The role of genetically modified crops for food security

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Achieving sustainable food security will require game-changing technologies from all areas of science

- Genetics / Breeding
- Agronomy
- Digital technologies
- Etc.

Common approaches in plant breeding

- Mass selection
- Backcrossing
- Wide crosses
- Hybridization
- Mutagenesis
- Marker-assisted selection

"Conventional breeding"

("natural" and "safe")

- Agrobacterium-mediated gene transfer
- Biolistics
- Genome editing

"Genetic engineering (GMOs)"

("unnatural" and "risky")

GMOs: controversial topic

- The public and policy debate is primarily focused on risks
- Regulatory procedures were put in place treating GMOs very differently from other technologies
- However, 30 years of research and 20 years of commercial experience have shown that GM crops are not more risky than conventionally bred crops

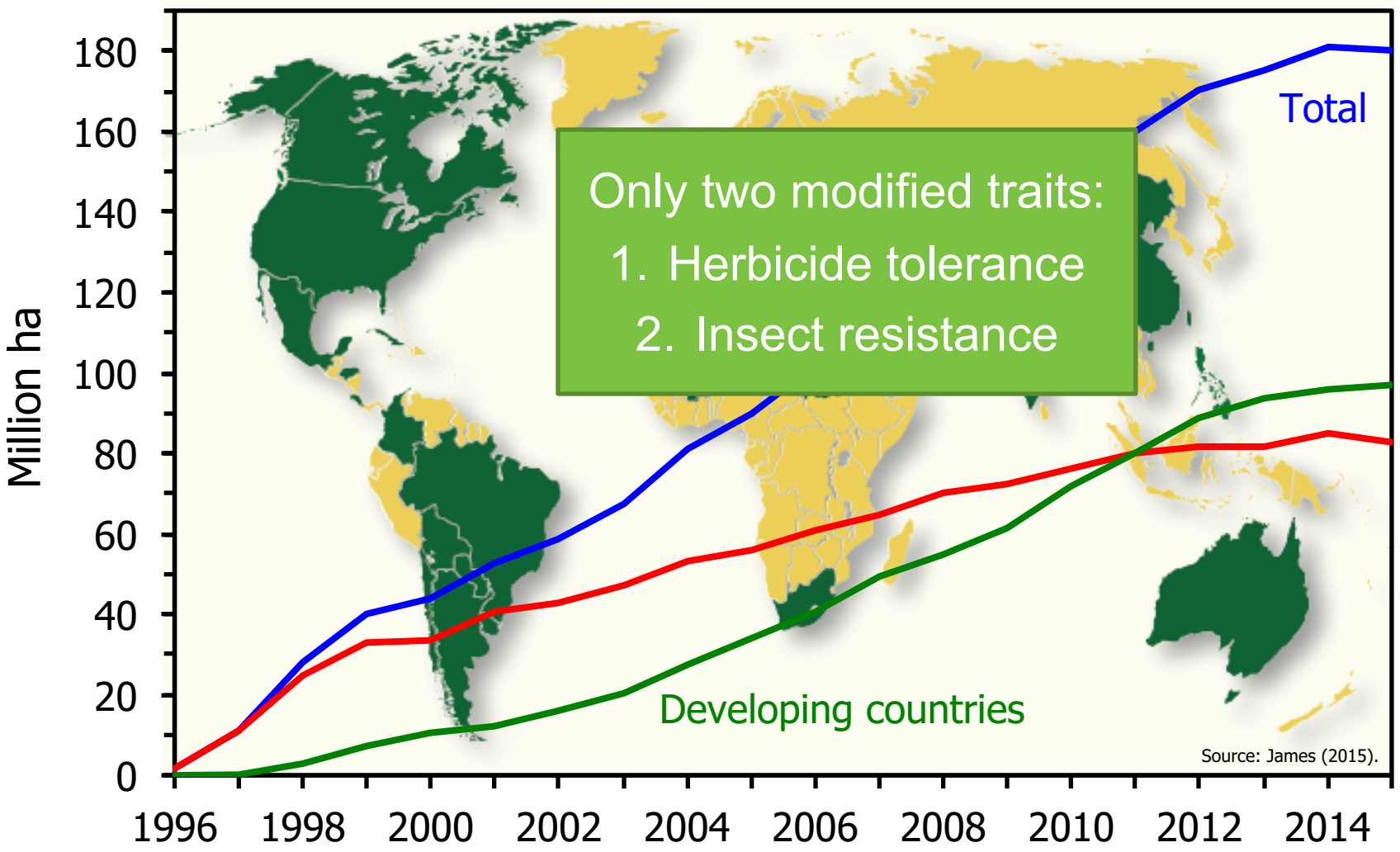
This conclusion was drawn by:

- WHO
- FAO
- OECD
- European Research Directorate
- EASAC (European Academies)
- International Council for Science
- Union of German Academies of Science
- British Royal Society
- British Medical Association
- French Academy of Sciences
- French Academy of Medicine
- National Academy of Sciences (USA)
- Brazilian Academy of Sciences
- Mexican Academy of Sciences
- Indian Academy of Sciences
- Chinese Academy of Sciences
- Nuffield Council on Bioethics
- Etc.

- The public has not taken note of this scientific evidence

Beyond risks, what do we know about GM crop impacts?

Global area cultivated with GMOs

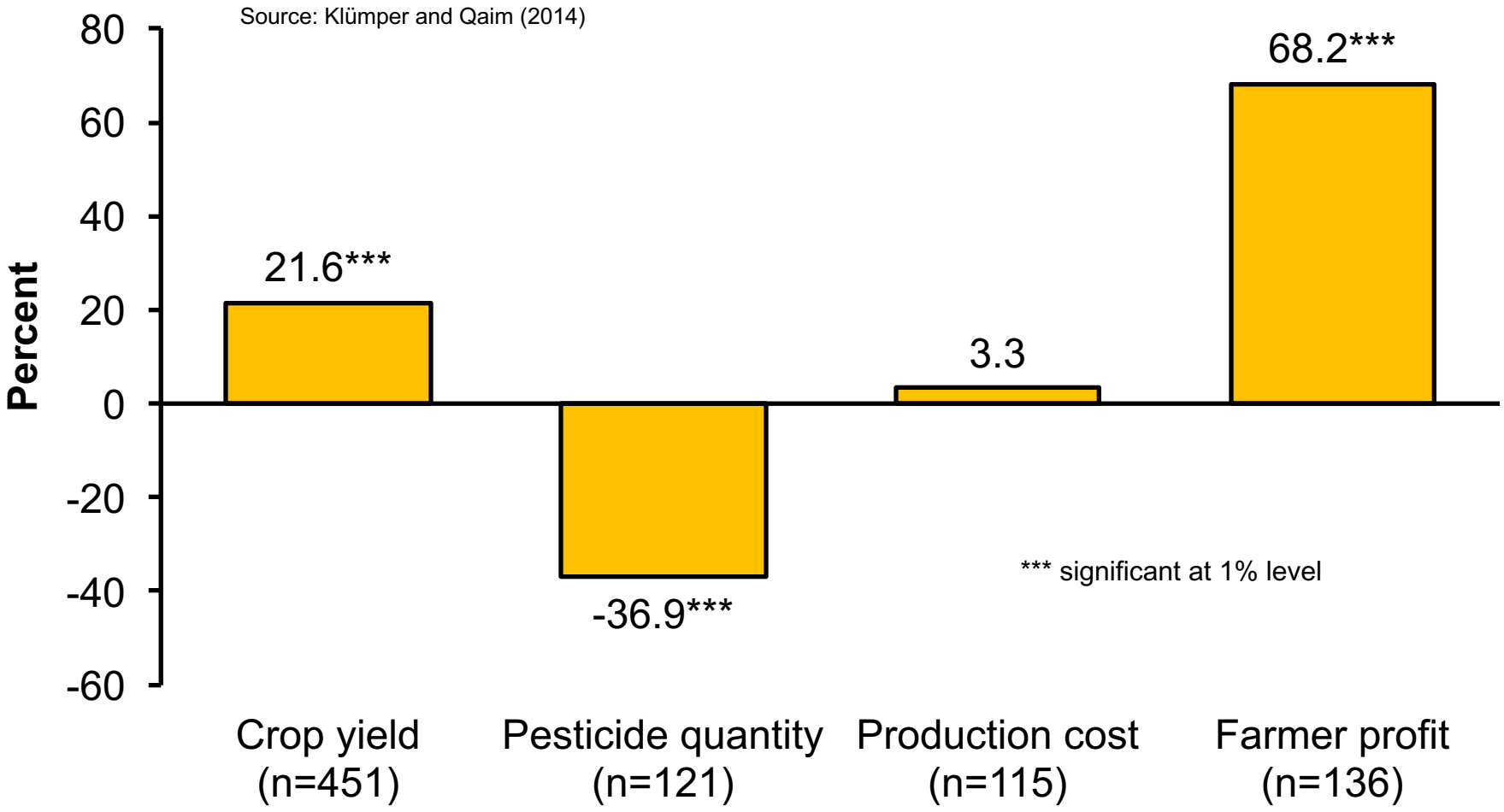


Impact studies

- Many impact studies carried out over the last 20 years:
  - ✓ Focusing on different countries
  - ✓ With different types of data
  - ✓ With different methodologies
  - ✓ With different results

- GMO supporters and opponents refer to their “preferred studies” in the debate, leading to further polarization
- Meta-analysis can be useful to:
  - ✓ Draw broader lessons from the cumulated evidence
  - ✓ Explain reasons for heterogeneity in impacts

Global meta-analysis of GM crop impacts



Breakdown by type of GM trait

	All GM crops	Insect resistance	Herbicide tolerance
Yield	21.6***	24.9***	9.3**
Pesticide quantity	-36.9***	-41.7***	2.4

Source: Klümper and Qaim (2014).

In some regions, weed resistance to glyphosate has reduced the benefits of herbicide-tolerant crops over time.

Breakdown by geographical region

Meta-regression results (percentage point effects)

	Yield	Pesticide	Farmer profit
Developing country (dummy)	14.2***	-19.2***	59.5***

