Global Impact of Biotech Crops: economic & environmental effects 1996-2012

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Background

- 9th annual review of global GM crop impacts
- Authors of 17 papers on GM crop impacts in peer review journals
- Current review in 2 open access papers in journal GM crops. www.landesbioscience.com/journal/gmcrops
- Full report available at www.pgeconomics.co.uk

Coverage

- Cumulative impact: 1996-2012
- Farm income & productivity impacts: focuses on farm income, yield, production
- Environmental impact analysis covering pesticide spray changes & associated environmental impact
- Environmental impact analysis: greenhouse gas emissions

Methodology

- Review and use of considerable economic impact literature plus own analysis
- Uses current prices, exch rates and yields (for each year) & update of key costs each year: gives dynamic element to analysis
- Review of pesticide usage (volumes used) or typical GM versus conventional treatments
- Use of Environmental Impact Quotient (EIQ) indicator
- Review of literature on carbon impacts – fuel changes and soil carbon

Key Findings

Pesticide change 1996-2012

503 million kg

reduction in pesticides & 18.7% cut in associated environmental impact

Carbon Emissions 2012

cut of 27 billion kg co2 release; equal to taking 11.9 million cars off the road

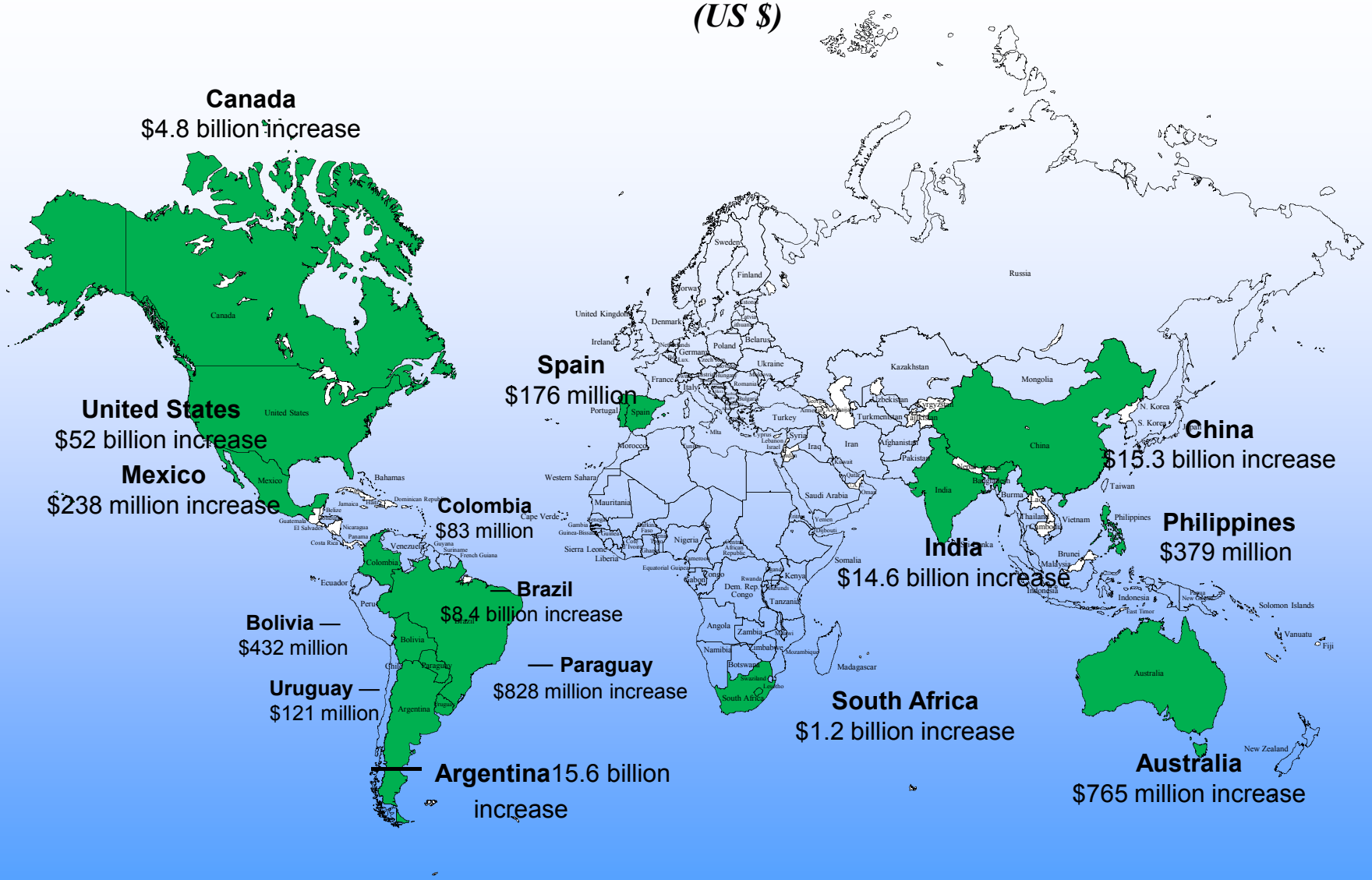
