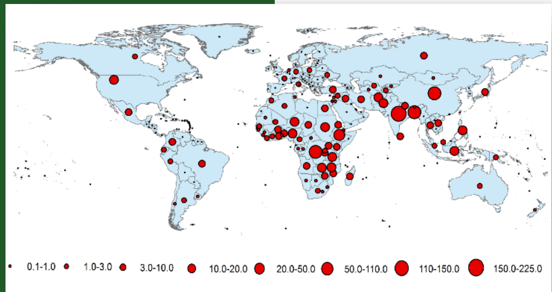

Foresight Analysis and *Ex-ante* Assessment of Promising Technologies: *To Inform Decision Making*

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Strategic Foresight Conference, IFPRI, Washington DC, & Nov 2014

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Outline

- Why foresight analysis and what it reveals
- Assessment of promising technologies
- Case study – Groundnuts promising technologies
- Summary
- Way forward

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Why Foresight Analysis?

- Global food economy is in a state of **FLUX**

Drivers of Change

- Growing population
- Rising incomes
- Changing diets
- Restrictive trade policies
- Climate change
- Natural Resource degradation
- Food crops used for bio-fuel

Higher and more volatile food prices and increasing food and nutritional insecurity

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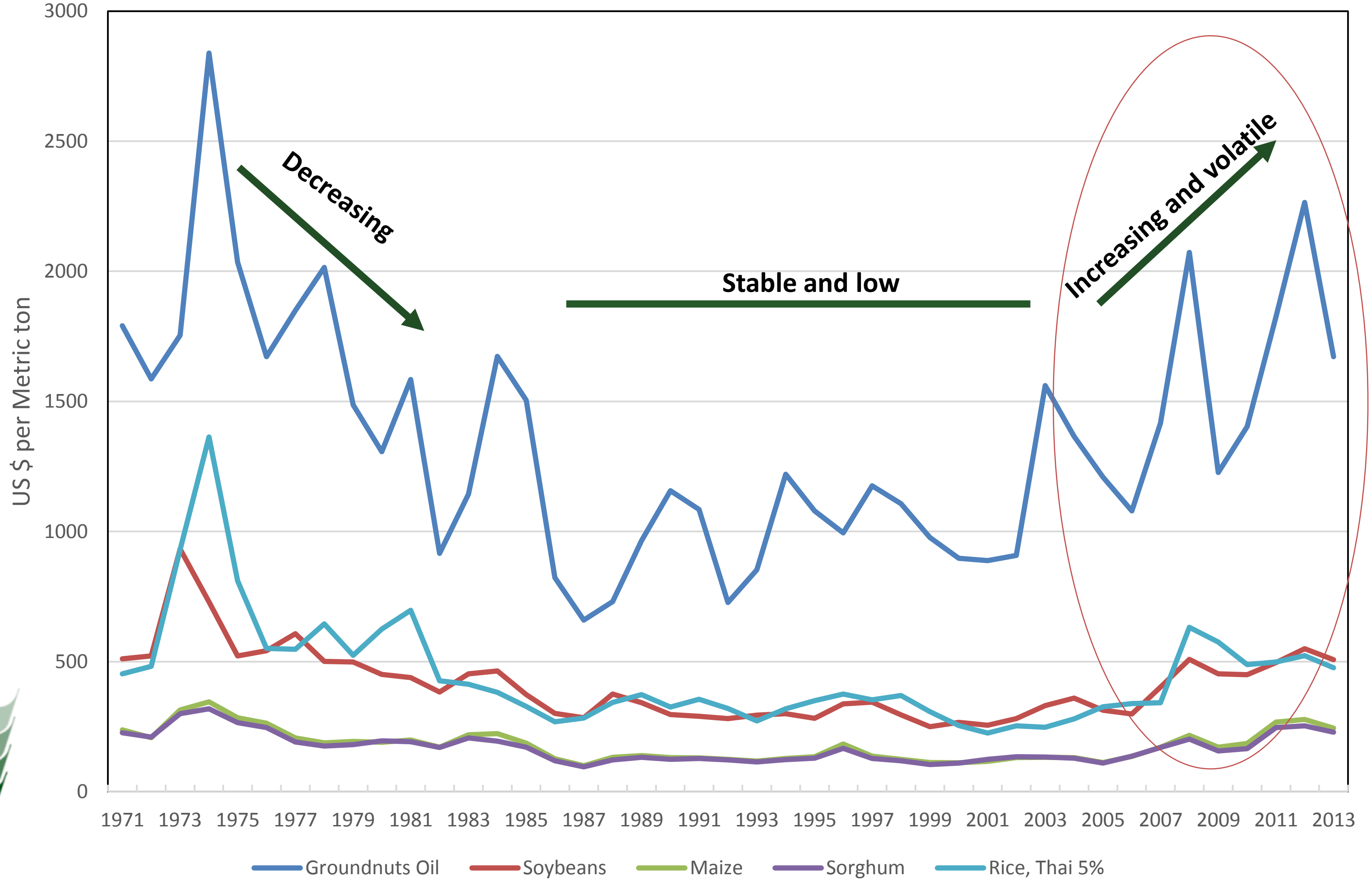
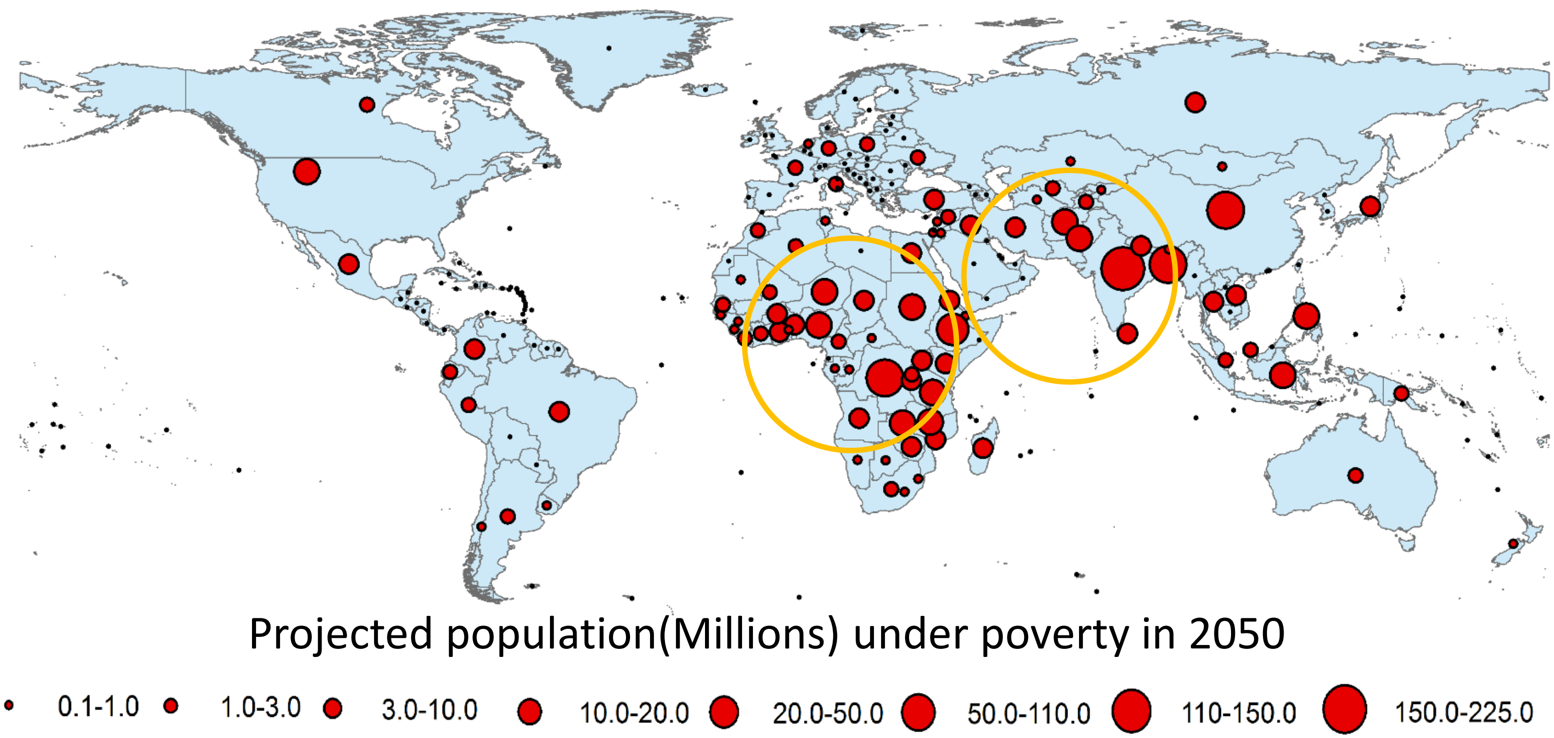
Prices for Agricultural Commodities, 1971-2013