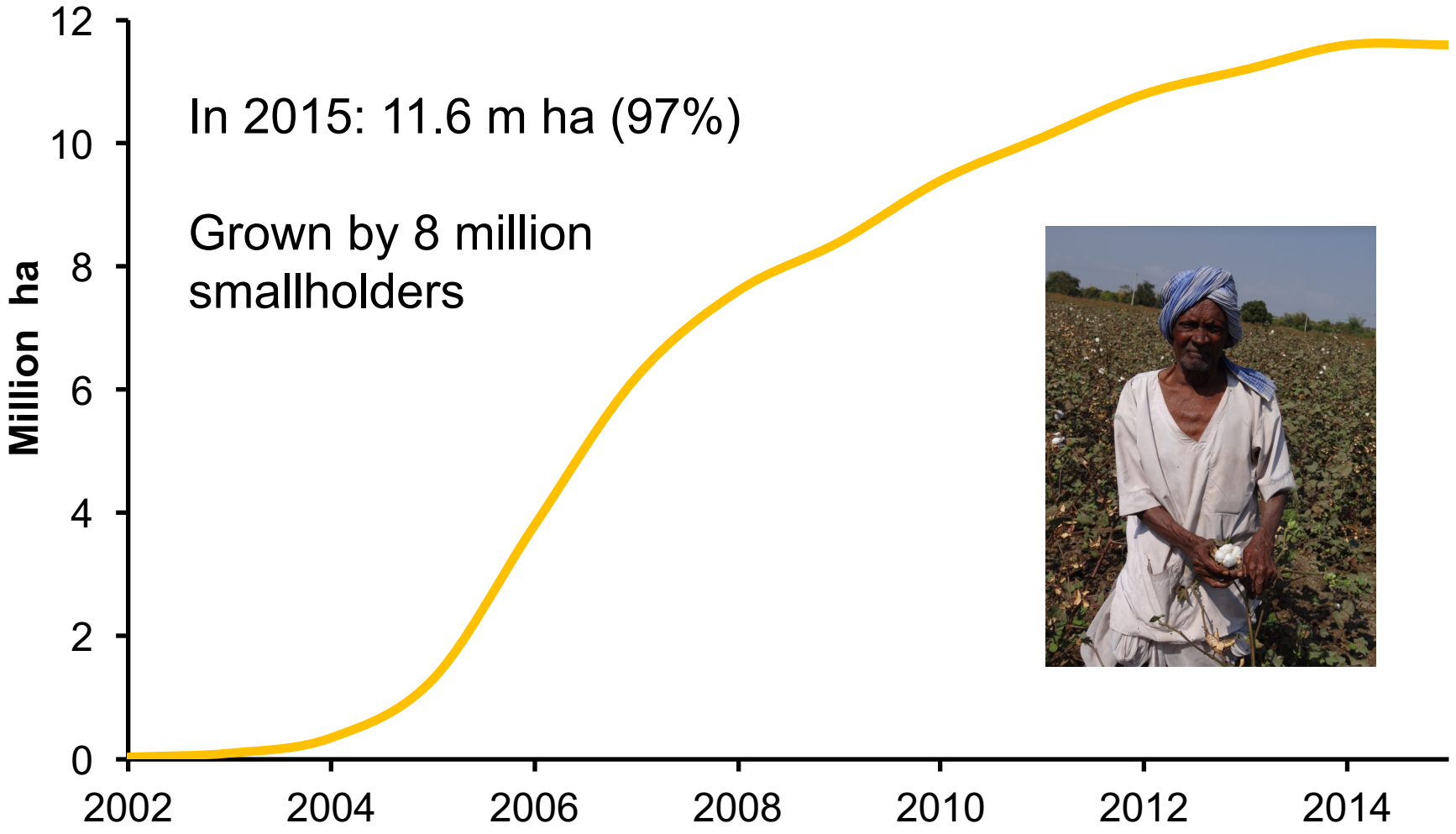
Source: Klümper and Qaim (2014).

Developing-country farmers benefit more, because:

1. They suffer more from pest and disease problems
2. Most GM technologies are not patented there, hence seeds are cheaper than in developed countries

