Aviation Fuels: International Seminar

Availability of Biomass in the World and Its Use in Biofuels Production

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Key Issues on Biomass Availability: Different Types of Feedstocks

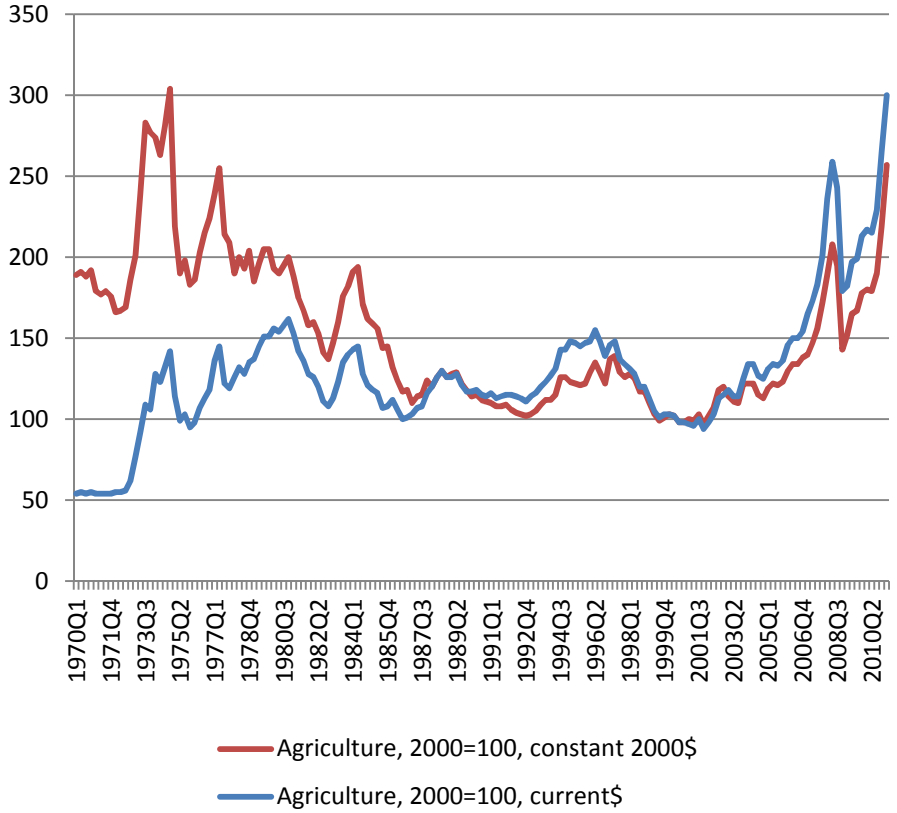
- Types of feedstock: widespread crops or new crops (or non food crops)
- Factors that determine the prices of agricultural feedstocks
- Specificities of agricultural products: inelastic demand and supply shocks
- Current competitiveness of agricultural biomass
- Drivers to increase supply:
  - Availability of resources: land and water
  - Land productivity improvement
- Future scenarios for biomass consumption
- Sustainability issues

Key Issues on Biomass Availability: Different Types of Feedstocks

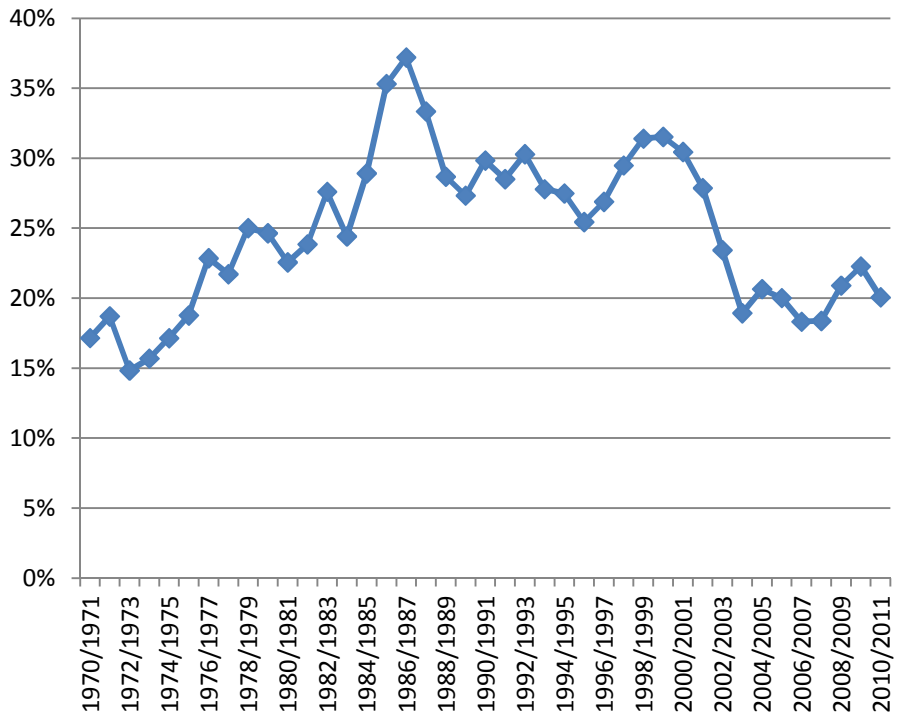
	Widespread feedstocks	Energy dedicated (non food) feedstocks
Straightness	• Sugarcane, vegetable oils (soybean, rapeseed, palm, etc.), sources of cellulose (sugarcane bagasse and planted forest) • Already available • Strong accumulated knowledge • Dominated production practices • Availability of varieties for different climate conditions: temperate but, more important, tropical conditions • Several researches going on: food market	• Jatropha, carmelina, energy cane, etc. • Do not compete directly with food: if use marginal land or as a second crop (reminding that second crops are possible only in tropical or subtropical areas) • Huge potential to increase yields in a fast way (low level of depart)
Weaknesses	• Food versus fuel debate • Land use issues • Food market (demand) as the driver for pricing: are expensive, in another words • How to achieve above trends yields increase • Strong correlation with the energy market (fertilizers)	• Are even more expensive and economics are not well known yet • Are not available in large scale • Very restricted availability of varieties and technological packages • Restricted knowledge on plant behavior and physiology in field conditions • No mechanical cropping and harvesting • **Marginal land?**

Prices and Stocks (1970 onward)

Agricultural Commodities Price Index (real and nominal)

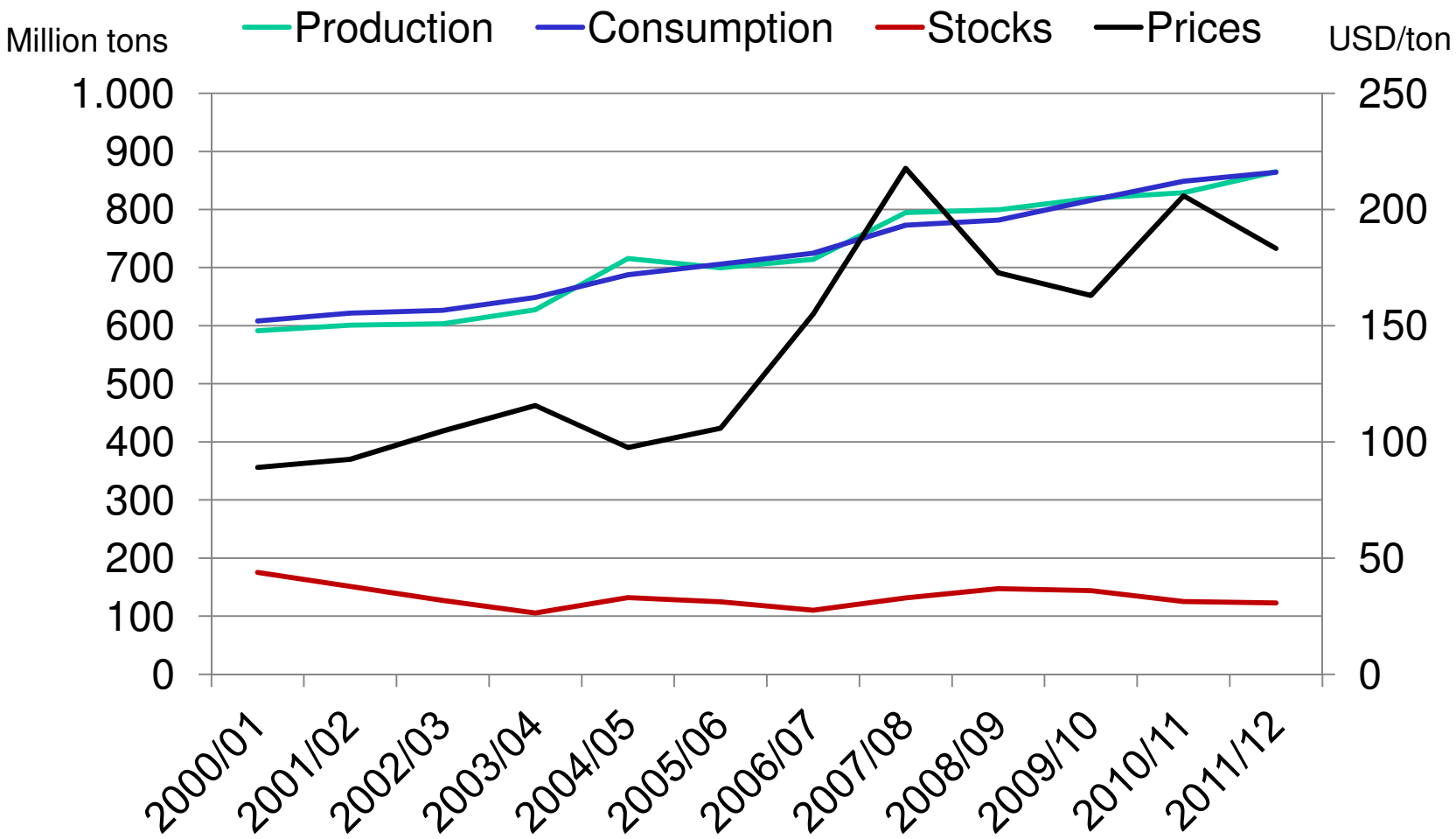


Stock to Use Ratio (percentage)



