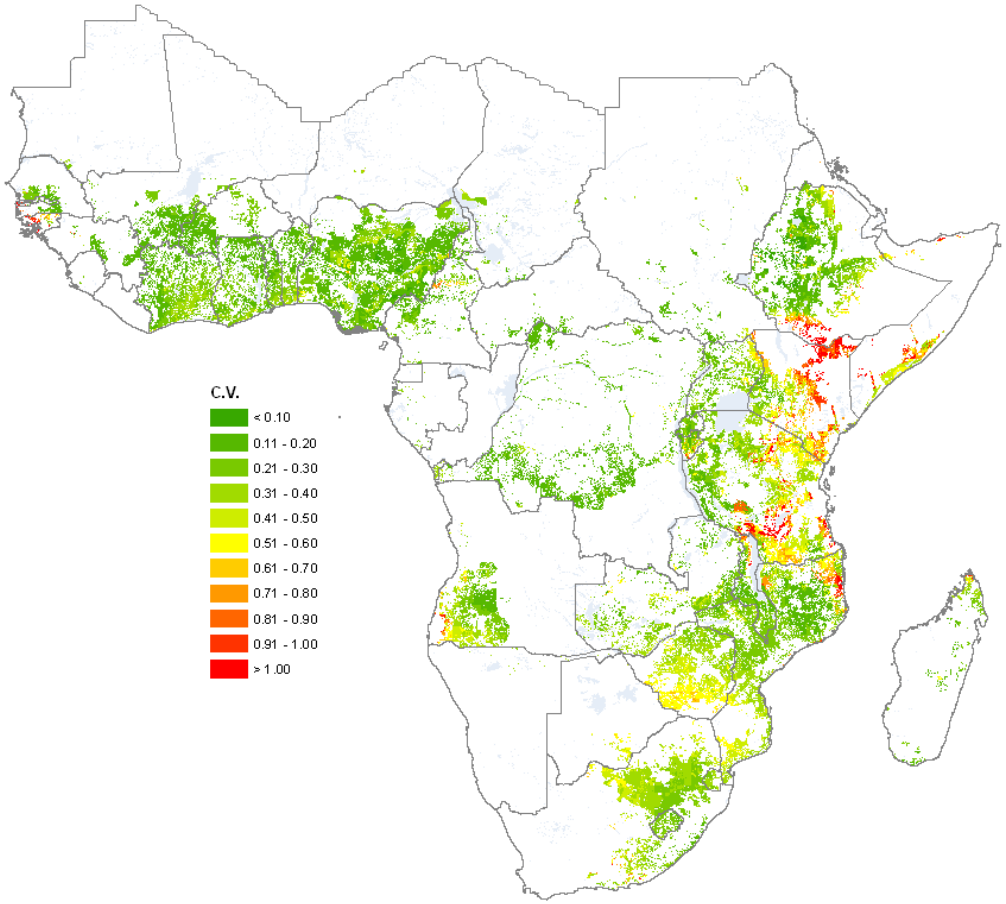
Stochasticity

Rainfall variability



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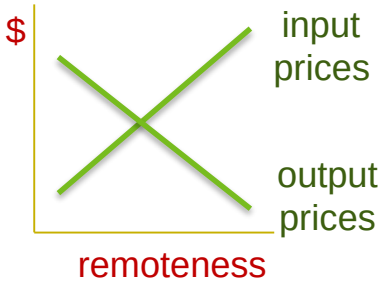
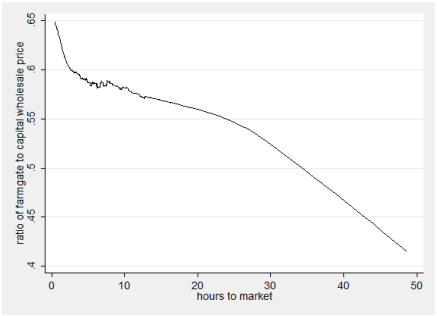
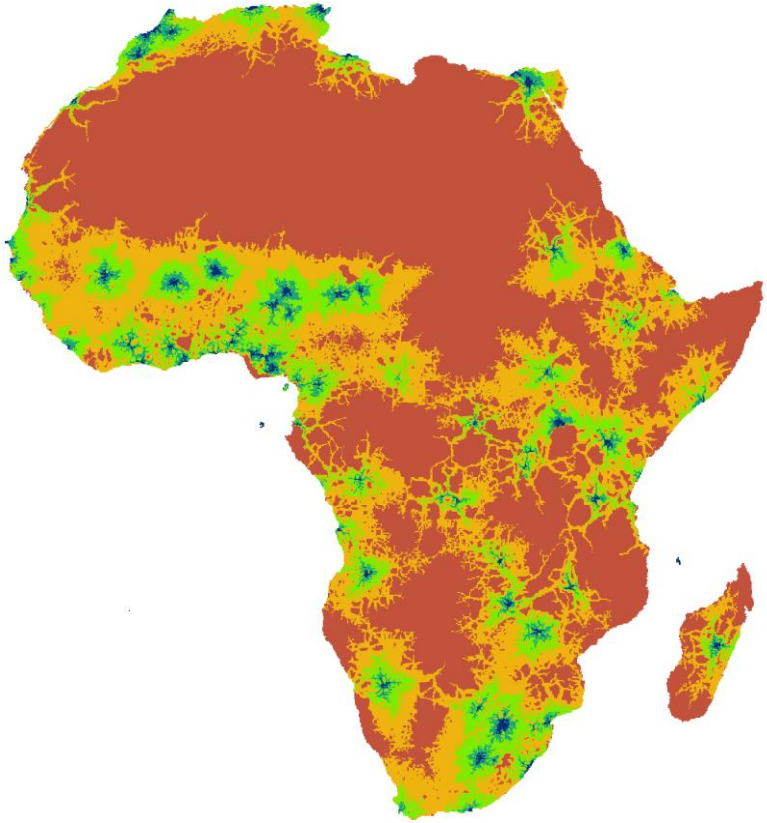
Input price modeling







- Market price data from various MIS