Global farm income 1996-2012

$116.6 billion increase

Farm income gains 2012: highlights

- Total farm income benefit $18.8 billion
- Equal to adding value to global production of these four crops of 6%
- Average gain/hectare: $117
- Income share: 50% each developed and developing countries

Farm income gains 1996-2012 by country (US $)



Farm income benefits: EU (US $ million)

	2012	1996-2012	% of crop using technology 2012 (Spain)
Insect resistant corn	39.9	195.1	30

Year first used: IR corn 1998 Spain
Average benefit/ha 1998-2012 $205/ha

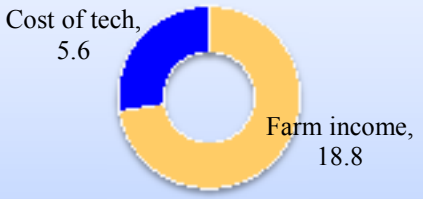
Other farm level benefits

GM HT crops	*GM IR crops*
Increased management flexibility/convenience	Production risk management tool
Facilitation of no till practices	Machinery & energy cost savings
Cleaner crops = lower harvest cost & quality premia	Yield gains for non GM crops (reduced general pest levels)
Less damage in follow on crops	Convenience benefit
	Improved crop quality
	Improved health & safety for farmers/workers

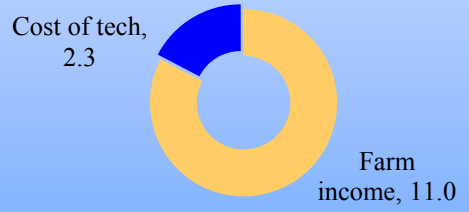
In US these benefits valued at $10 billion 1996-2012

Cost of accessing the technology ($ billion) 2012

- Distribution of total trait benefit: all (tech cost 23%) – **every $1 invested in seed = $3.3 in extra income**



- Distribution of benefit: developing countries (tech cost 21%) **every $1 invested in seed = $3.7 in extra income**