What do we know about GM crop impacts in a small farm context?

Bt cotton adoption in India



Impact analysis with panel data

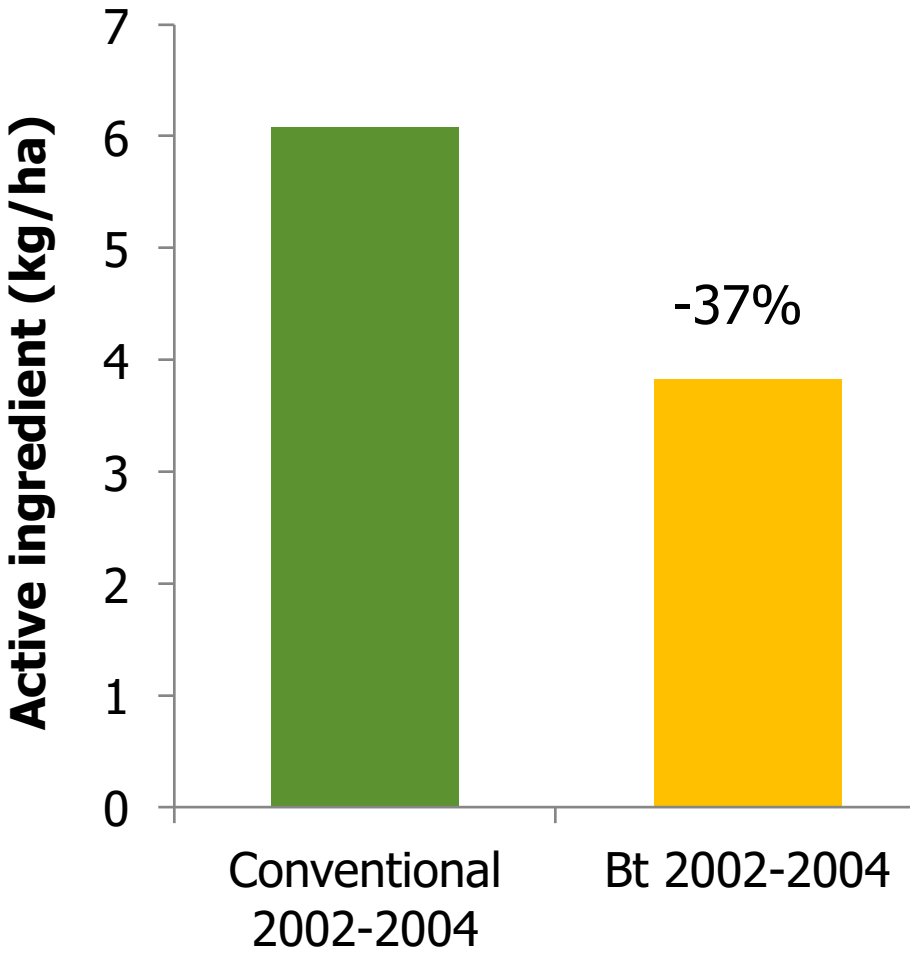
Survey of 530 farm households in four states

