

Phase-II: Capacity Building Project on Biosafety

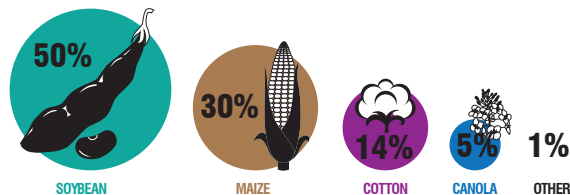
Genetically Modified Crops – Adoption & Impact



The cultivation of genetically modified (GM) crops on farmers' fields started in 1996. By 2014, GM crops were being grown in 28 countries on an area of 181.5 million hectares. USA, Brazil, Argentina, India and Canada are five top GM growing countries, together accounting for approx. 90% area of the GM cultivation.

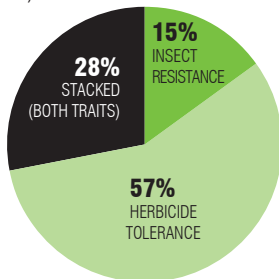
GM crops and traits

Soybean, maize, cotton and canola with herbicide tolerance and insect resistance are the major GM crops grown around the world.



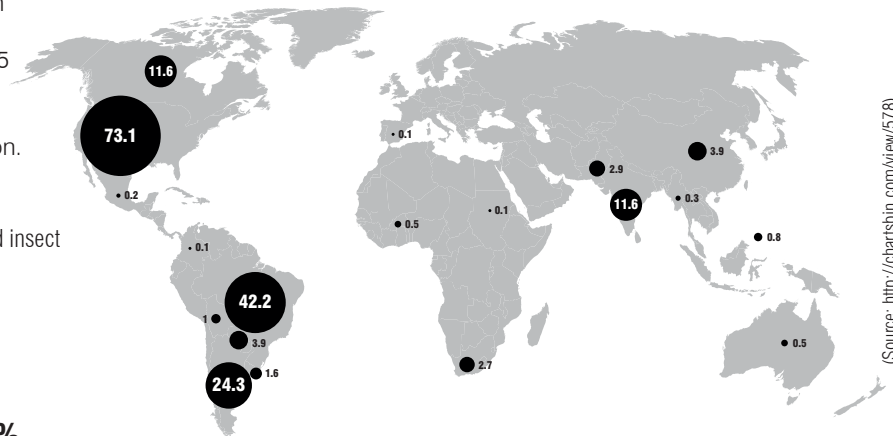
Major global GM crops (% area)

Other GM crops: alfalfa, sugarbeet, papaya, squash, eggplant and potato (CBAN, 2015)



GM traits (% area)

Other GM traits: virus resistance, drought tolerance, fruit and tuber quality (CBAN, 2015)



(Source: <http://chartsbin.com/view/578>)

GM Crops in pipeline beyond insect resistance and herbicide tolerance:

- High oleic soybean
- Virus resistant cassava
- Golden rice
- Drought tolerant sugarcane
- β -carotene fortified banana

Impact of GM crops

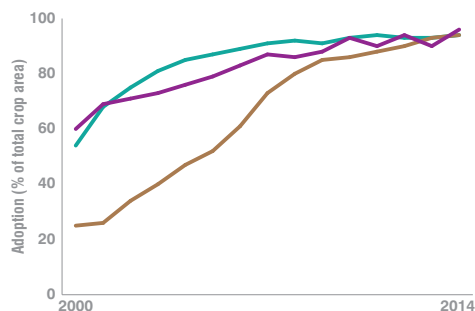
An analysis of 147 original studies on GM soybean, maize and cotton from the world over revealed that compared to their non-GM counterparts the GM crops gave 21.6% higher yield, consumed 36.9% less pesticides, thus saving pesticide costs by 39.2%, and the GM adopting farmers earned 68.2% higher profits (Klumper & Qaim, 2014).