- Price observations from georeferenced household survey data

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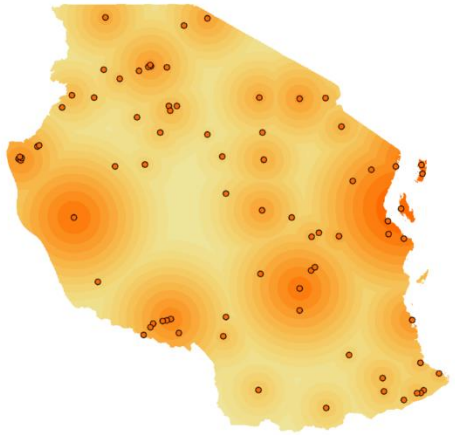
Input price modeling



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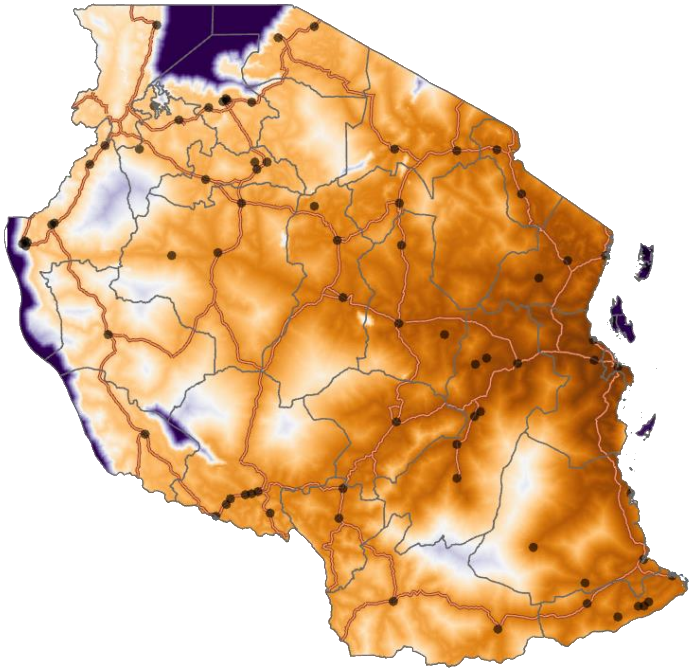
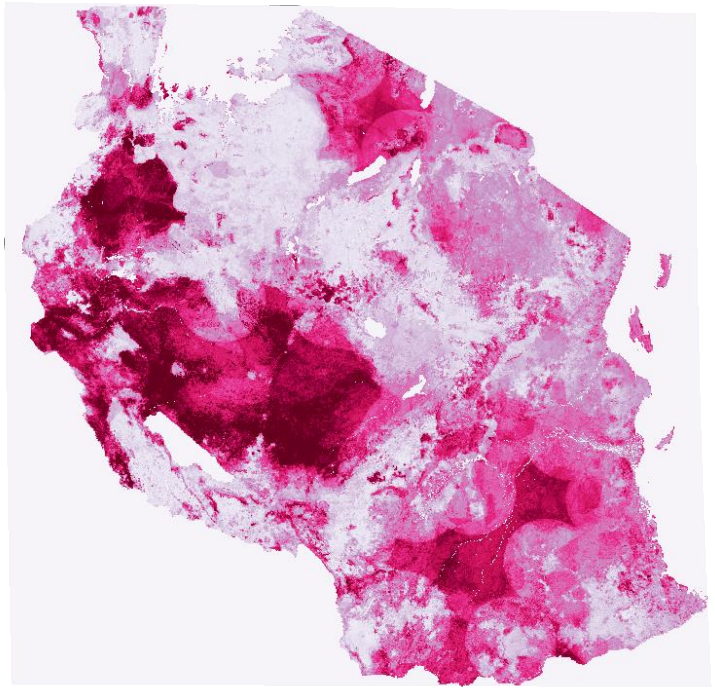
Prices: Maize market prices