Four waves of panel data (2002-08)

Analysis of:

- impacts
- impact dynamics

Bt impact on insecticide use in India



Bt impact on yield and farmer profit in India

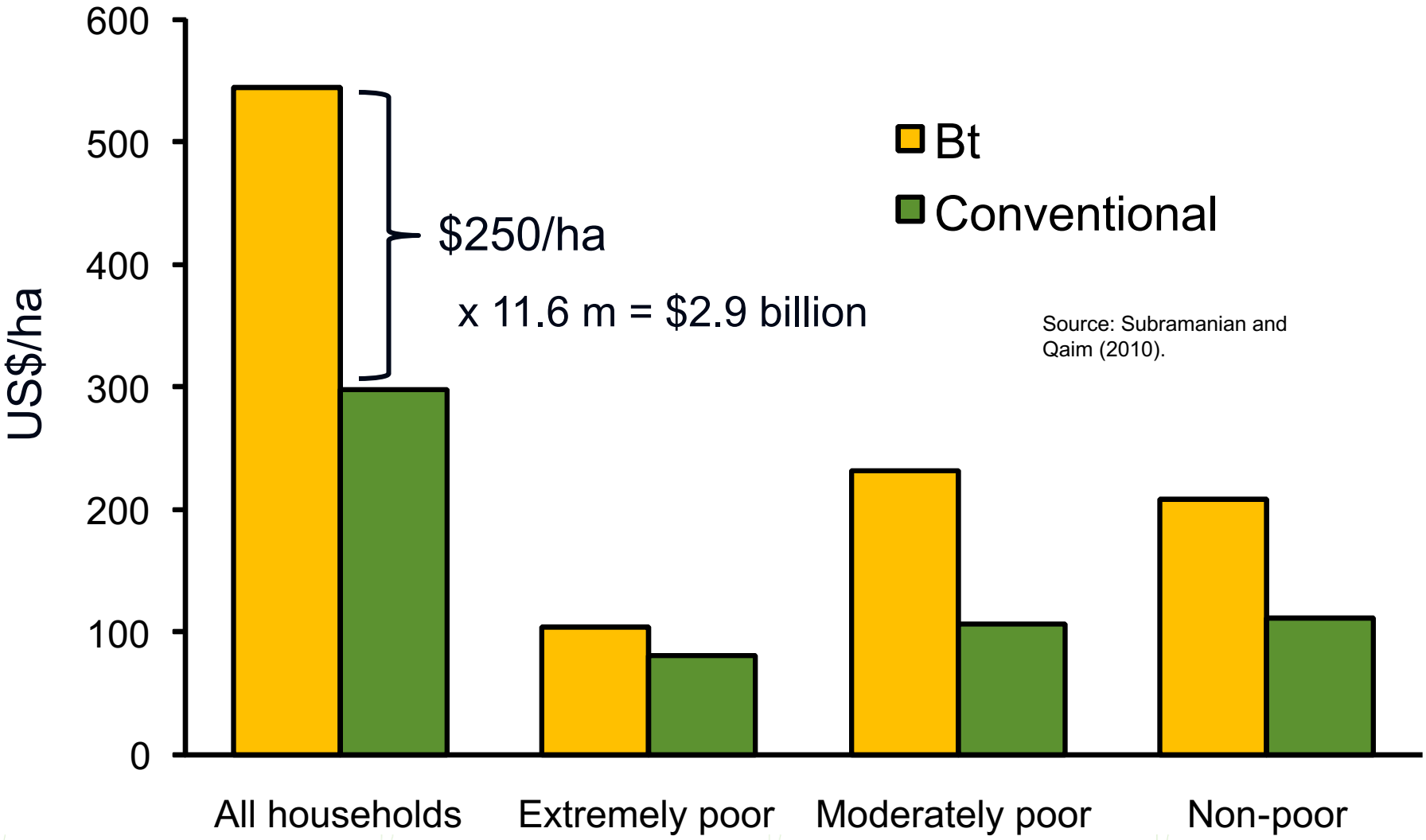
	Yield (kg/ha)	Profit ($/ha)
Bt effect	311*** (+24%)	94*** (+50%)
Change over time	0 / +	0 / +