Source: World Bank (data accessed on 2 April, 2014)
Note: Price are in real 2010 US$.

Foresight Analysis Reveals!

Demand and supply of grain legumes in **Low Income Food Deficit Countries (LIFDC)***



Projected population(Millions) under poverty in 2050

Source: IMPACT model projection
Note: Grain legumes - groundnuts, chickpea, pigeonpea and soybeans; *There are 62 countries classified under LIFDC by FAO

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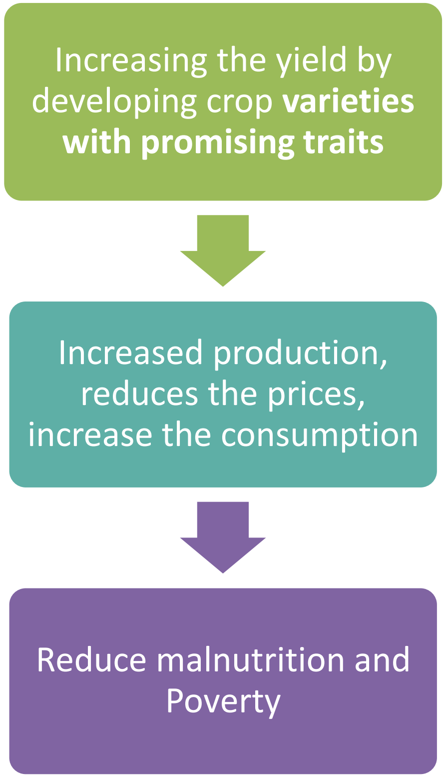
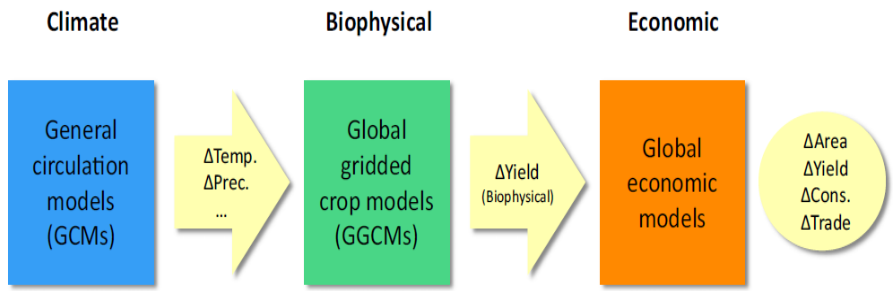
Goal of Global Futures and Strategic Foresight