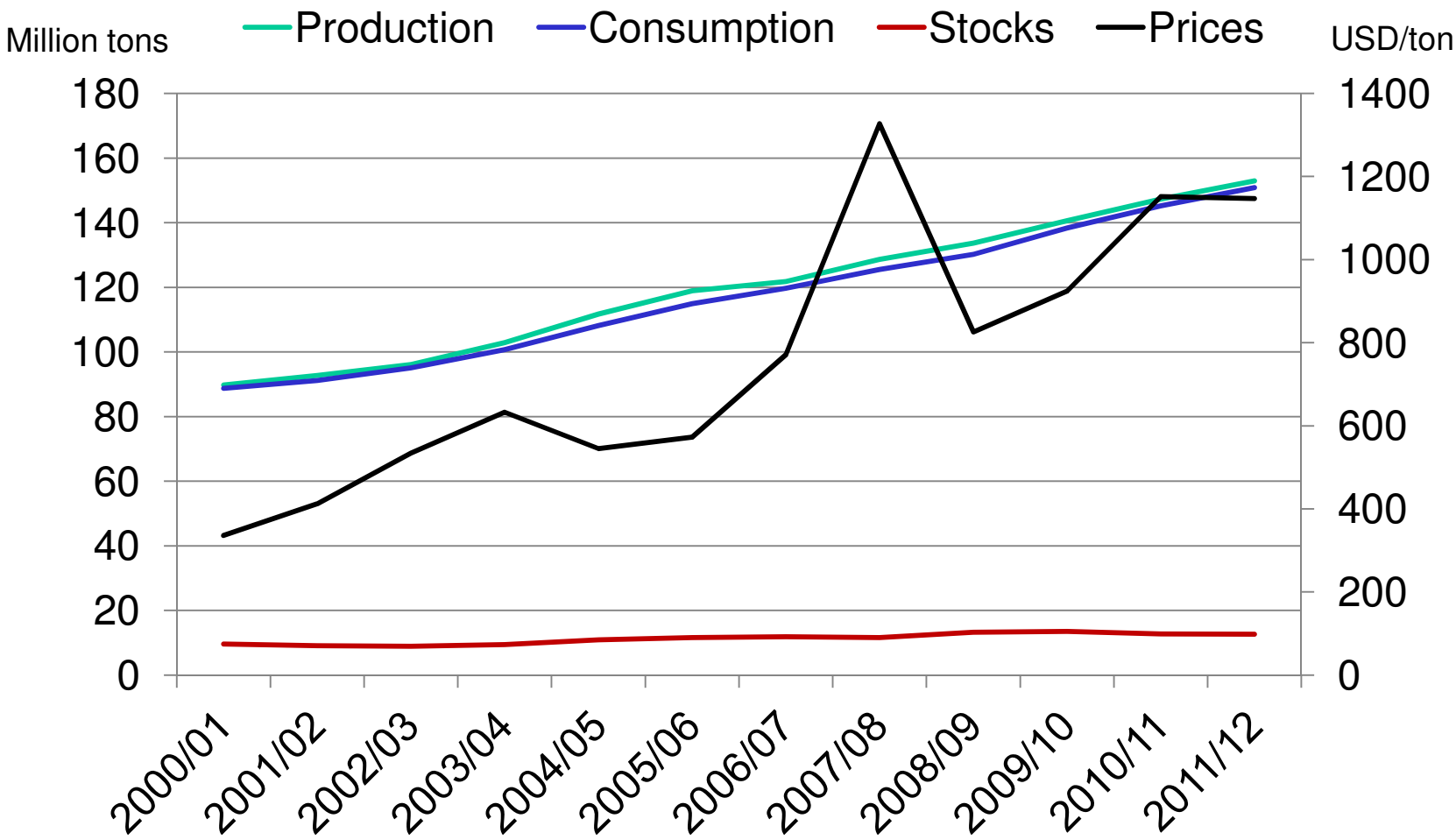
Source: The World Bank, USDA.