Bt impact on household living standard

	Household consumption (US$)	Calorie intake (kcal/person)
Bt effect	321** (+18%)	145*** (+5%)

Sources: Kathage and Qaim (2012), Qaim and Kouser (2013).

Household income effects per ha of cotton



Future prospects

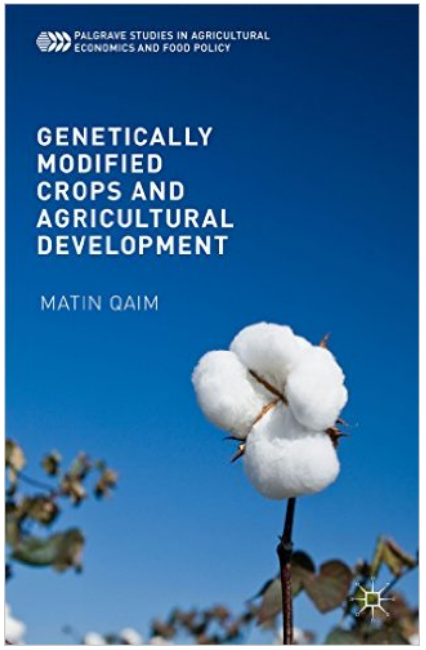
- Evidence suggests that GM crops can be beneficial for farmers and the environment
- Productivity increases also reduce market prices and make products more accessible for consumers
- So far, very limited range of GM technologies. Future technologies could be much more beneficial
- Many interesting GM technologies tested in the field:
  - Drought-tolerant and salt-tolerant maize, rice, and wheat
  - Maize and rice with higher nitrogen use efficiency
  - Micronutrient-rich rice, sorghum, cassava, and banana
  - Etc.
- Will these technologies ever be commercialized?

Serious overregulation

- Many countries in Africa and Asia have established EU-style regulatory systems (strict, complex, heavily politicized)
- Fuels public notion that GM crops are dangerous
- Makes technology unnecessarily expensive
- Contributes to industry concentration (multinationals)
- Contributes to focus on large countries and selected crops with large commercial potential
- Even humanitarian projects suffer from the same hurdles
- EU anti-biotech attitudes have far-reaching global implications
- Arguing that gene editing is different will not solve the broader issue that perceptions are driving science policies

Conclusion

- Game-changing technologies can only materialize when the global society is sufficiently open for them
- Issues of public acceptance can be overcome with honest science communication (more integrity in the debate)
- The CGIAR should play a bigger role in this endeavor, as this will be key for achieving sustainable food security



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