- To support increases in agricultural productivity and environmental sustainability by evaluating promising technologies, investments, and policy reforms
- Evaluation of selected “virtual crops,” specifically drought- and heat-tolerant varieties and combinations



Modeling climate impacts on agriculture: Incorporating economic effects



Source: Nelson et al., PNAS (2014)

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Promising Technologies and Countries of Adoption

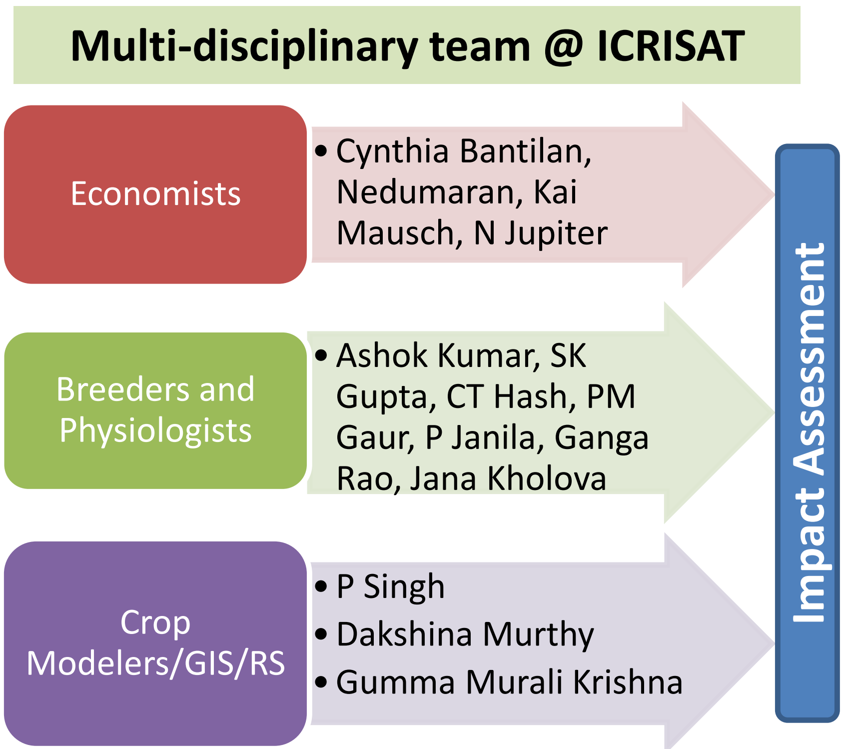
CROP	TECHNOLOGY	COUNTRIES
Maize (CIMMYT)	Drought tolerance	Angola, Benin, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Uganda, the United Republic of Tanzania, Zambia, and Zimbabwe
	Heat tolerance	Bangladesh, India, Nepal, and Pakistan
Wheat (CIMMYT)	Drought tolerance	Iran and Turkey
	Heat tolerance	India and Pakistan
	Drought + Heat tolerance	Argentina and South Africa
Rice (IRRI and IFPRI)	Drought tolerance	Bangladesh, Cambodia, India, Lao People's Democratic Republic, Nepal, Sri Lanka, and Thailand
Potato (CIP)	Drought tolerance, Heat tolerance, and Drought + Heat tolerance	Bangladesh, China, Kyrgyzstan, India, Nepal, Pakistan, Tajikistan, and Uzbekistan
Sorghum (ICRISAT)	Drought tolerance	Burkina Faso, Eritrea, Ethiopia, India, Mali, Nigeria, Sudan, and The United Republic of Tanzania
Groundnut (ICRISAT)	Drought tolerance, Heat tolerance, and Drought + Heat tolerance + high yielding	Burkina Faso, Ghana, India, Malawi, Mali, Myanmar, Niger, Nigeria, Uganda, United Republic of Tanzania, and Viet Nam
Cassava (CIAT)	Biological controls of a Mealybug pest infestation	China, India, Indonesia, Lao People's Democratic Republic, Myanmar, and Thailand

Strategic Foresight @ ICRISAT-Intro

- 5 Mandate crops
  - **Dryland Cereals** – Sorghum and Pearl Millet
  - **Grain Legumes** – Groundnuts, Chickpea and Pigeonpea
- Grown in harsh environment by poor small holder farmers
- Major constraints
  - Sorghum/millets – drought, heat
  - Groundnut – drought, aflatoxin
  - Chickpea – Insects/pests, drought, heat, diseases
  - Pigeonpea – Insects/pests, development of hybrids

Global Futures Project and Strategic Foresight @ ICRISAT

- ❖ GFP activities integrated in CRP-PIM
- ❖ Multidisciplinary team created and institutionalized (14 member team)
- ❖ Promising technologies were identified and prioritized for evaluation
- ❖ Collaboration with other CRPs and Global Projects like AgMIP (data sharing, model enhancement, capacity building)