USA

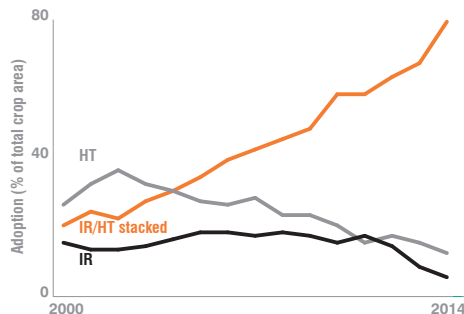
KEY: ■ Value — Quantity



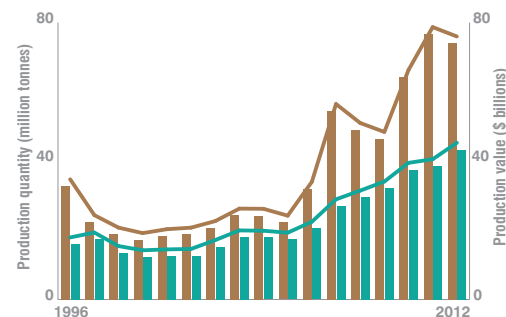
- Largest producer of GM crops in the world with total production area 73.1 million hectares (2014) and global market share of ~ 40%.
- Commercialized GM crops: HT/IR/HT-IR maize, HT/IR/HT-IR cotton, HT soybean, HT canola, IR/HT potato, VR squash, VR papaya, sugarbeet, HT alfalfa.
- Farm income gain from GM crops (1996-2013) - US \$ 58.4 billion



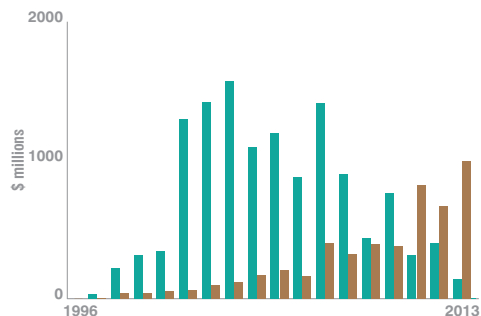
Adoption of GM maize, soybean and cotton
(Data source: Cornejo et al., 2014)



Adoption of IR, HT and multiple GM traits
(Data source: Cornejo et al., 2014)



Production quantity and value of GM soybean and maize
(Data source: FAOSTAT)



Impact of GM soybean and maize as increase in national farm income each year
(Data source Brookes & Barfoot, 2015)

Some new commercialized crops/traits:

- Innate™ potato which does not bruise on cutting or injury, and produces lesser amount of acrylamide, a possible carcinogen, during high temperature frying
- HarvXtra™ alfalfa with reduced lignin for higher animal digestibility and wider harvesting duration
- Arctic™ apple which does not brown on bruising, biting or slicing
- DroughtGard™ maize with drought tolerance trait and improved hydro- efficiency for soil moisture conservation

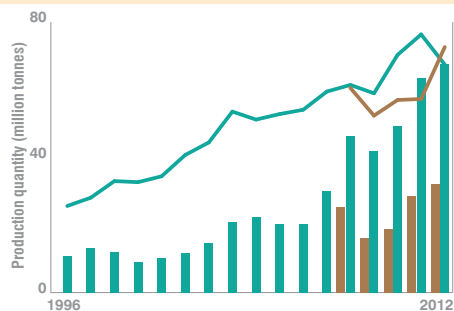
HT : Herbicide Tolerance
VR : Virus Resistance

IR : Insect Resistance

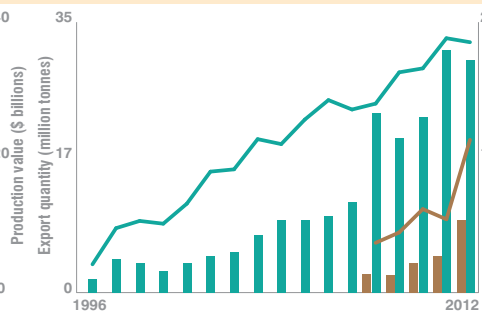
BRAZIL



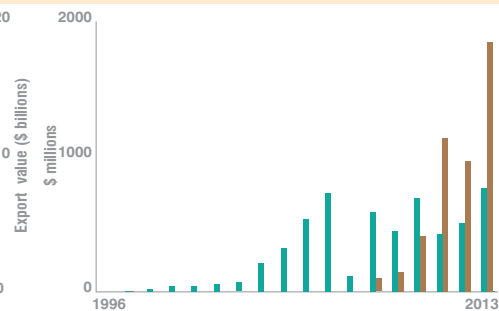
- Total GM production area : 42.2 million hectares (2014)
- Commercialized GM crops: IR/HT soybean, IR cotton, IR maize
- GM area as % of total area under the crop (2014) : soybean 93%, maize 82%, cotton 65%
- Farm income gain from GM crops (2003-2013): US \$ 11.8 billion



Production quantity and value of soybean and maize
(Data source: FAOSTAT)



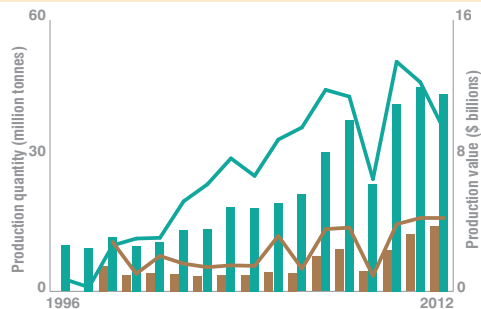
Export quantity and value of soybean and maize
(Data source: FAOSTAT)