Supply Shocks: Corn



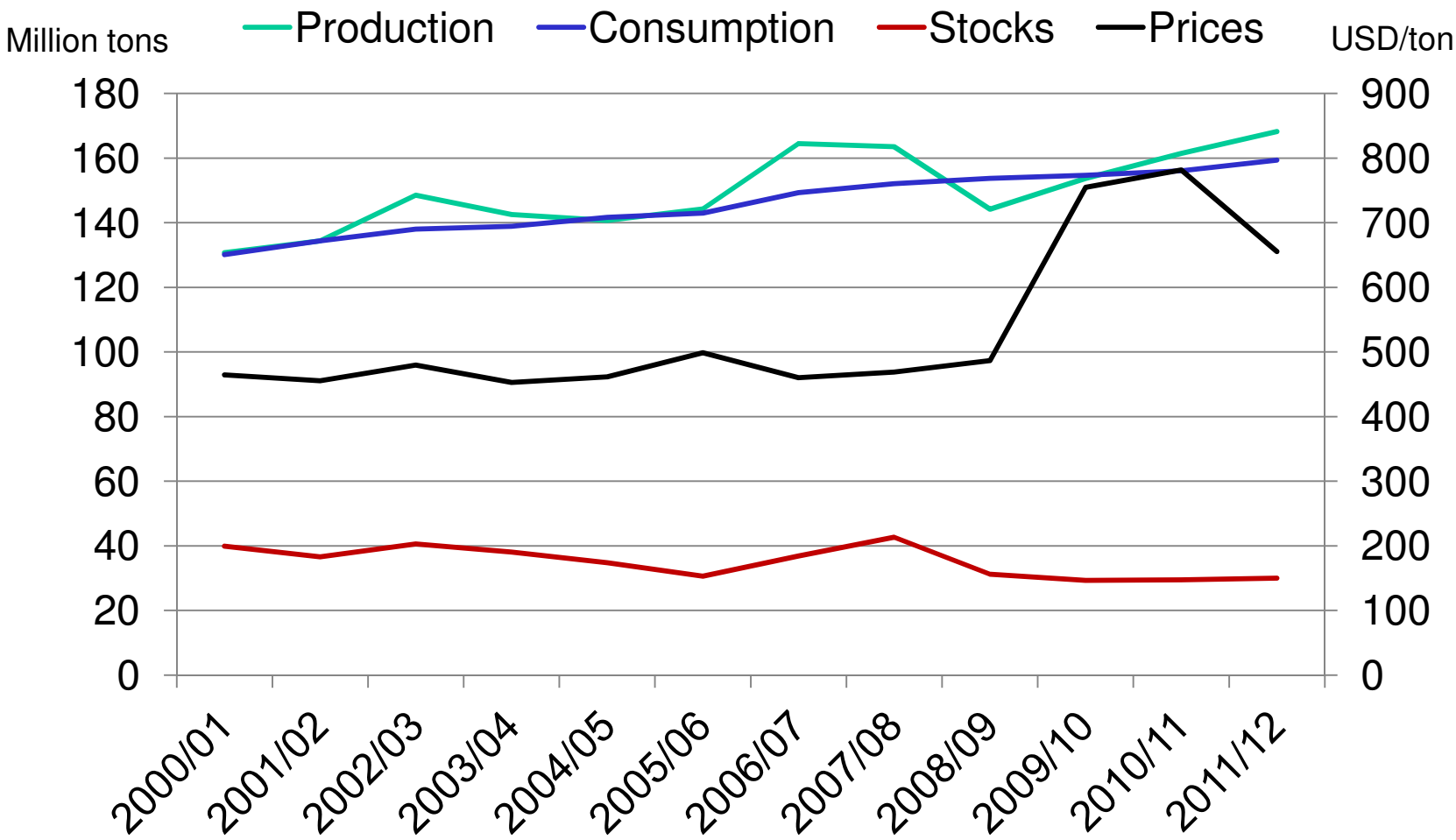
Source: USDA; FAPRI

Supply Shocks: Vegetable Oils



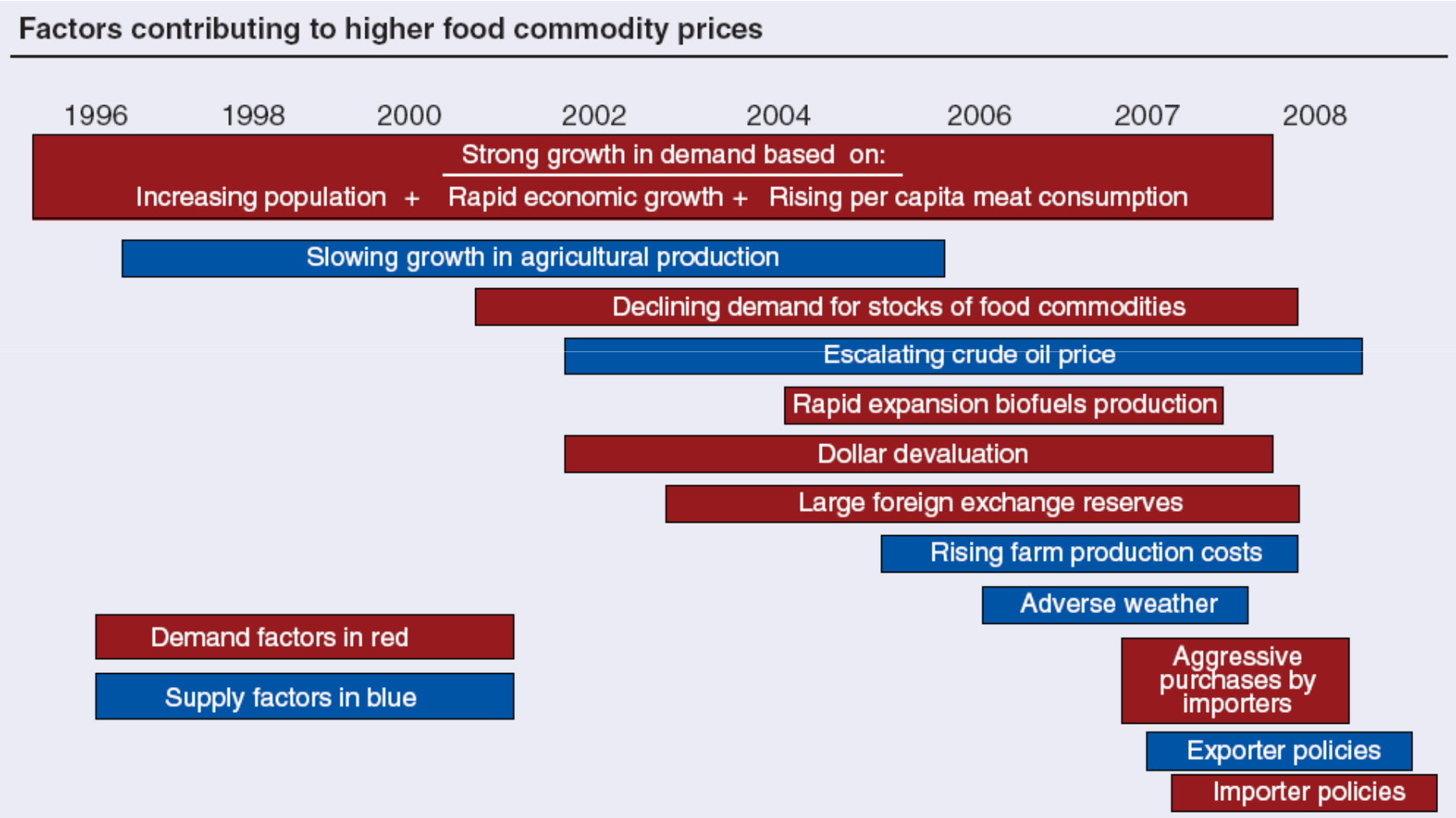
Source: USDA; FAPRI

Supply Shocks: Sugar



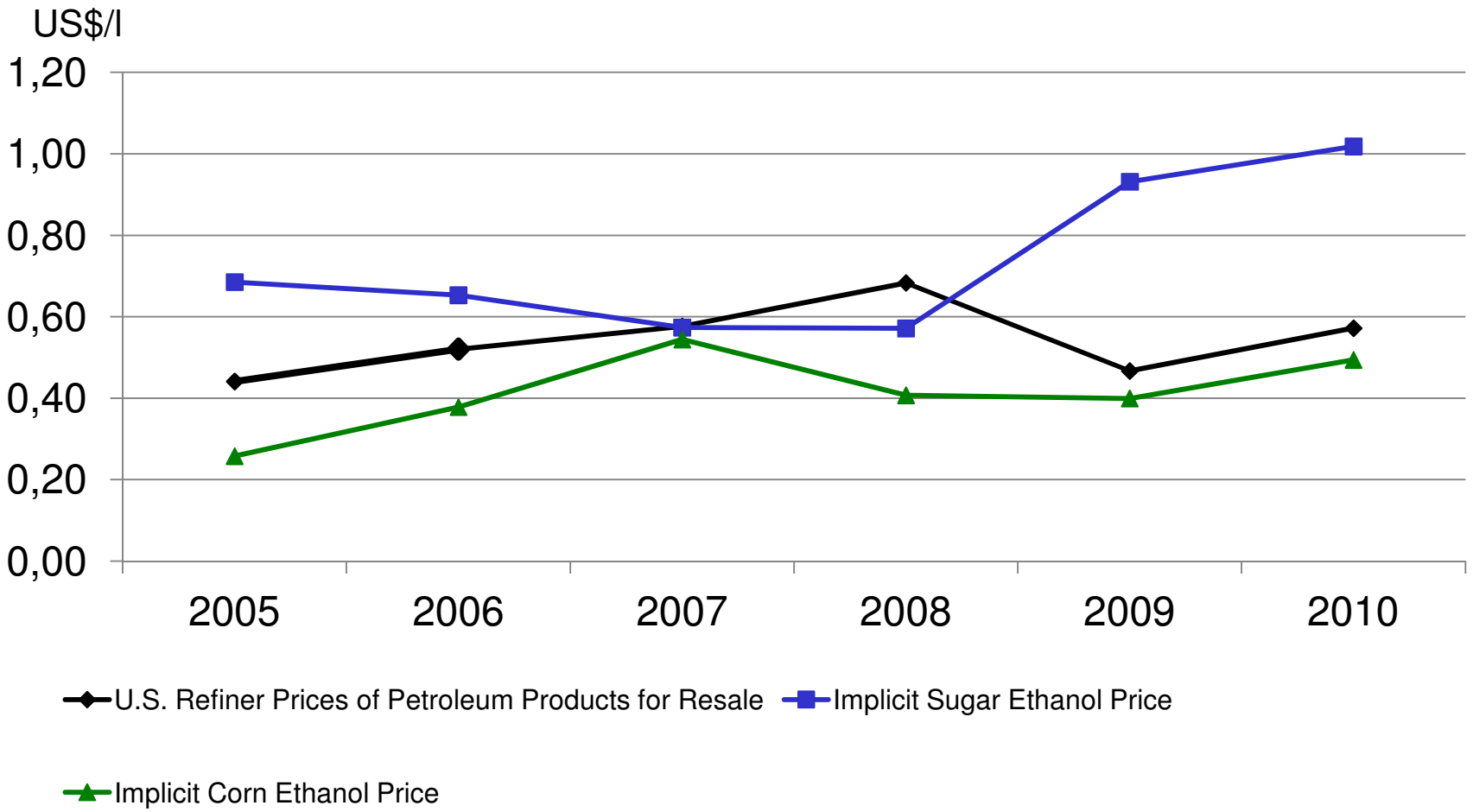
Source: USDA; FAPRI

Factors Contributing to Higher Agricultural Commodities Prices



Fonte: Trostle, R. (2008).

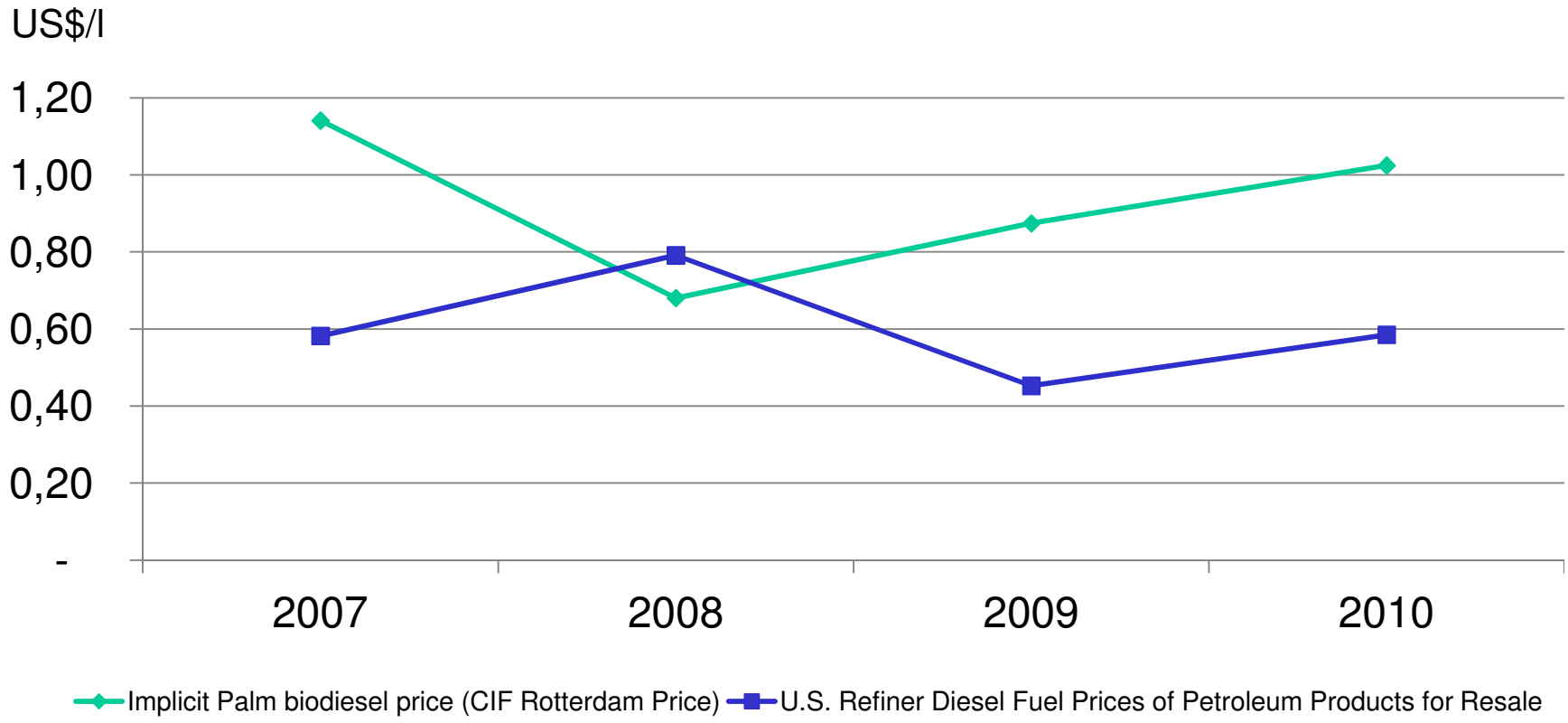
Implicit biofuels prices: Ethanol



Note: 1) NY11 for sugar and FOB Gulf for corn; not corrected by energy content

Source: ICONE, original data from U.S. Energy Information Administration (2012) and Fapri (2011)