Market access



Market price



$r^2 = 0.9$

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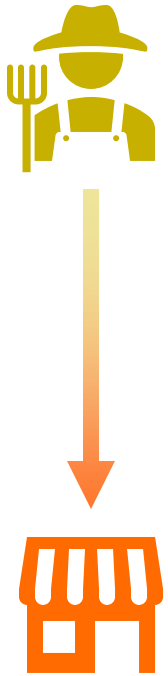
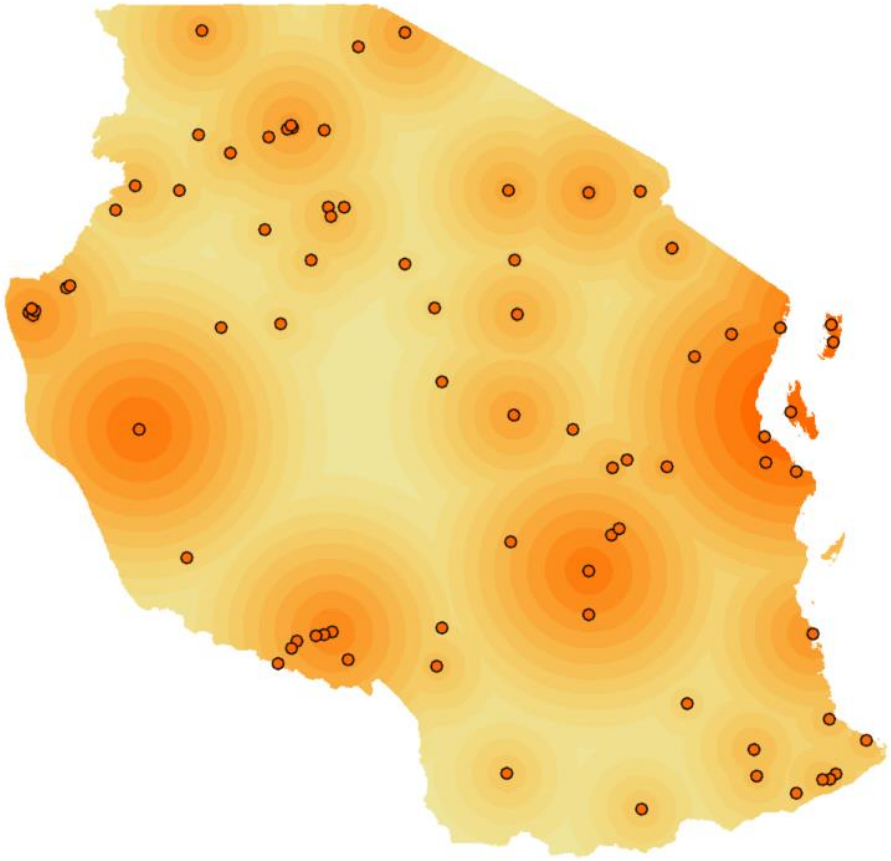
Prices: Farmgate prices