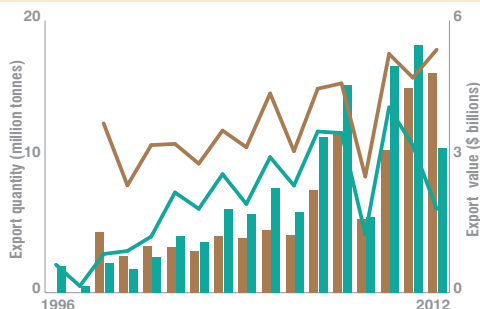
Impact of GM soybean and maize as increase in national farm income each year (Data source Brookes & Barfoot, 2015)

ARGENTINA

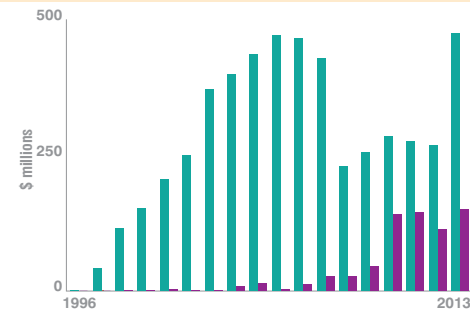
- Total GM crop production area: 24.3 million hectares (2014)
- Commercialized GM crops: HT soybean (100%), IR/HT cotton (100%), IR/HT/IR-HT maize (80%)
- GM area as % of total area under crop (2014) : soybean 100%, maize 80%, cotton 100%
- Farm income gain from GM crops (1996-2013): US \$ 17.5 billion



Production quantity and value of soybean and maize
(Data source: FAOSTAT)



Export quantity and value of soybean and maize
(Data source: FAOSTAT)



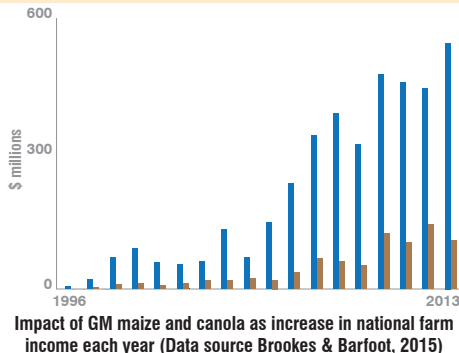
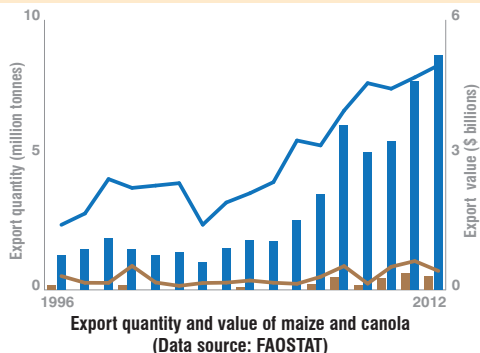
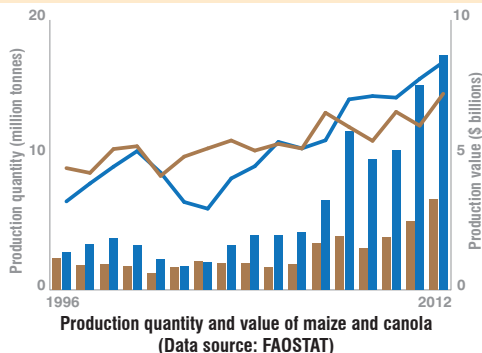
Impact of GM soybean and cotton as increase in national farm income each year (Data source Brookes & Barfoot, 2015)

CANADA



- Total GM production area: 11.6 million hectares (2014)
- Commercialized GM crops: HT canola, HT/IR/HT-IR maize, HT soybean, HT sugarbeet