ICRISAT Focused Crops and Technologies

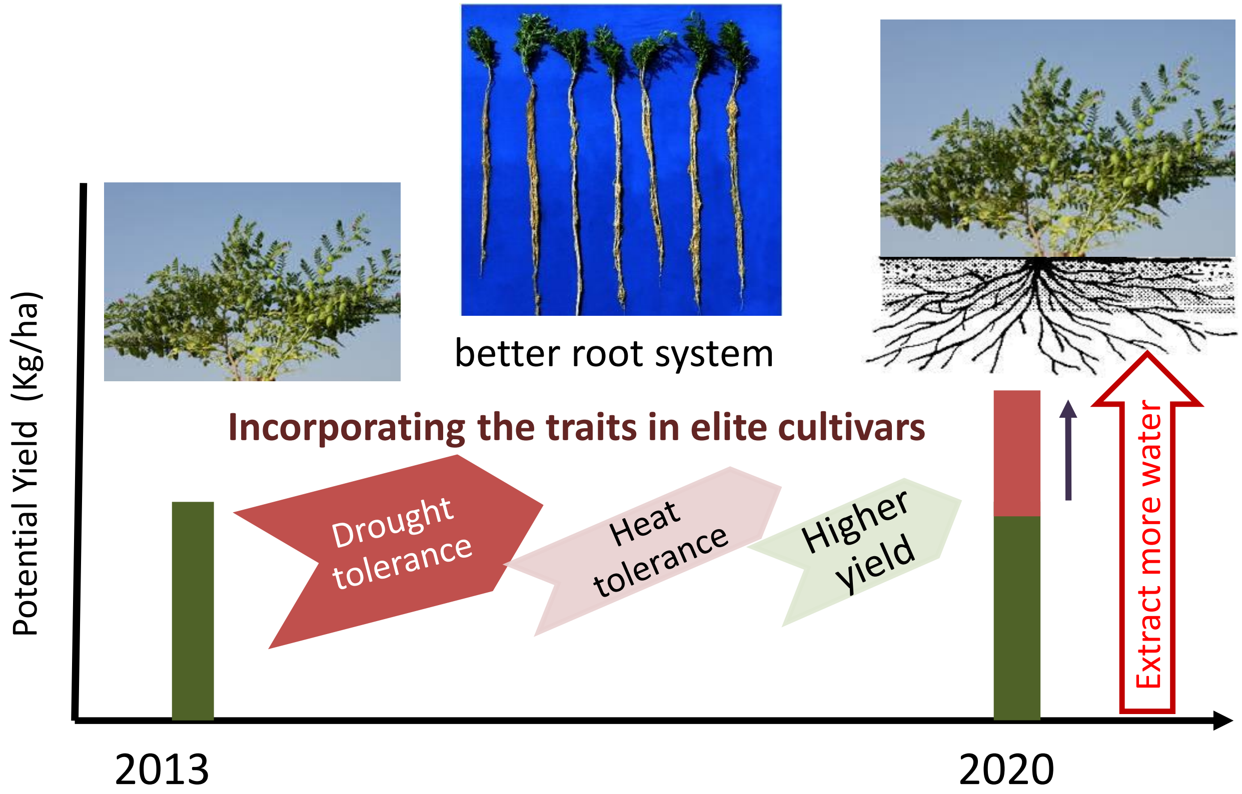
- Crops (discussion with breeders, physiologist, crop modelers and economists)
  - Dryland cereals – Sorghum
  - Grain Legumes – Groundnut

- Technologies focused based on potential of current crop model suites available
  - Drought
  - Heat
  - High yield potential
  - Combination of Heat + drought + high yield

- During 2013-14 with support of CRP-PIM – Chickpea and Pearl millet was identified as next priority crops

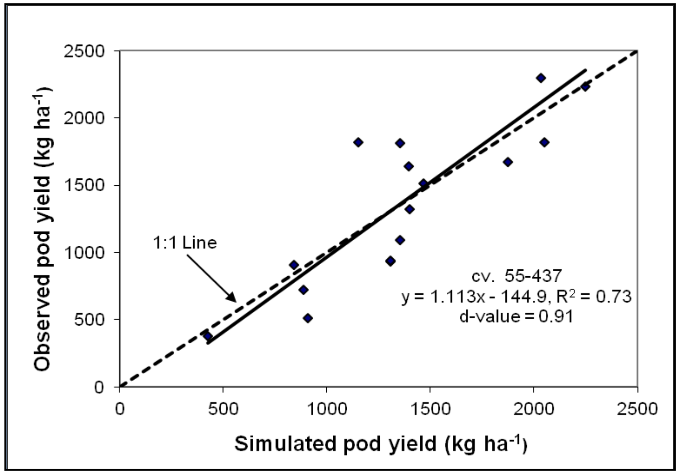
Evaluation of Promising Technologies: Virtual Cultivars

- Target of the crop improvement scientists – develop promising technologies with higher yield



Crop Model Calibration and Development of Virtual Promising Cultivars

- DSSAT Crop Model
- Baseline Cultivars selected - **JL 24**, **M 335** and **55-437**
- Location
  - Anantapur and Junagadh sites in India
  - Samanko (Mali) and Sadore (Niger) sites in West Africa
- calibrate and validate baseline cultivars
- Manipulated the genetic co –efficient of baseline cultivars and developed the virtual promising cultivars for each locations
  - **Drought Tolerant**
  - **Heat Tolerant**
  - **Drought + Heat + yield Potential**
- Estimate the yield change for each technology compare to baseline cultivars in each location