Implicit biofuels prices: Biodiesel



Source: ICONE, original data from U.S. Energy Information Administration (2012) and Fapri (2011)

Land Use: Cropland and Pasture (2000)

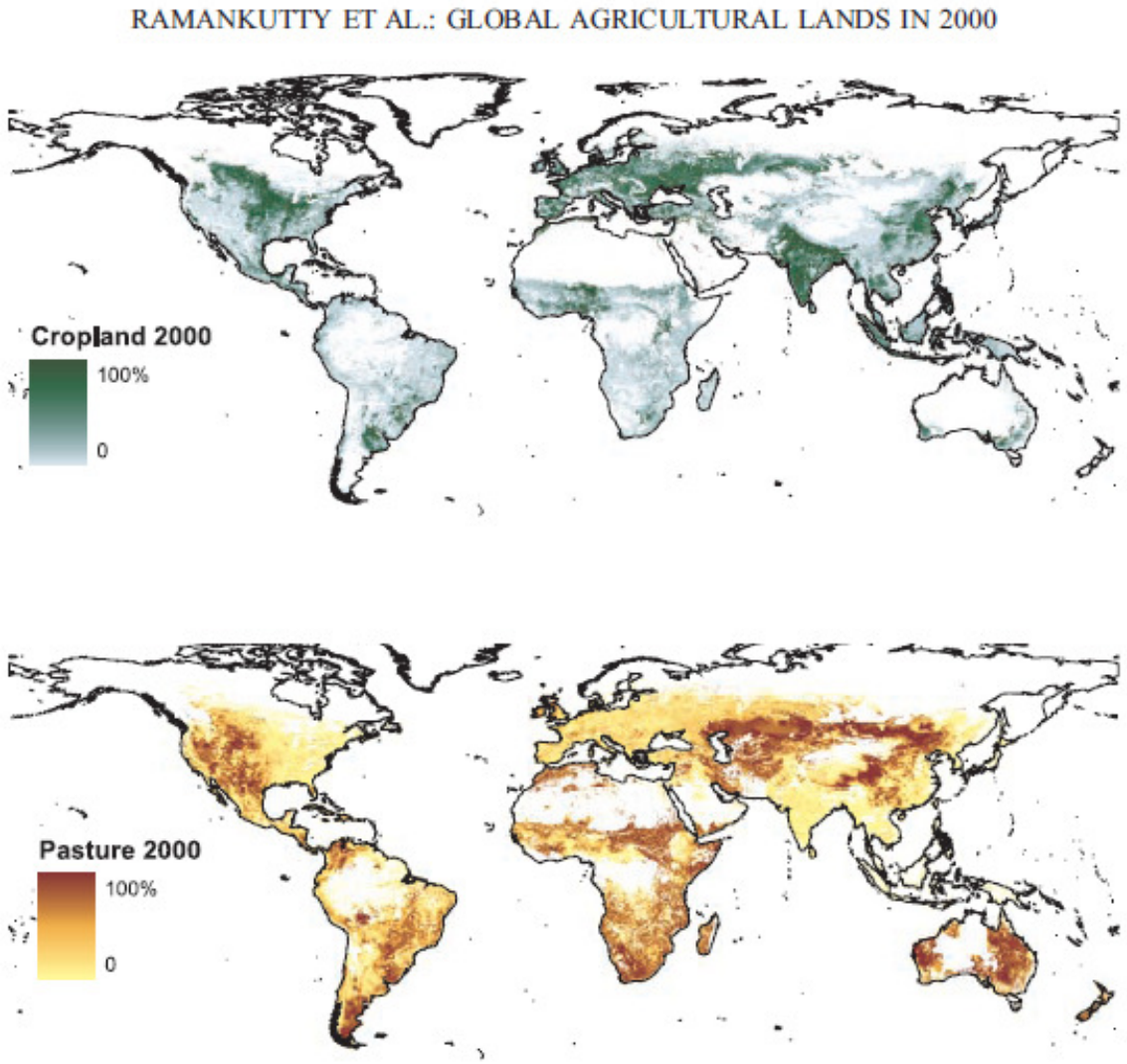
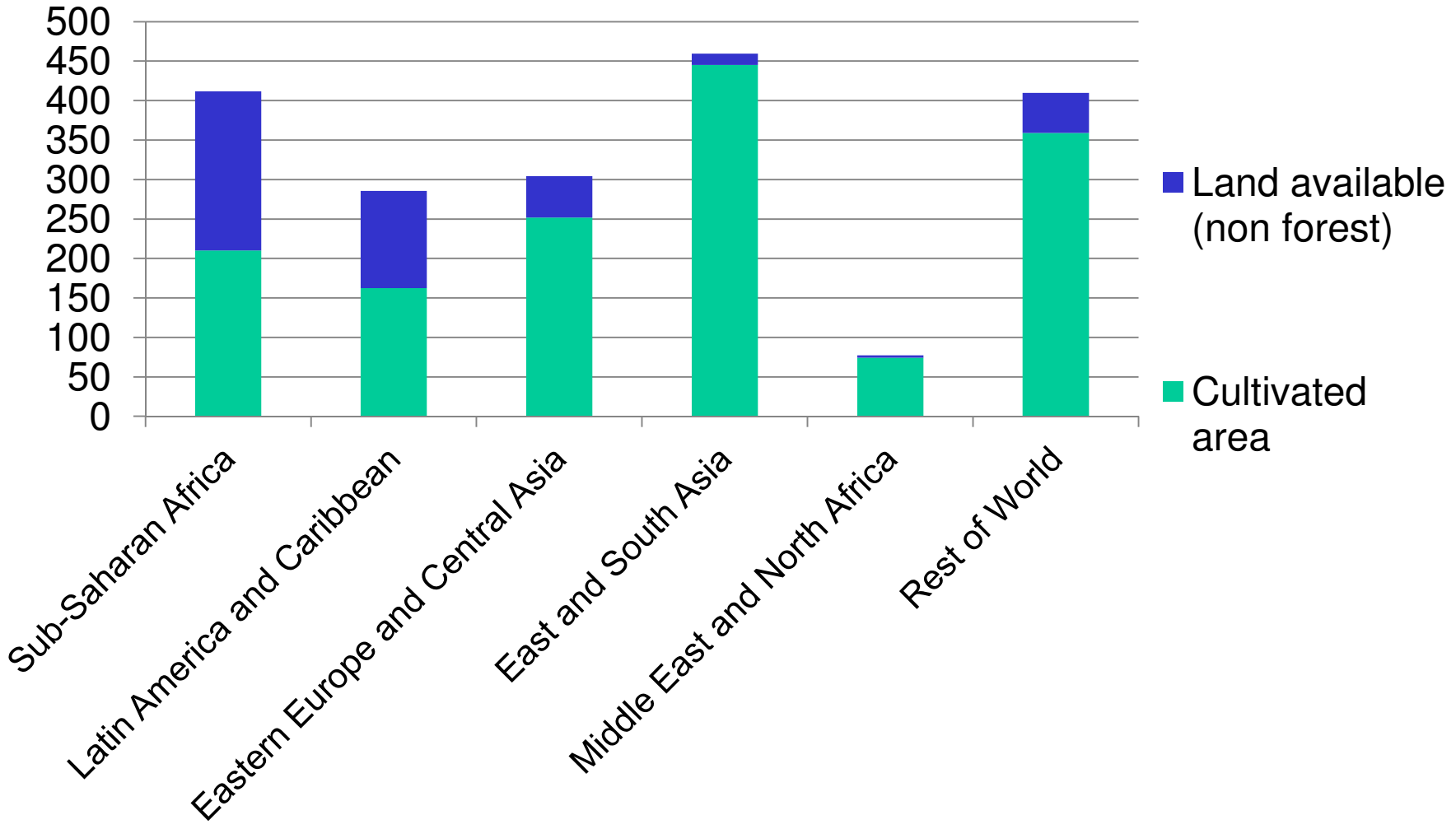


Figure 6. Final estimates of croplands and pastures from this study. This is the final result obtained by calibrating the combined land cover data set against the agricultural inventory data (Step 1), using 1000 bootstrap estimates for the parameters, and then further adjusting the predictions to match the inventory data at the administrative unit level (Step 2).

Area in million km2	Total	
	Cropland	Pasture
North America	2.74	3.33
South America	1.08	4.32
Africa	2.67	9.2
Europe	1.28	0.65
Former Soviet Union	2.1	3.43
Asia	4.71	4.34
Pacific developed	0.41	2.85
Total above	14.99	28.12

Source: Ramankutty, N.; Evan, A. T.; Monfreda, C.; Foley, J. 2008. Farming the planet: 1. Geographic distribution of global agricultural lands in the year 2000. Global Biogeochemical Cycles, vol. 22, gb1003.