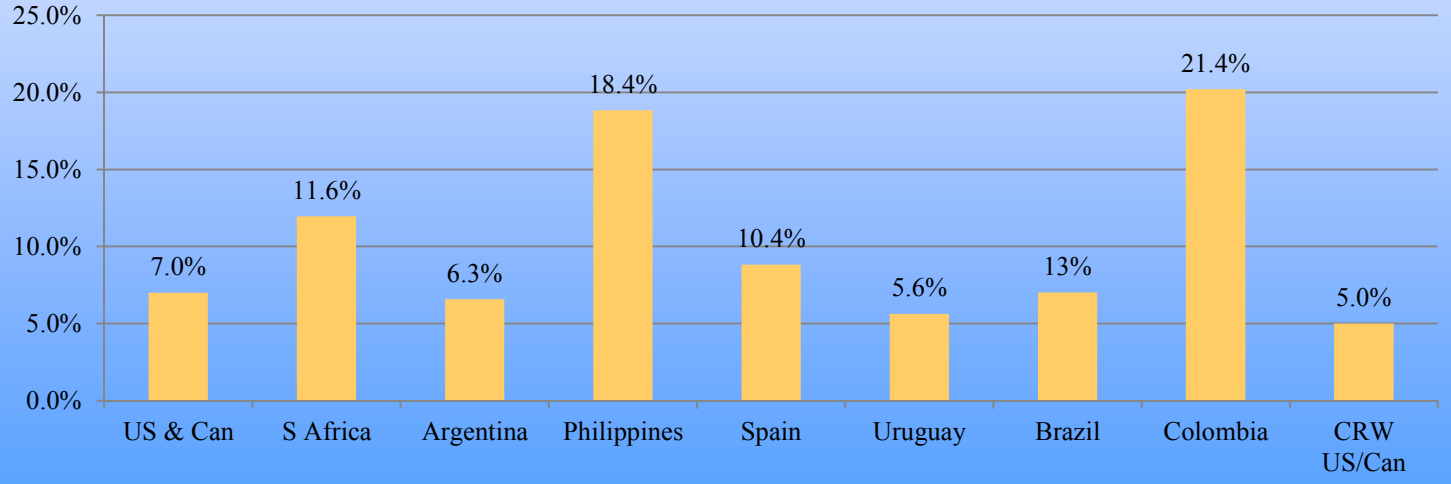


Cost of tech goes to seed supply chain (sellers of seed to farmers, seed multipliers, plant breeders, distributors & tech providers)

Yield gains versus cost savings

- 42% ($49 billion) of total farm income gain due to yield gains 1996-2012
- Balance due to cost savings
- Yield gains mainly from GM IR technology & cost savings mainly from GM HT technology
- Yield gains greatest in developing countries & cost savings mainly in developed countries
- HT technology also facilitated no tillage systems – allowed second crops (soy) in the same season in S America

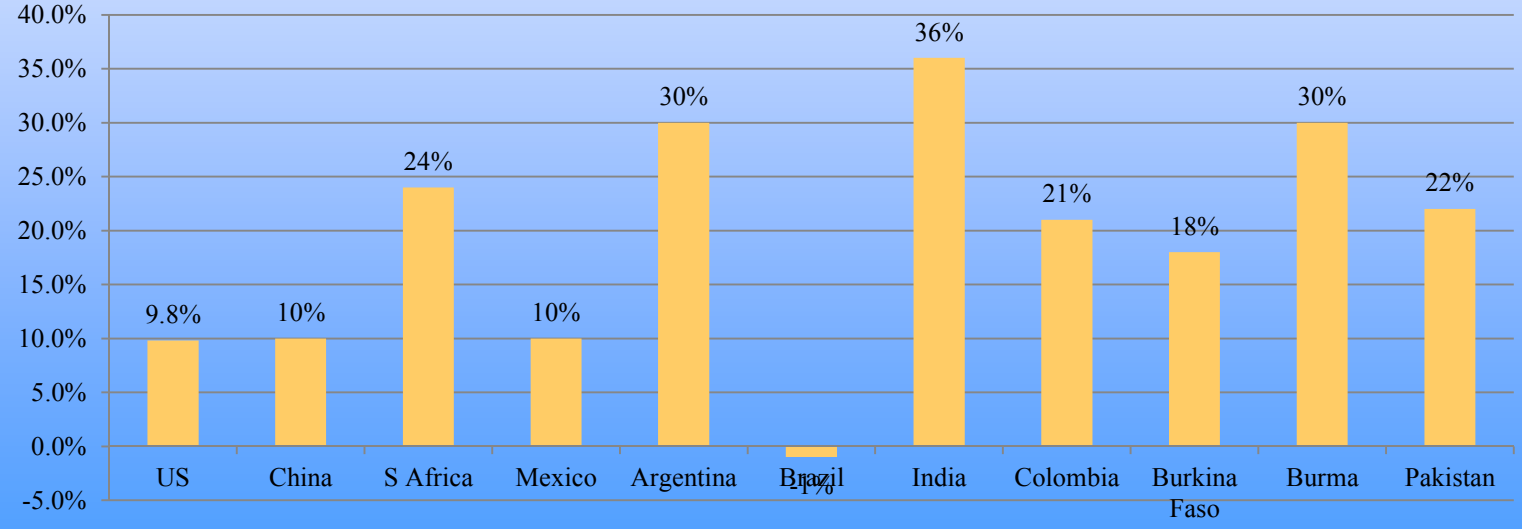
IR corn: average yield increase 1996-2012