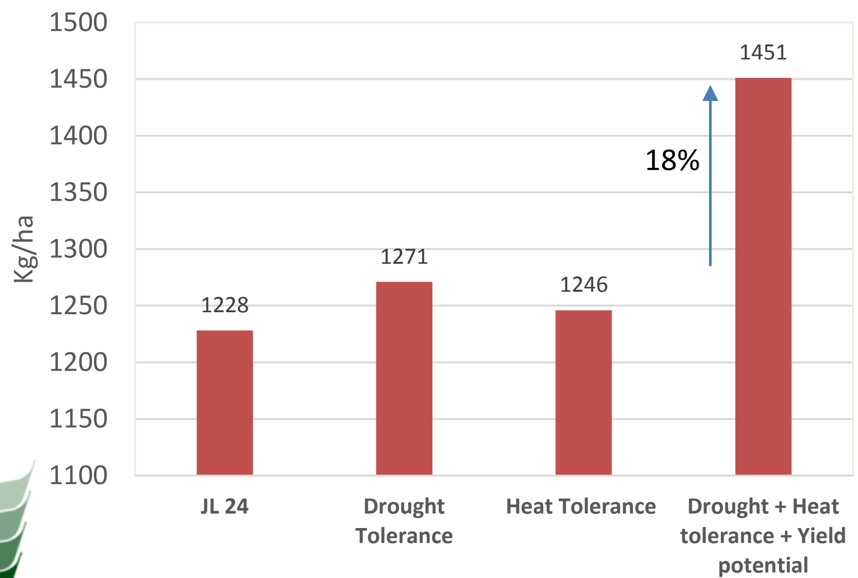


- Data source: **Breeders yield trial data**; NARS trial data
- National Bureau of Soil Survey and Land Use Planning, Nagpur India; WISE soil database
- India Meteorological Department (IMD); NASA website (http://power.larc.nasa.gov/)

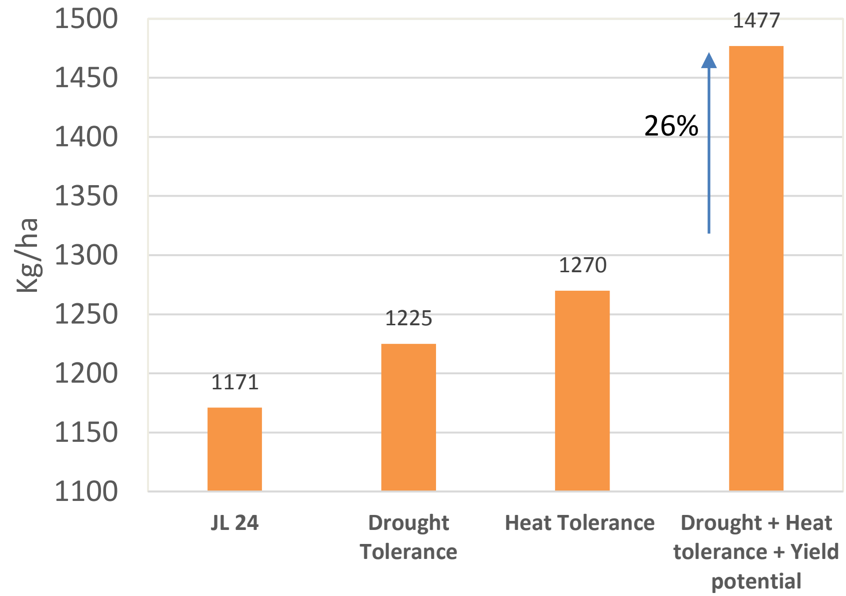
Step 1: Simulated Yield of Promising Technologies of Groundnuts