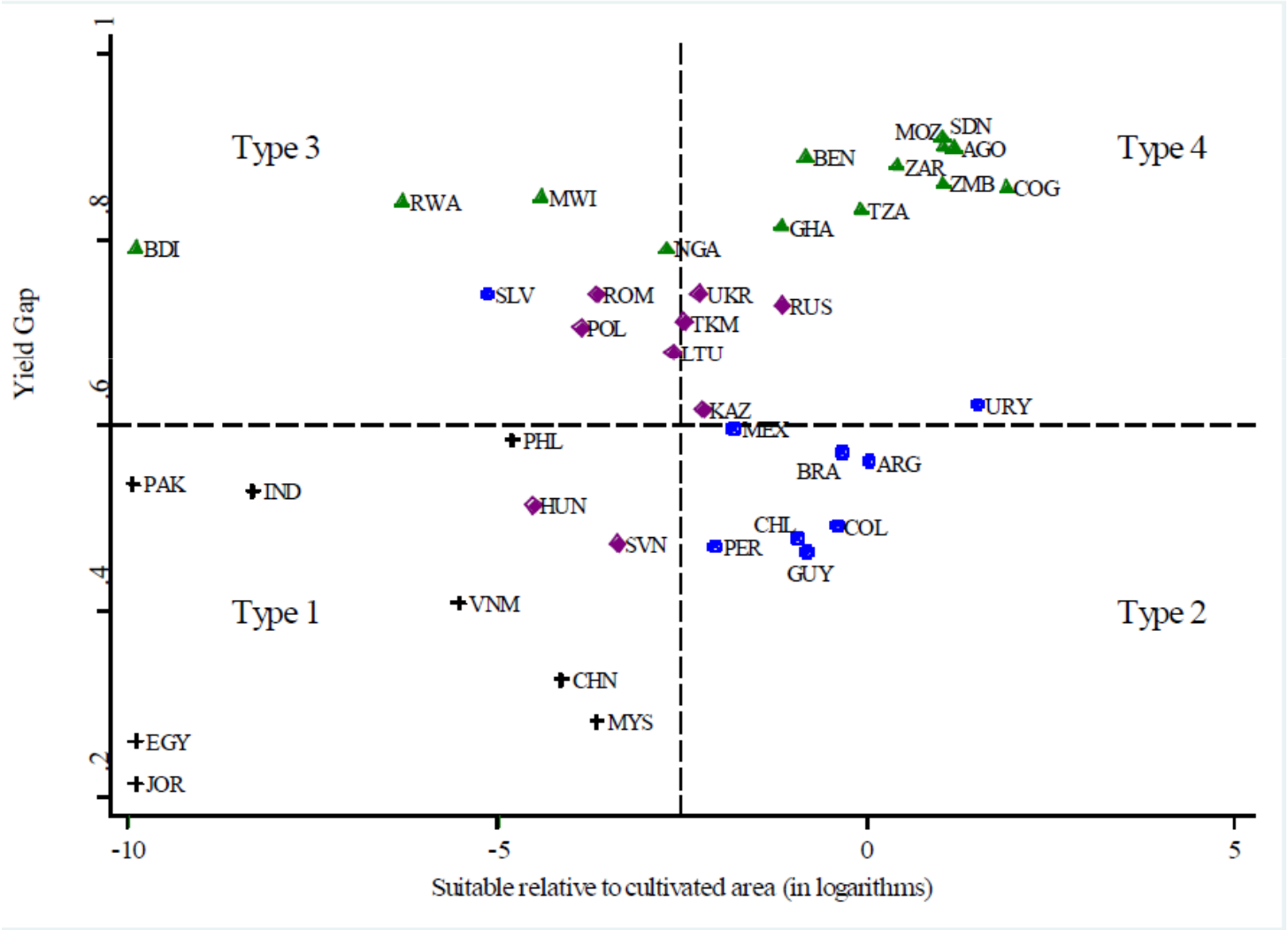
Potential Land Availability (million ha)



Source: Fischer and Shah (2010), cited in World Bank, 2010
(Rising Global Interest in Farmland: Can it Yield Sustainable and Equitable Benefits?) x

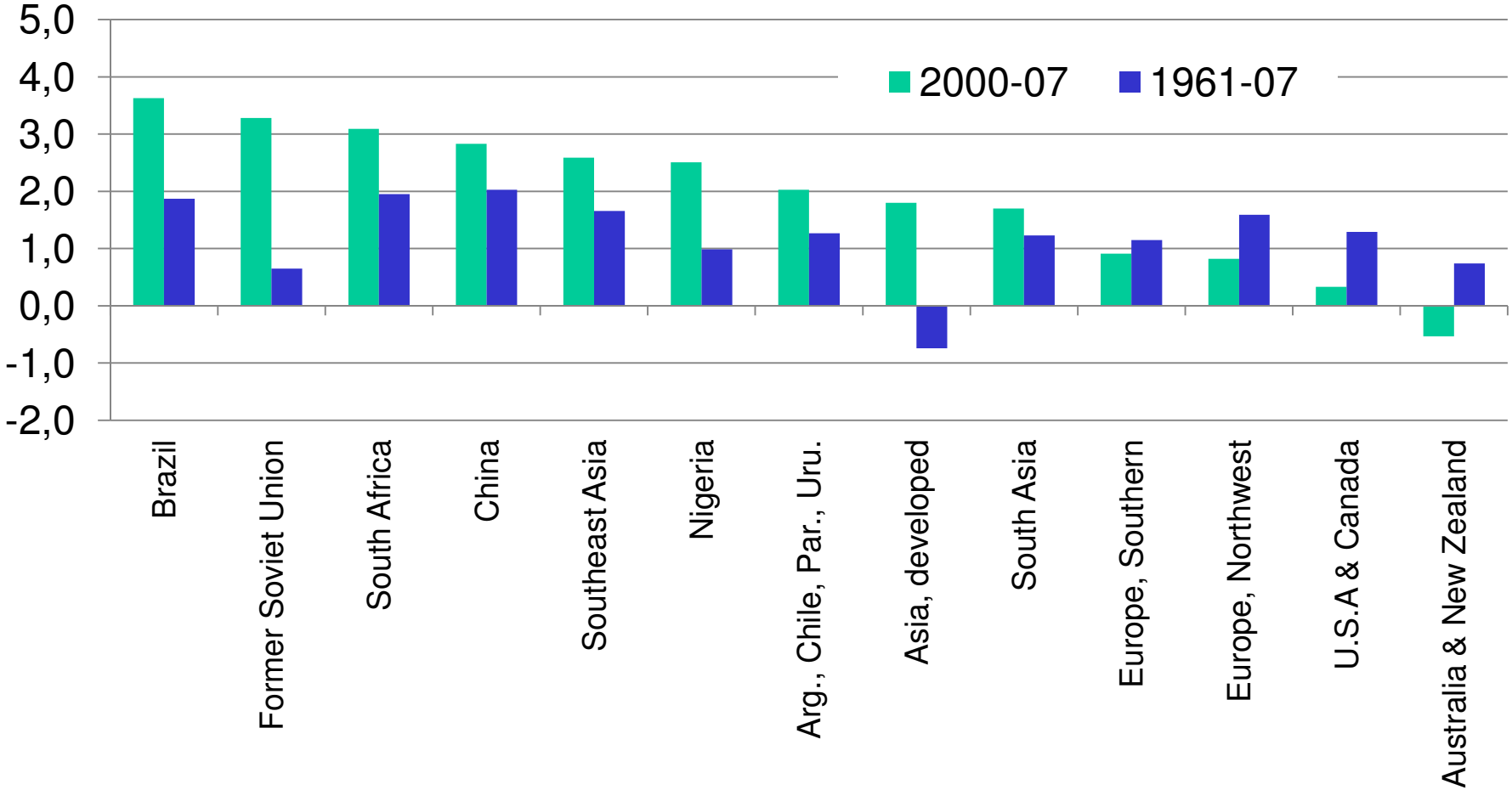
Potential for Increasing Yields

Figure 1. Potential land availability vs. potential for increasing yields



Source: Fischer and Shah (2010), cited in World Bank, 2010
(Rising Global Interest in Farmland: Can it Yield Sustainable and Equitable Benefits?)

AGRICULTURAL TFP GROWTH
(average annual % over period)