Average across all countries:

+10.4%

IR cotton: average yield increase 1996-2012

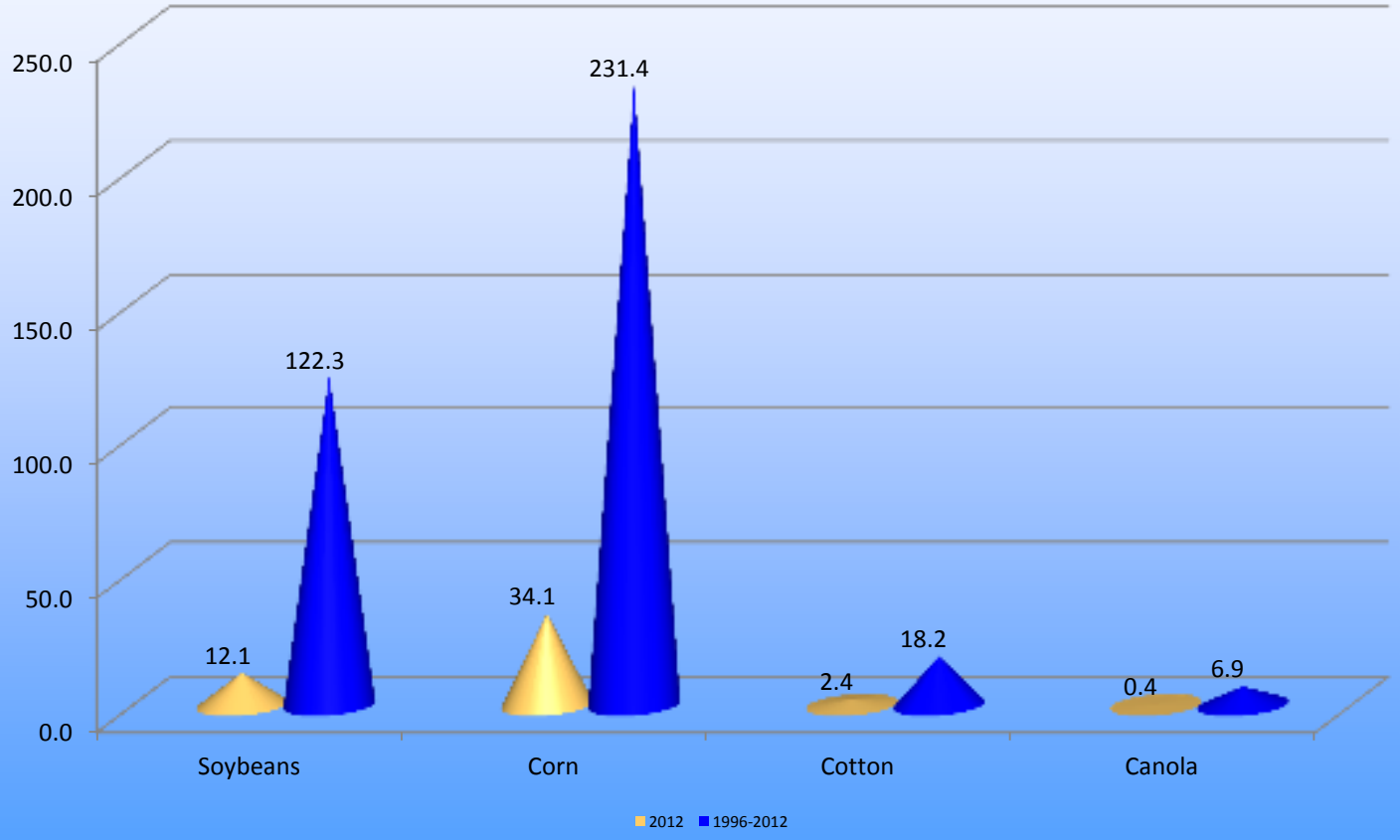


Average across all countries:
+16.1%

HT traits: yield and production effects

Trait/country	Yield/production effect
HT soy: Romania, Mexico, Bolivia	+23%, +7% & +15% respectively on yield
HT soy: 2nd generation: US & Canada	+10% to +11% yield
HT soy Argentina & Paraguay	Facilitation of 2nd crop soy after wheat: equal to +15% and +7% respectively to production level
HT corn: Argentina, Brazil, Philippines	+10%, +3% & +5% respectively on yield
HT cotton: Mexico, Colombia, Brazil	+8%, +4% & +2% respectively on yield
HT canola: US, Canada & Australia	+2.4%, +5.9% & +16.5% respectively on yield

Additional crop production arising from positive yield effects of biotech traits 1996-2012 (million tonnes)



Additional conventional area required if biotech not used (m ha)

	2012	1996-2012
Soybeans	4.9	49.4
Maize	6.9	47.0
Cotton	3.1	23.6
Canola	0.2	3.9
Total	**15.2**	**123.9**

Price impacts

- Additional production from biotech has contributed to lowering world prices of grains and oilseeds

Crop/Commodity	Biotech benefit to world prices (2007 baseline)
Soybeans	-5.8%
Corn	-9.6%
Canola	-3.8%
Soy oil	-5%
Soymeal	-9%
Canola oil & meal	-4%

Source: Brookes G et al (2010) The production and price impact of biotech crops, Agbioforum 13 (1) 2010. www.agbioforum.org

Impact on pesticide use

- Since 1996 use of pesticides down by 503 m kg (-8.8%) & associated environmental impact -18.7% - equivalent to 2 x total EU (28) pesticide active ingredient use on arable crops in one year
- Largest environmental gains from GM IR cotton: savings of 205 million kg insecticide use & 28% reduction in associated environmental impact of insecticides

Impact on greenhouse gas emissions

Lower GHG emissions: 2 main sources:

- Reduced fuel use (less spraying & soil cultivation)
- GM HT crops facilitate no till systems = less soil preparation = additional soil carbon storage

Reduced GHG emissions: 2012

- Reduced fuel use (less spraying & tillage) = 2.1 billion kg less carbon dioxide

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- Facilitation of no/low till systems = 24.6 billion kg of carbon dioxide not released into atmosphere