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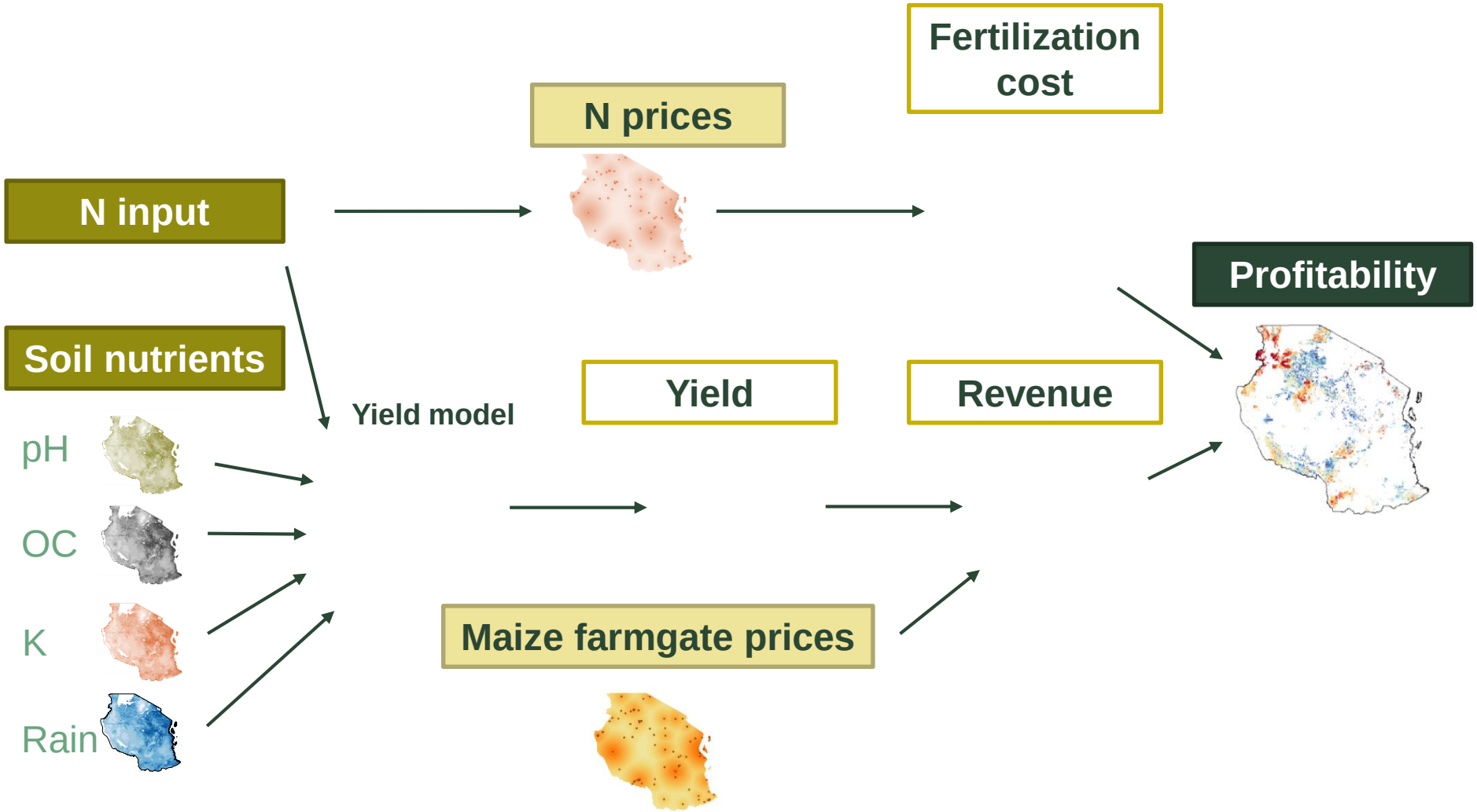
Fertilization cost