Location: Anantapur, India; Baseline Cultivars: JL 24

Yield under Current Climate

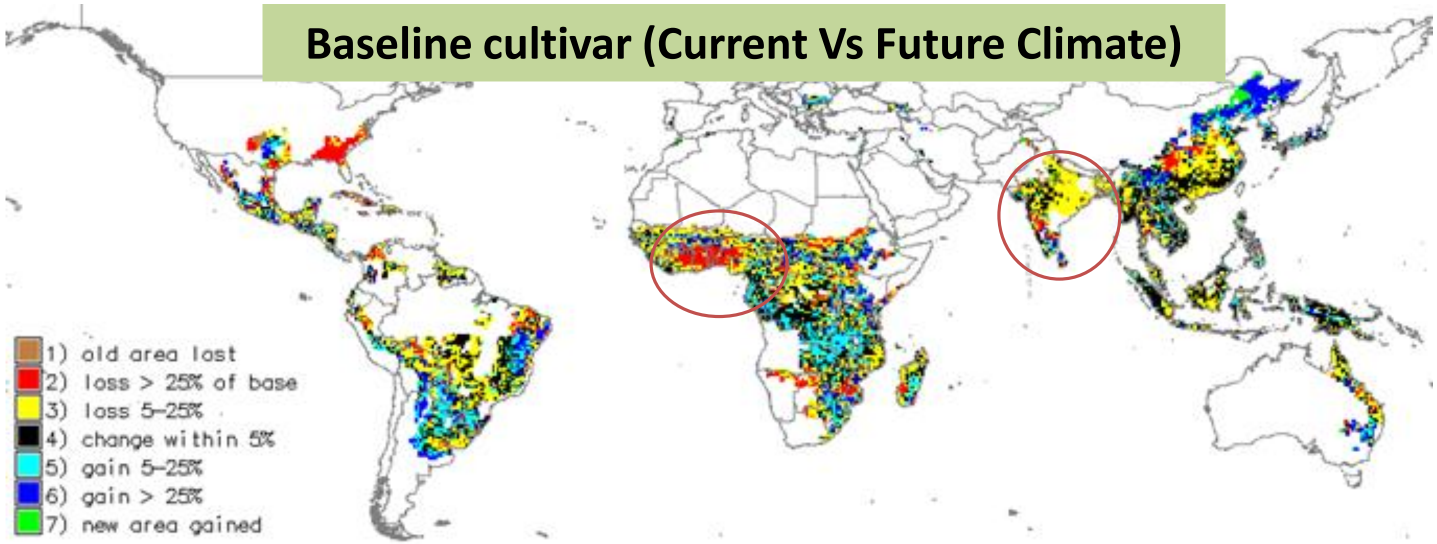


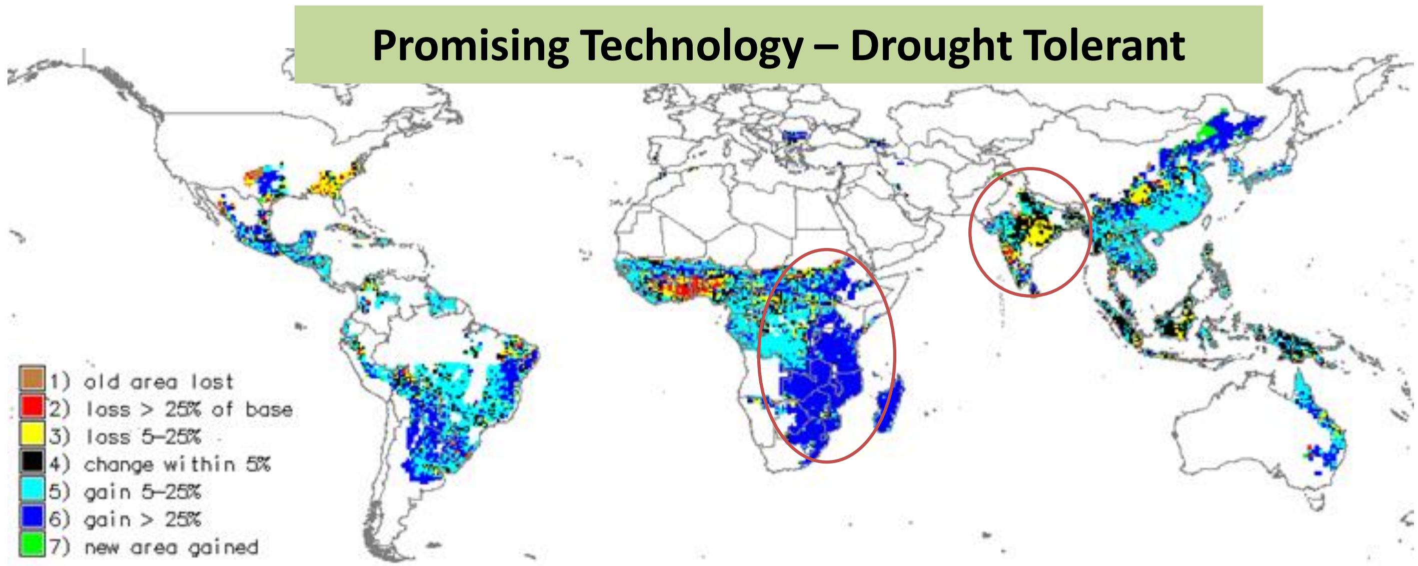
Yield under Climate change 2050 (HADCM3, A1B scenario)



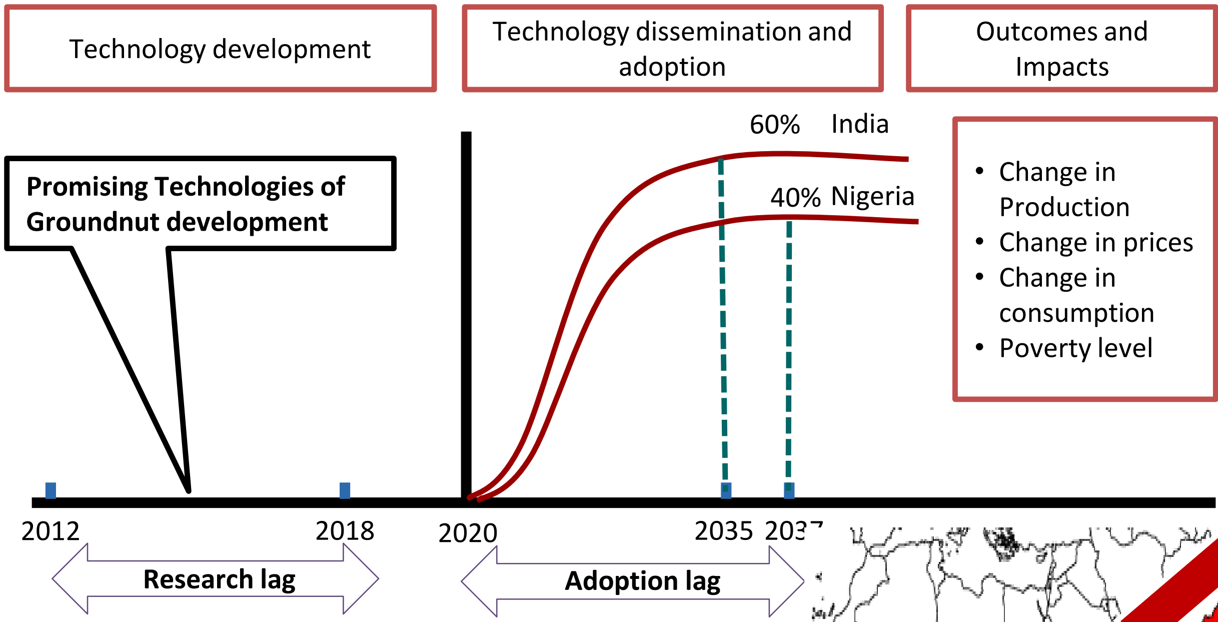
Source: Singh, P., Nedumaran, S., Ntare, B.R., Boote, K.J., Singh, N.P., Srinivas, K., and Bantilan, M.C.S. 2013. Potential benefits of drought and heat tolerance in groundnut for adaptation to climate change in India and West Africa. *Mitigation and Adaptation Strategies for Global Change*.