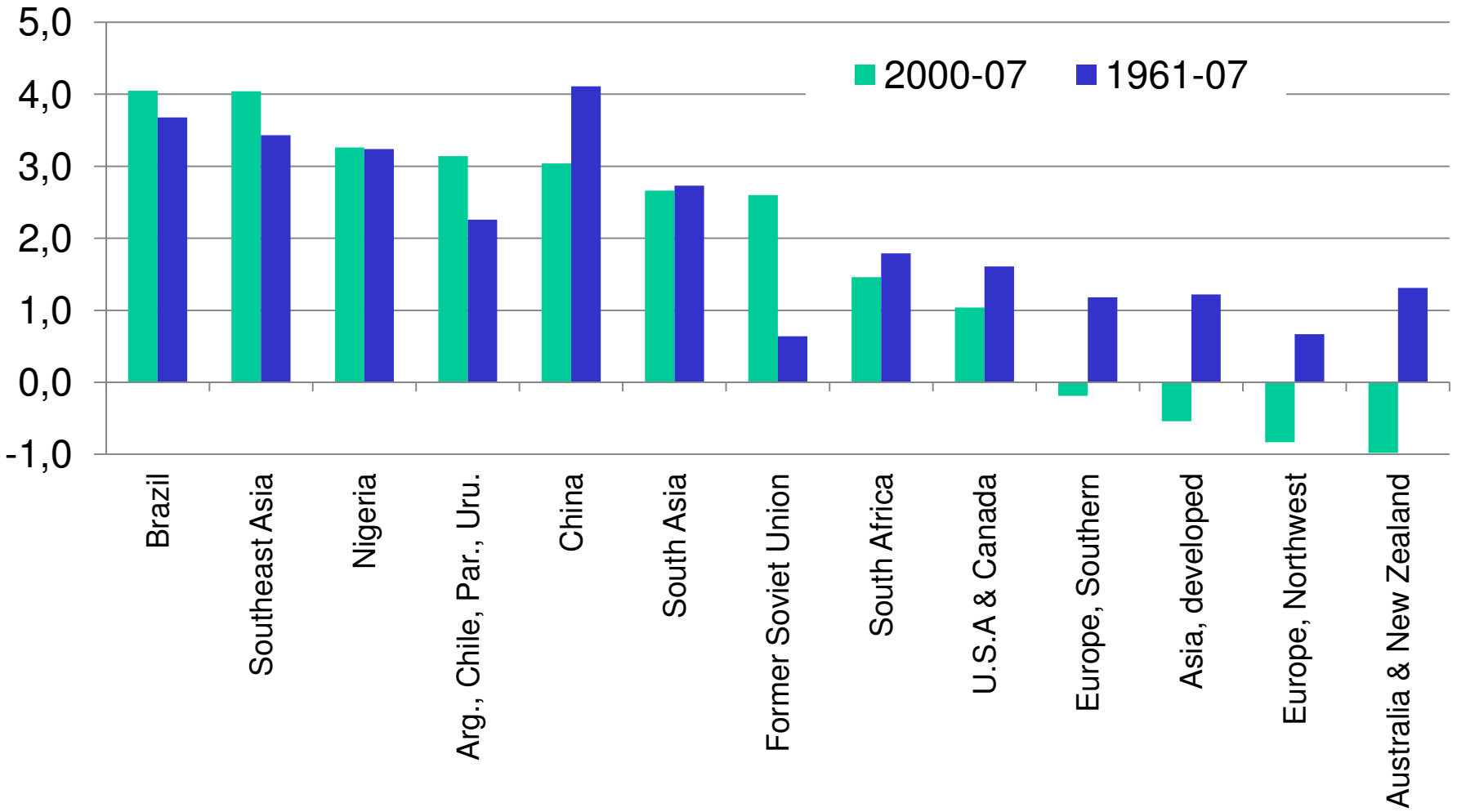


TFP (Total factors productivity): represents resources efficiency (such as labour, capital and land). The bigger the TFP growth the more efficient the production become.

Source: Alston, J,M,, B,A, Babcock, and P,G, Pardey eds (2010), The Shifting Patterns of Agricultural Productivity Worldwide, CARD-MATRIC Electronic Book, Center for Agricultural and Rural Development, The Midwest Agribusiness Trade Research and Information Center, Iowa State University, Ames, Iowa, Available at: www,matric,iastate,edu/shifting_patterns

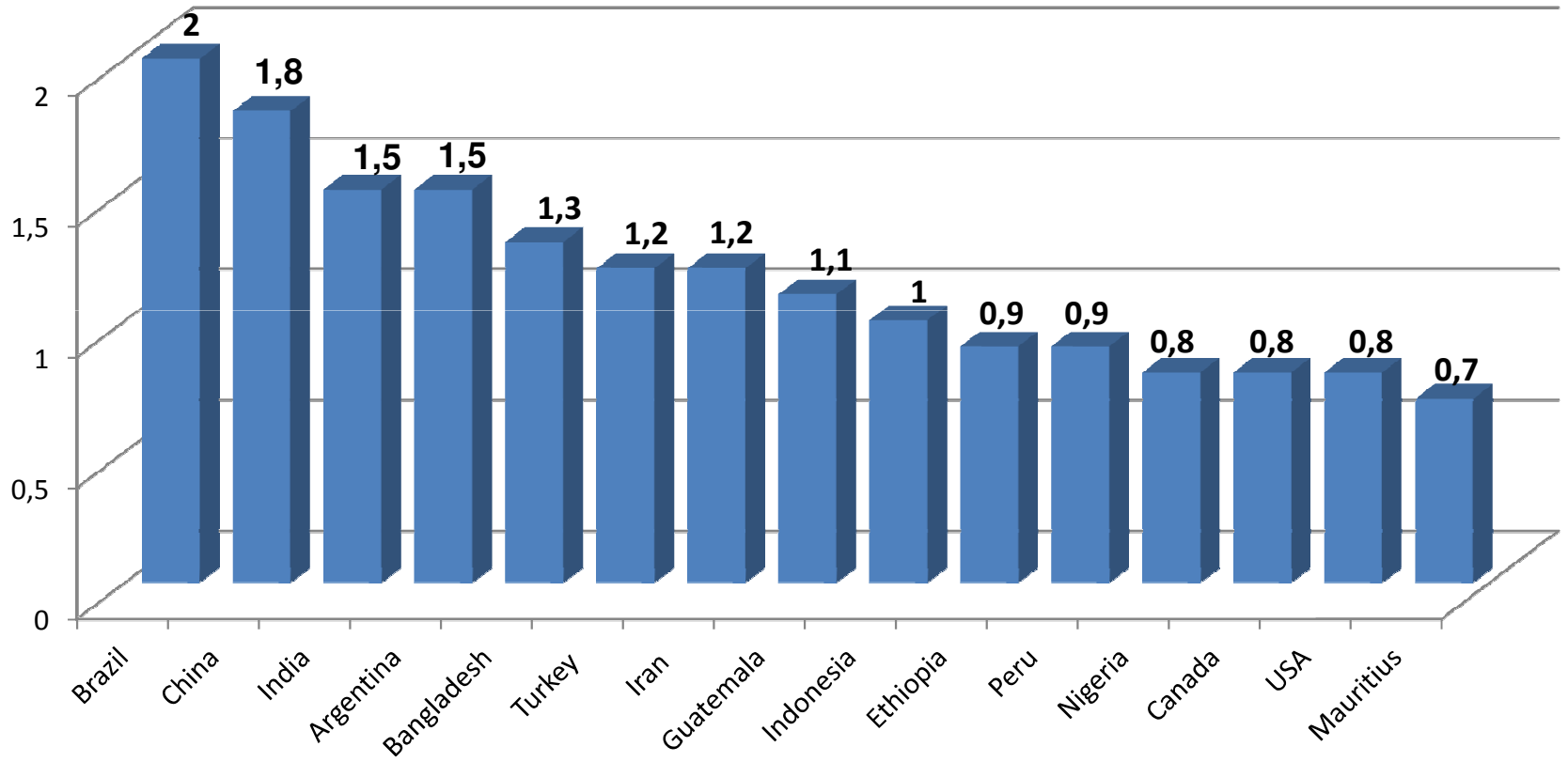
AGRICULTURAL OUTPUT GROWTH

(average annual % over period)



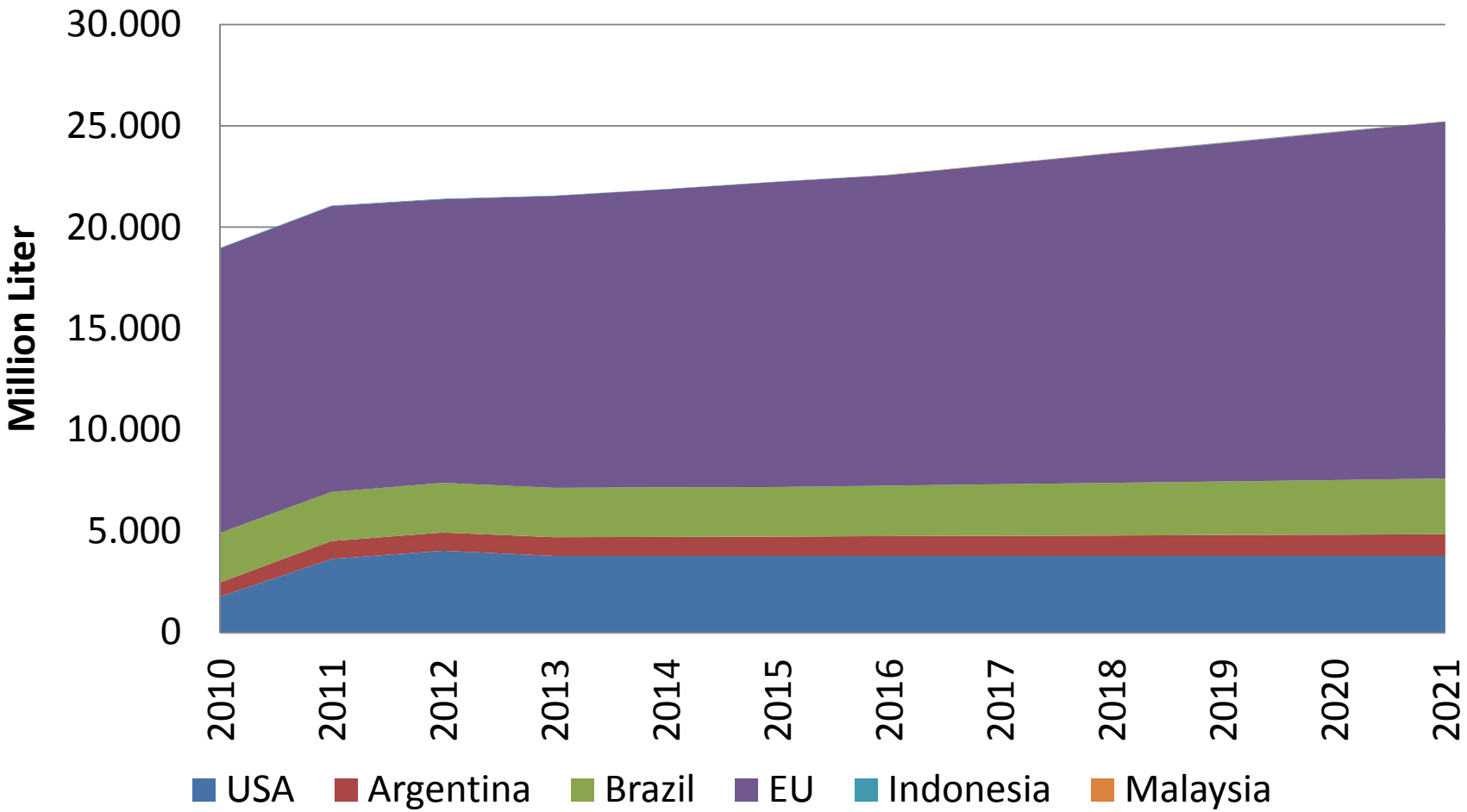
Source: Alston, J,M,, B,A, Babcock, and P,G, Pardey eds (2010), The Shifting Patterns of Agricultural Productivity Worldwide, CARD-MATRIC Electronic Book, Center for Agricultural and Rural Development, The Midwest Agribusiness Trade Research and Information Center, Iowa State University, Ames, Iowa, Available at: www,matric,iastate,edu/shifting_patterns