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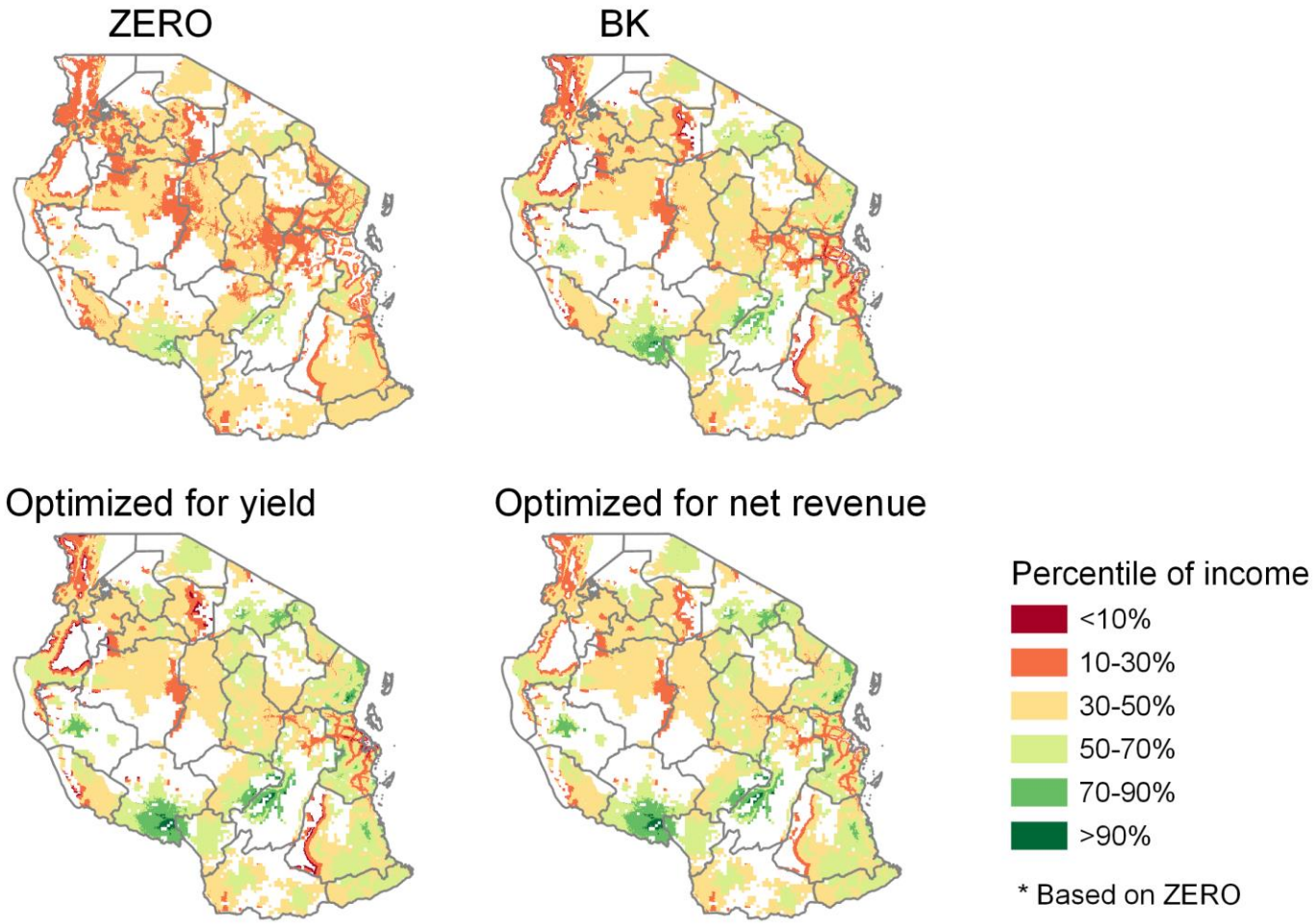
Scenarios