Step 2: Spatial Change in Groundnut Yield



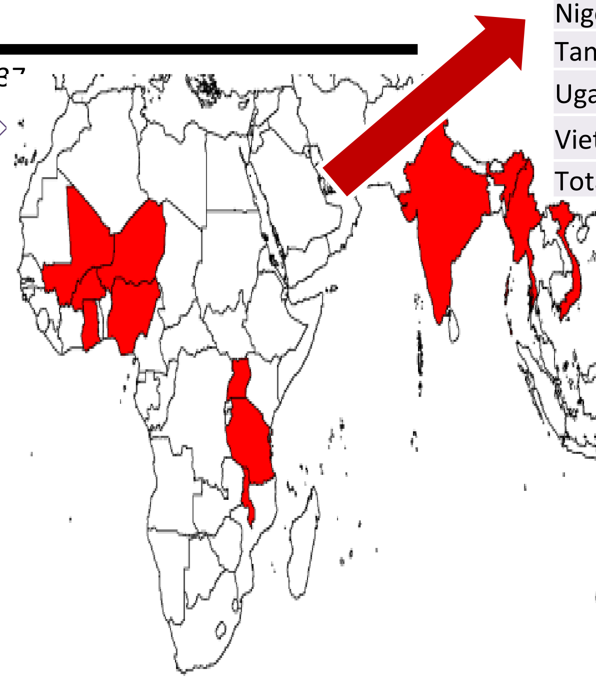


Step 3: Technology Development and Adoption Pathway Framework



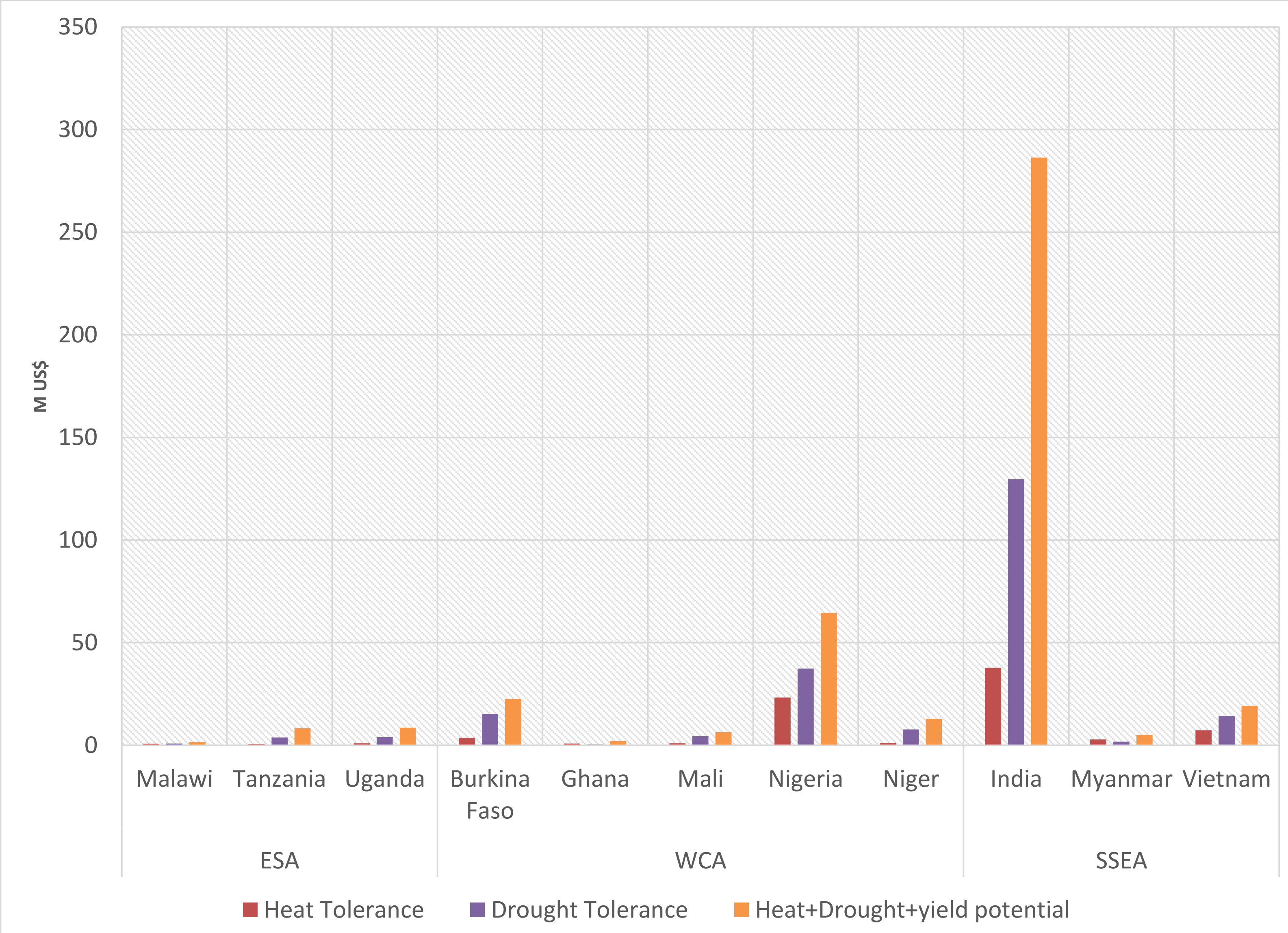
Target countries

Target countries	Production share (%)
Burkina Faso	1.2
Ghana	1.62
India	12.99
Malawi	0.7
Mali	1.01
Myanmar	3.84
Niger	0.51
Nigeria	10.72
Tanzania	1.73
Uganda	0.76
Vietnam	1.84
Total	36.92