Increase of Agricultural Productivity from 1960 to 2005 (%)



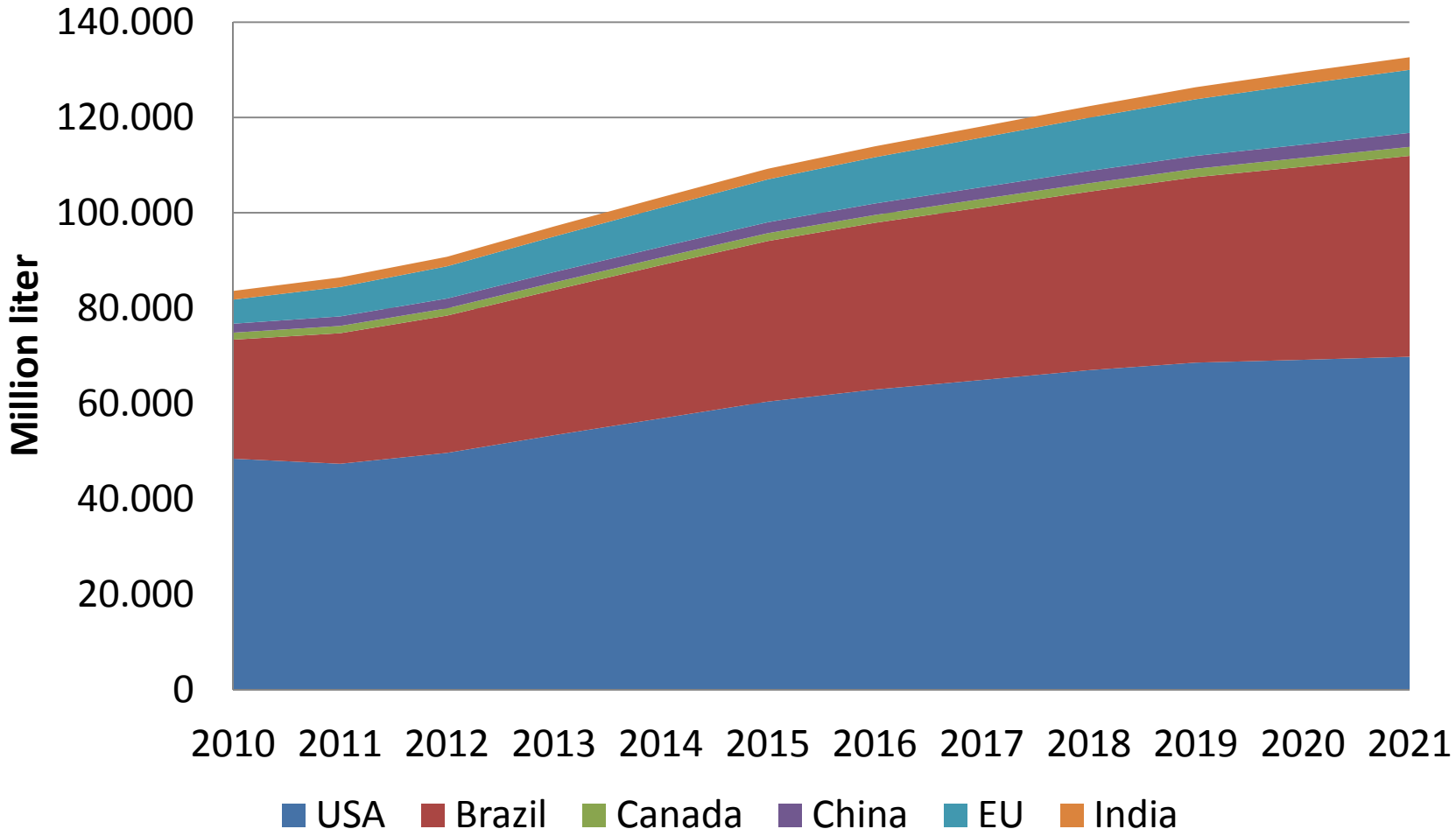
Source: FGV, cited in Ernst & Young, 2009
(Brasil sustentável: perspectivas do Brasil na Agroindústria)