Scenario		N input
ZERO		0 kg/ha
Blanket recommendation		100 kg/ha
Optimized	by Yield	Highest yields
	by Net revenue	Highest profitability

Net revenue



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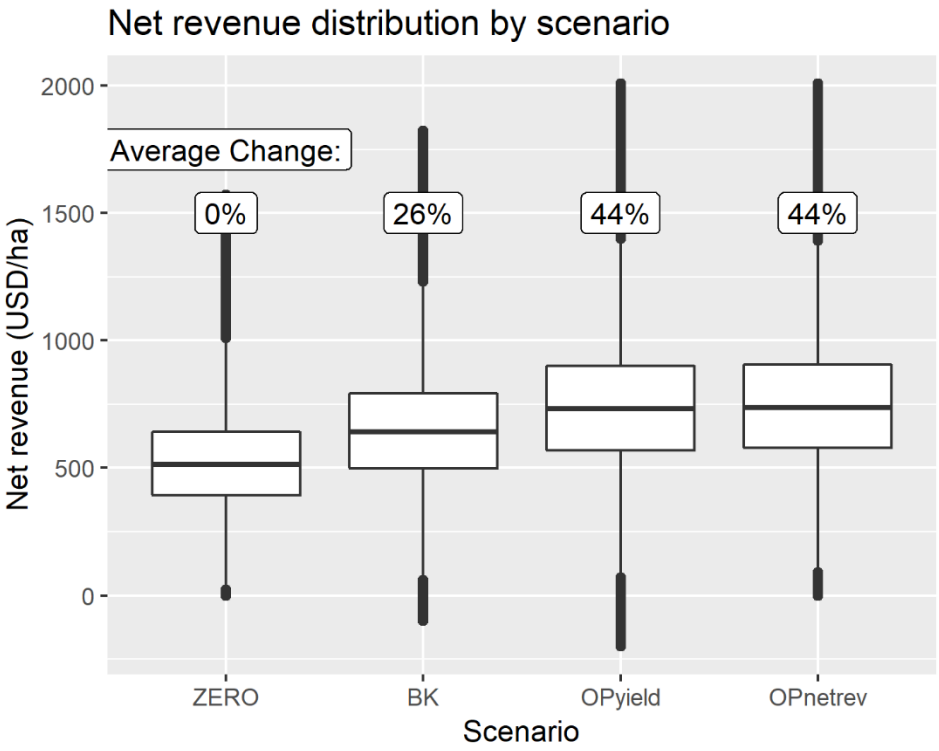
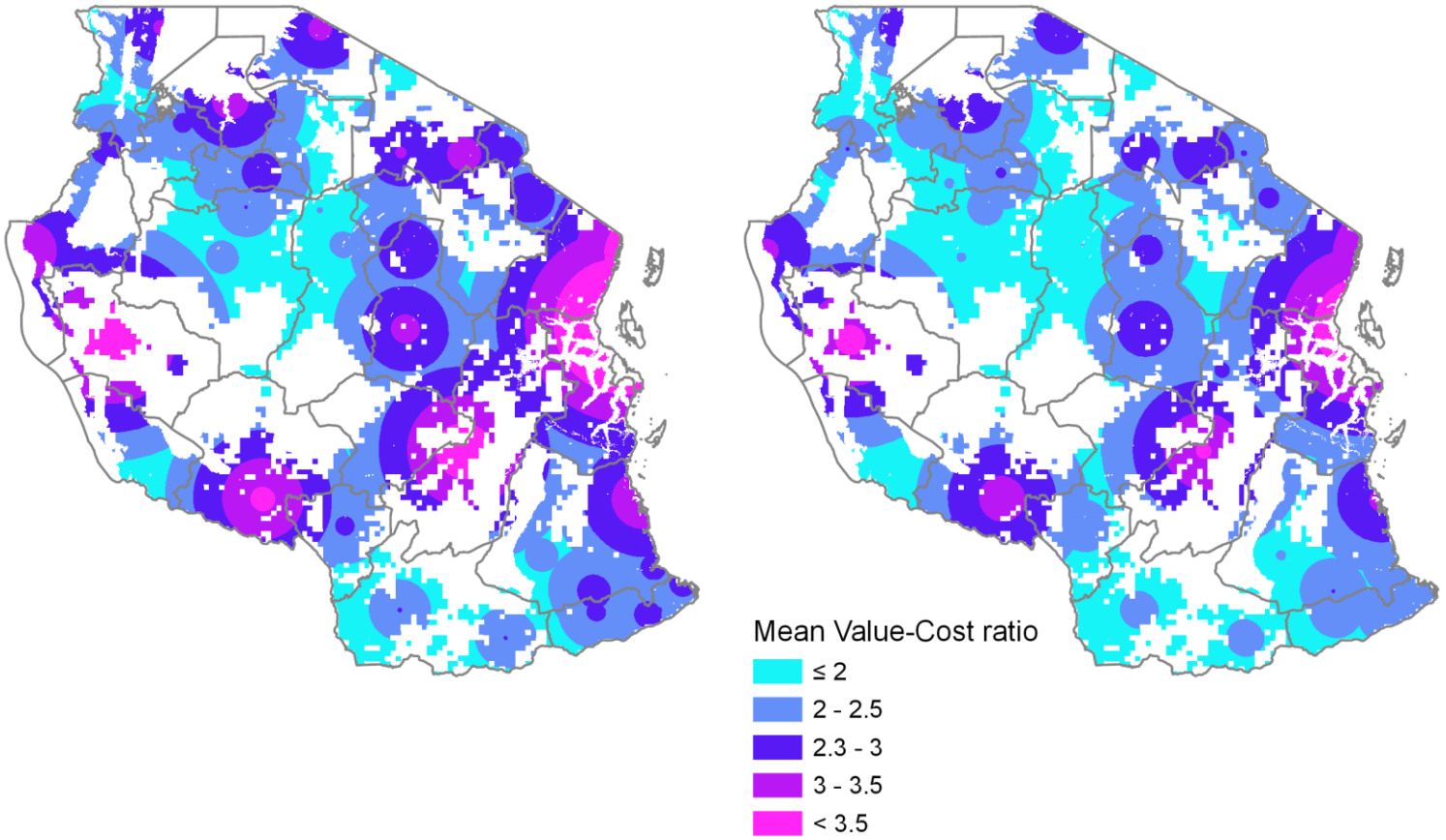
Profitability by scenario