Equivalent to removing 11.9 million cars — 41% of cars registered in the United Kingdom — from the road for one year

Reduced GHG emissions: 1996-2012

- less fuel use = 16.7 billion kg co2 emission saving (7.4 m cars off the road)
- additional soil carbon sequestration = 203 billion kg co2 saving if land retained in permanent no tillage. BUT only a proportion remains in continuous no till so real figure is lower (lack of data means not possible to calculate)

Concluding comments

- Technology used by 17.3 m farmers on 160 m ha in 2012
- Delivered important economic & environmental benefits
- + $116.6 billion to farm income since 1996
- -503 m kg pesticides & 18.7% reduction in env impact associated with pesticide use since 1996
- Carbon dioxide emissions down by 27 billion kg in 2012: equal to 11.9 m cars off the road for a year

Concluding comments

- ***GM IR technology***: higher yields, less production risk, decreased insecticide use leading to improved productivity and returns and more environmentally farming methods
- ***GM HT technology***: combination of direct benefits (mostly cost reductions) & facilitation of changes in farming systems (no till & use of broad spectrum products) plus major GHG emission gains
- ***Both technologies*** have made important contributions to increasing world production levels of soybeans, corn, canola and cotton
- ***GM HT technology*** has seen over reliance on use of glyphosate by some farmers in North/South America: contributed to weed resistance problems and need to change/adapt weed control practices. Resulted in increases in herbicide use in last few years but environmental impact of herbicides used are still better than conventional crop alternative

EU 28

- Farm users of IR maize getting important economic and environmental gains
- IR maize delivering better quality (lower mycotoxins) grain (note we feed it to animals not humans!)
- Most EU farmers not getting benefit of higher yields and lower costs – discouraged to use with non science-based co-existence rules or illegal national bans on planting
- EU farm sector losing out competitively with imports and on world markets
- EU citizens missing out on environmental benefits