Biodiesel Consumption



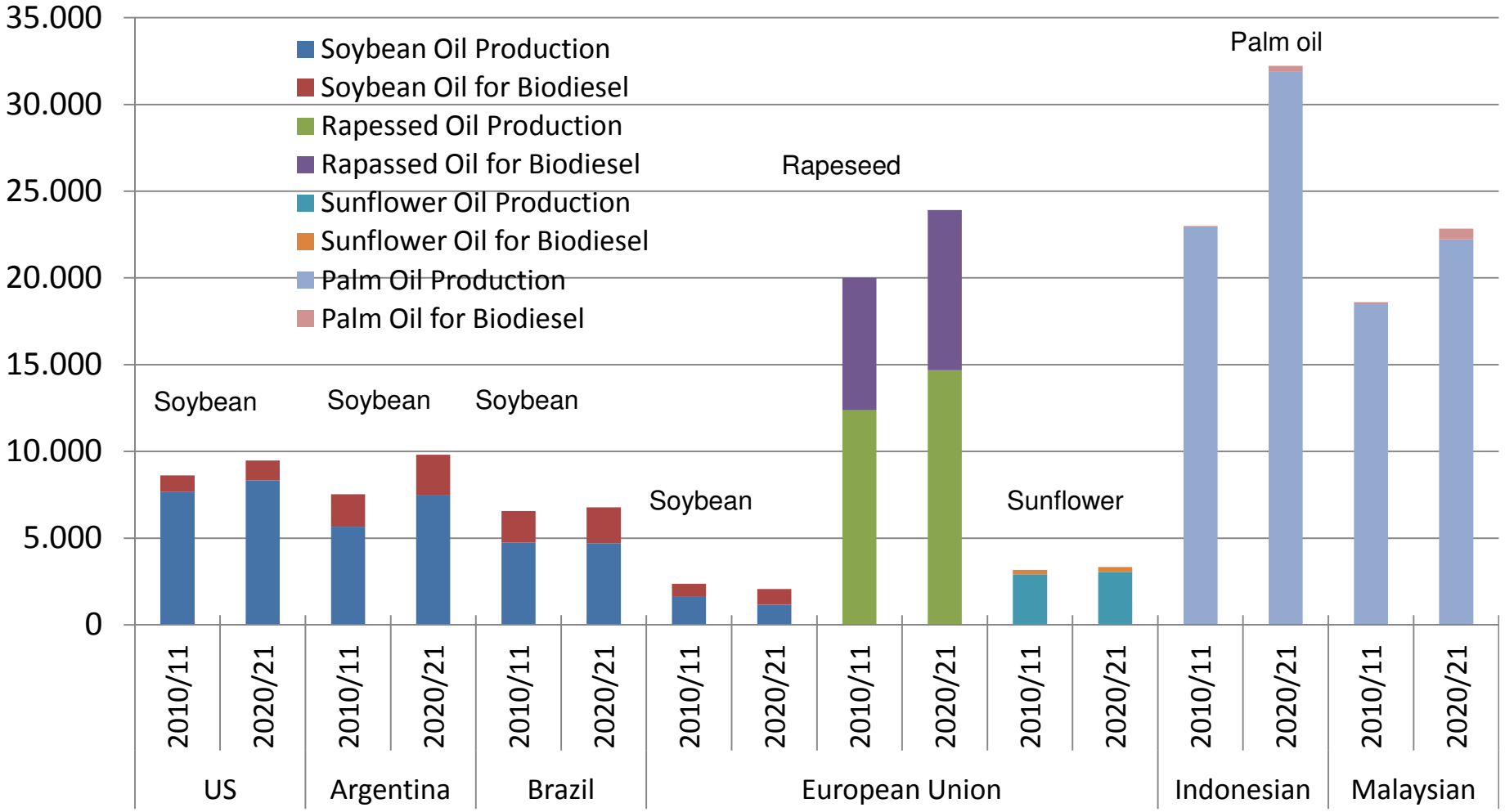
Source: Fapri 2012

Ethanol Consumption



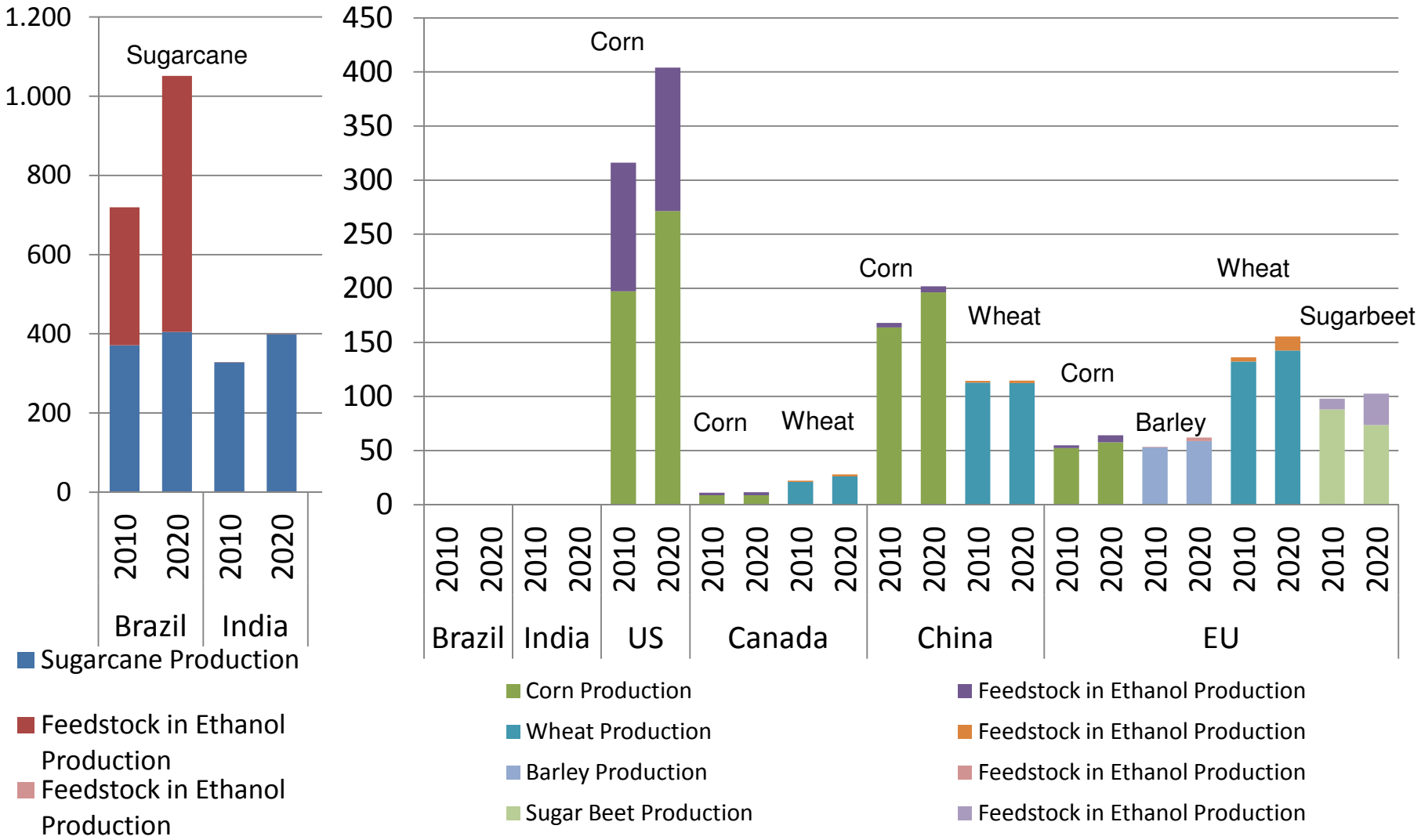
Source: Fapri 2012

Demand for biofuel in total demand (1,000 tons)



Source: Fapri 2012

Demand for ethanol in total demand (million tons)



Source: Fapri 2012

Biofuels and Sustaitability: Evolution

2006 IV IPCC report; climate change

2007 Biofuels as solution

2008 Biofuels as the bad guys

- Food vs fuel
- Direct deforestation (focusing in GGE)

2009 Intense debate: future of the industry

- Financial crisis: lower commodities prices;
- ILUC was incorporated into the lesgislations (EPA; CARB; RED);
- Multiplication of multi-stakeholder initiatives and certification standards;

2010 Some definitions but still several questions

- EPA e CARB: LCA pathways; LUC emissions established (EPA)
- RED: no definition
- Evolvement of the indirect effects agenda

Induced effects: local impacts (food vs fuel, livelihood security), biodiversity, water.

Sustainability

- Magic sentence: to produce in a sustainable way
  - That sounds a bit simplistic to me
- The use of crops that do not compete by land does not guarantee the sustainability
  - Food versus fuel: potential local impacts; small global impacts
- There are several methodological issues to be tackled:
  - LCA calculations: specially with respect to land use emissions (direct and indirect), current or future technology, soil carbon balances, credits for the electricity generated
- Biojet fuels must take advantage of the investments made on biofuels for automobiles
- A lot of the sustainability issues on biomass are related to land
  - Marginal land vs degraded (or low productivity) land?
- Yields must be improved and the production has to expand in tropical areas (more sun)
- Sustainability standards: are they ready to provide the level of confidence the aviation industry is seeking for?

"Complete lifecycle analysis of a cane-derived renewable jet fuel in Brazil and benchmarking of cane-derived renewable jet fuel against major sustainability standards"

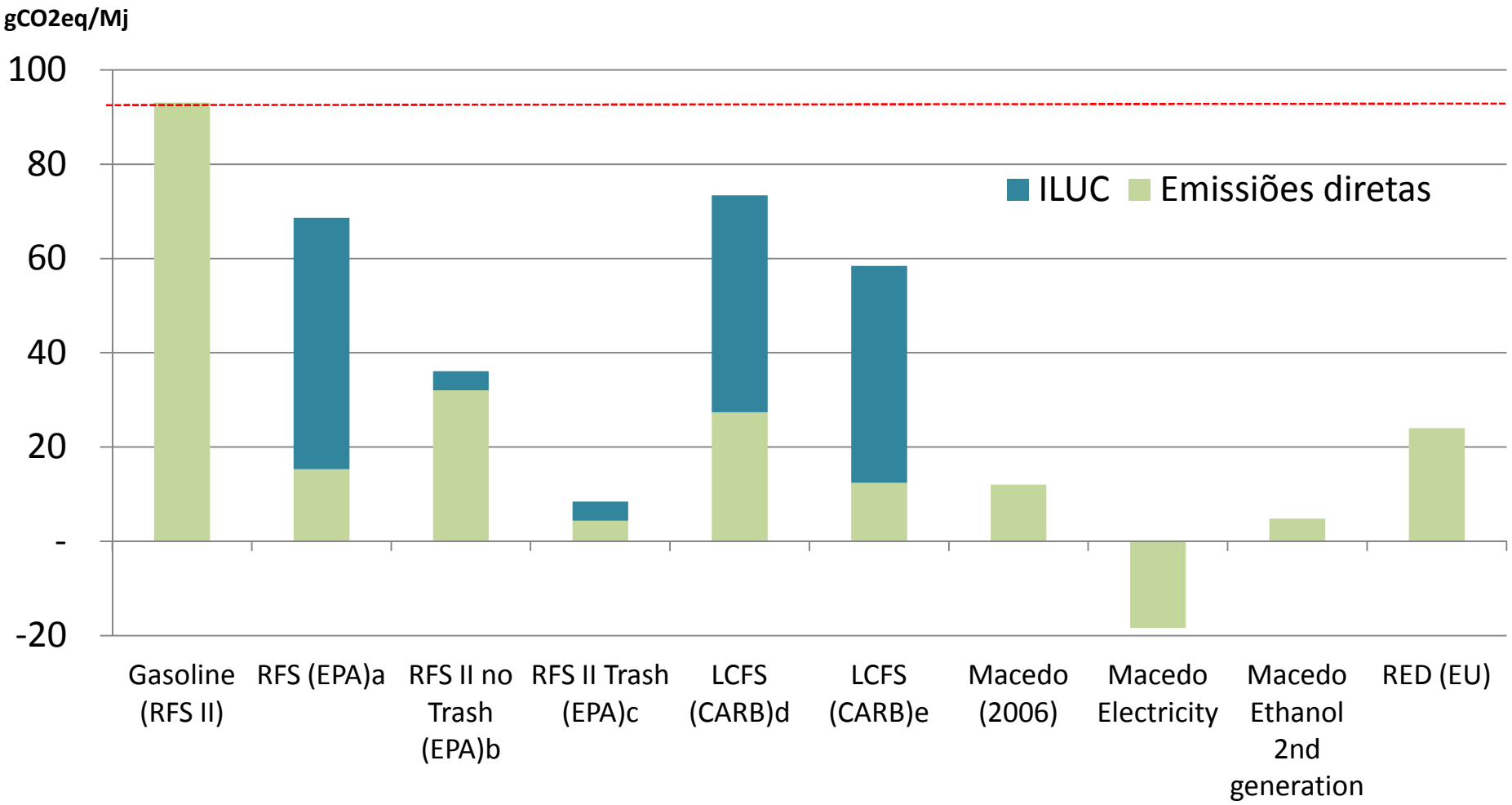
- Phase 1: comparison of sustainability standards
  - Gap analysis and benchmark of principles and criteria
  - Bonsucro, RSB, ISCC, IDB scorecard (versões EU-RED)
  - Desk research e interviews (standards, companies being certified and certifiers)
- Phase 2: development of a Life Cycle Analysis for biojet fuels from Brazilian sugarcane (sustainability study)
  - Full LCA: comprises direct and indirect emissions (based on EPA methodology)
  - Direct emissions and LUC emissions: GREET (CARB) ; Brazilian Land Use Model e GTAP
- Phase 3: dissemination of the results: non-scientific and scientific

Sponsors:

BOEING EMBRAER BID AMYRIS

WWF: external advisor

GHG Emissions: Sugarcane Etanol



Nota: "a" = valor inicial; "b" valor revisado, cogeração substituindo energia marginal, sem recolhimento de resíduos; "c" cogeração substituindo de eletricidade média e colheita mecanizada; "d" sem cogeração; "e" cogeração substituindo eletricidade na média e colheita mecanizada.
Fonte:EPA, CARB;RED;Macedo (2009). Organização ICONE