Value-Cost ratio

BK

Optimized for net revenue



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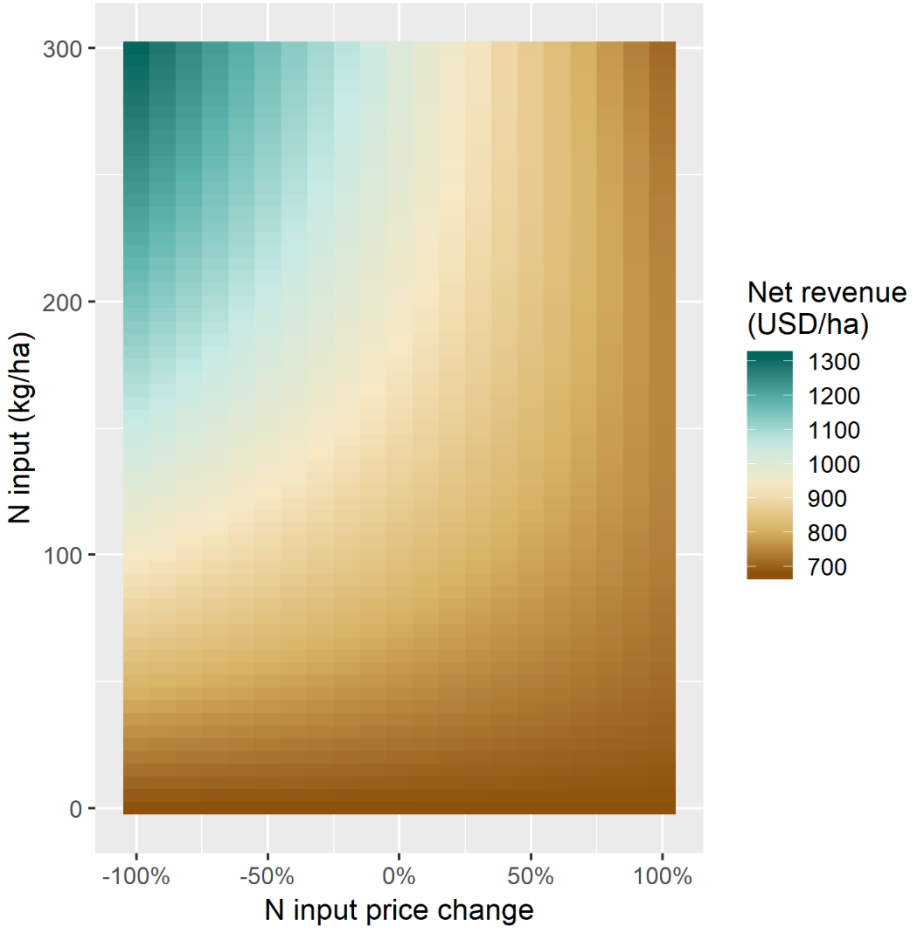
Price changes and Input



How much fertilizer is needed to increase maize production by 30%?