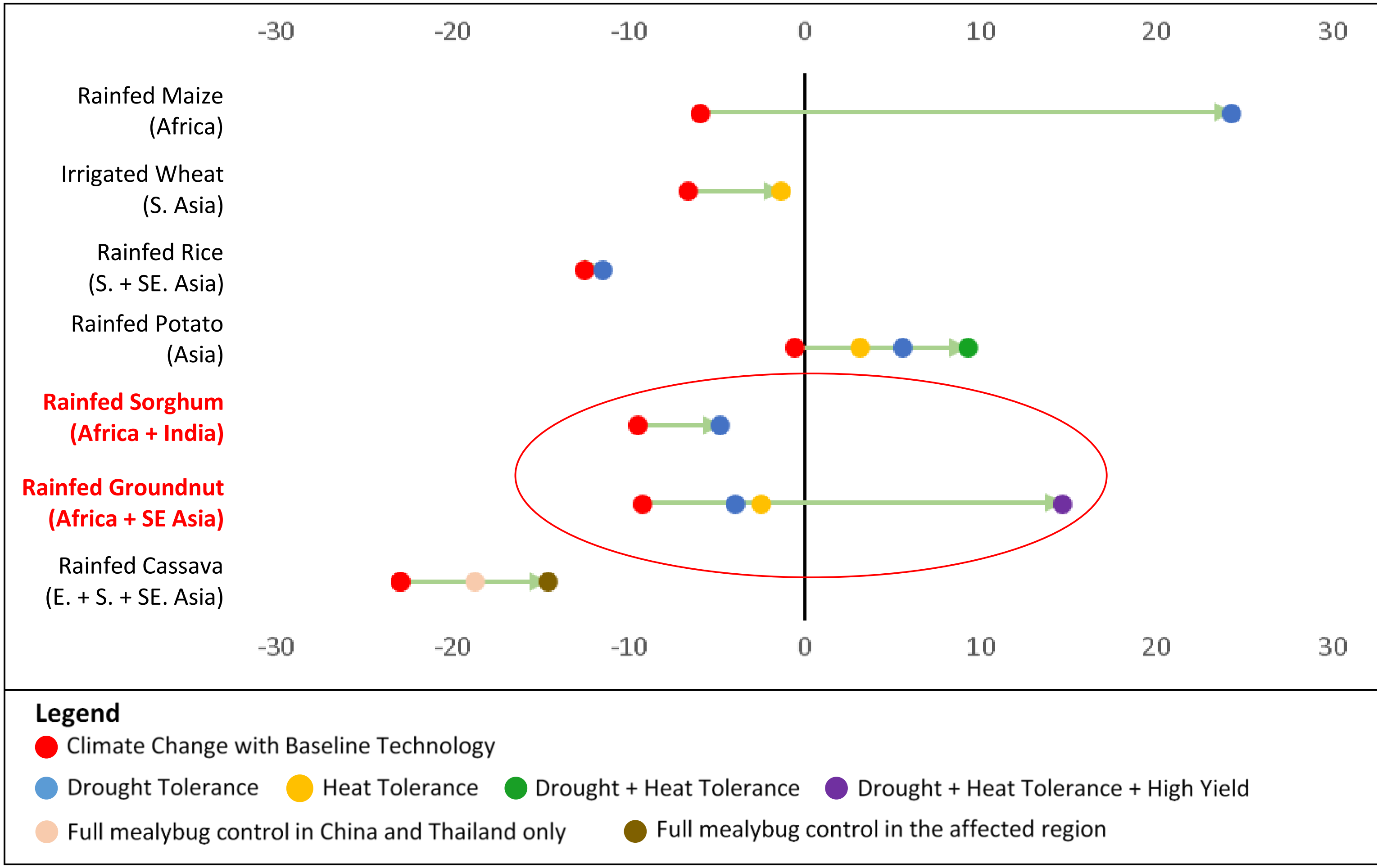
Nedumaran et al. (2013)

Potential Welfare Benefits and IRR (M US$)



Nedumaran et al. (2013)

Effects of Promising Technologies on the Impact of Climate Change on Yields in 2050



Summary

- Climate change impacts on yields are significant, although modest relative to long-term effects of socioeconomic change and productivity growth
- The promising varieties evaluated in this report are generally able to offset the negative yield impacts of climate change
- The combined-trait varieties clearly performed better than the single trait varieties
- The productivity gains observed in all of the technologies improved the regions' terms of trade
- All of the adopting regions would be less vulnerable to global price shocks under these scenarios
- The global consequences of the different technology scenarios varies by crop and technology - due to the total share of global production and the rate of adoption

Limitations

- Need to evaluate potential policies and alternative technologies under a wider set of climatic and socioeconomic conditions
- Current representation of climate change **fails to capture inter-annual variability**, which does not allow testing of the technologies under the extreme climate events
- Crop models used to capture changes in crop productivity – **High data intensive**
- The global benefits of the potential technologies are sensitive to assumptions on **adoption rates**; necessary to test the technologies under a broader range of adoption pathways
- Need careful attention to harmonization of scenarios in order to inform priority setting

Way Forward

- Evaluate the **additional promising technologies** (biotic stress tolerant and management options) with current GF/PIM Strategic foresight tool
- Provide evidence to **inform priority setting for CG centres and CRPs**
- Identify and **collaborate with pest and diseases modelling team**
- **Gender lens in foresight analysis and technology evaluation**

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Thank you!

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