Where to bundle with insurance?

Returns to site-specific nutrient mgt?

Correlation with fertilizer usage

Market demand for new blend?

Rainfall variability

Returns to fertilizer versus new variety?

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Acknowledgements

AI for Earth

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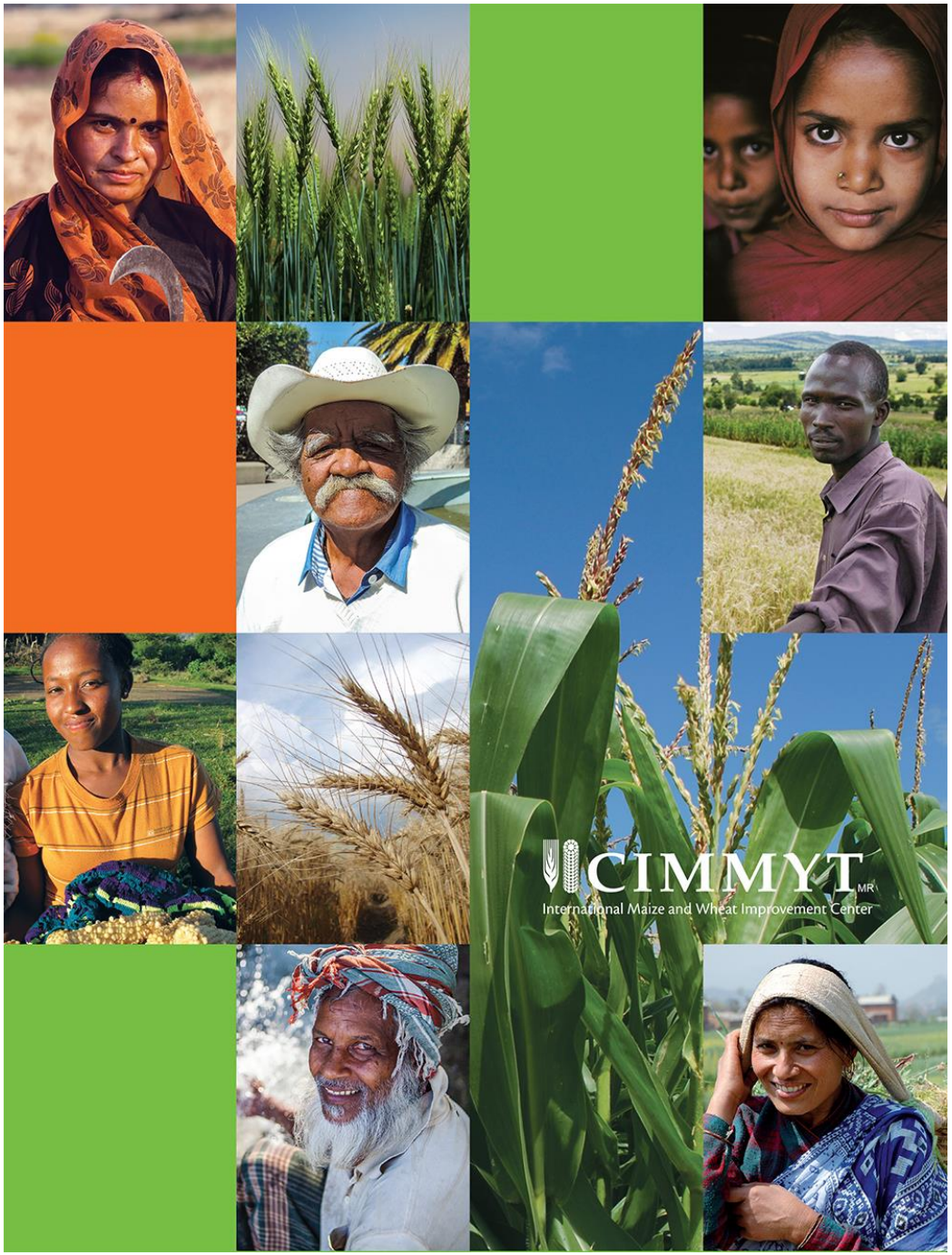

Thank you for your interest!