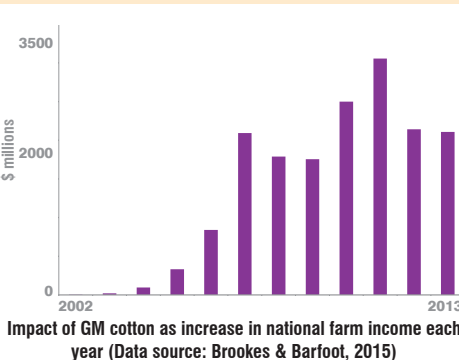
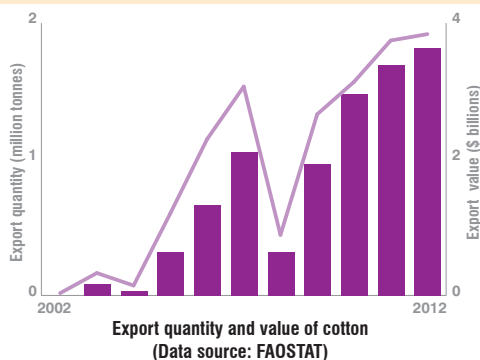
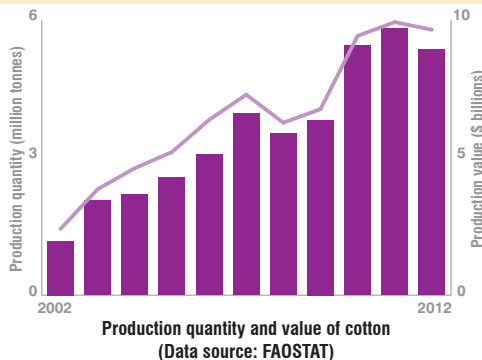
- GM area as % of total area under the crop (2014) : canola 95%, maize 93%, sugarbeet 96%
- Farm income gain from GM crops (1996-2013): US \$ 5.6 billion



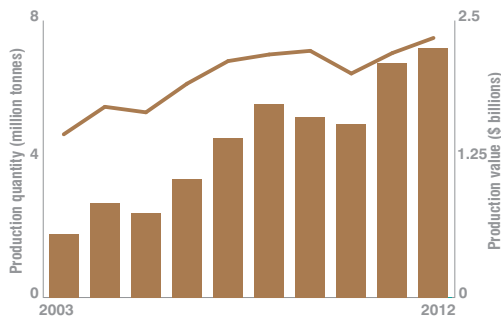
INDIA

- Total GM production area: 11.6 million hectares (2014)
- Commercialized GM crops: IR cotton

- GM area as % of total area under crop (2014) : 95%
- Farm income gain from GM cotton (2002-2013): US \$ 16.7 billion



PHILIPPINES



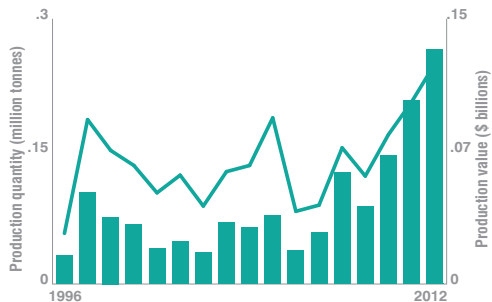
Production quantity and value of maize
(Data source: FAOSTAT)

KEY: ■ Value — Quantity

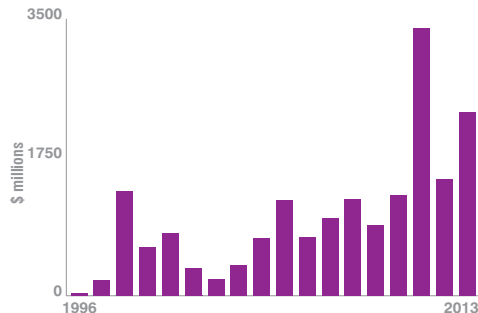


- Total GM production area : 0.81 million hectares (2014)
- Commercialized GM crop: IR/HT/IR-HT Maize
- Increased farm income from GM HT maize (2006-2013): US \$ 123 million
- Increased farm income from GM IR maize (2003-2013): US \$ 347.4 million

MEXICO



Production quantity and value of soybean
(Data source: FAOSTAT)



Impact of GM cotton as increase in national farm income each year
(Data source Brookes & Barfoot, 2015)

- Total GM production area: 0.17 million hectares (2014)
- Commercialized GM crop: IR cotton, HT soybean
- GM area as % of total area under crop (2014): cotton 94%
- Farm income gain due to GM crops (1996-2013): US \$ 293 million

Sources:

1. Brookes, G., Barfoot, P., 2012. GM crops & food: biotechnology in agriculture and the food chain. PG Economics Ltd, UK.
2. Brookes, G., Barfoot, P., 2015. GM crops: Global socio-economic and environmental impact 1996-2013. PG Economics Ltd, UK.
3. Cornejo, J., Wechsler, S., Livingston, M., Mitchell, L., 2014. Genetically engineered crops in the United States. USDA.
4. FAOSTAT. Retrieved from <http://faostat3.fao.org/download/Q/QC/E> (Accessed on 28.08.2015).
5. James, Clive. 2014. Global status of commercialized biotech/GM crops: 2014. ISAAA Brief No. 49. ISAAA: Ithaca, NY.
6. Klumper, W., Qaim, M., 2014. A meta-analysis of the impacts of genetically modified crops. PLoS ONE 9, e111629. Doi:10.1371/journal.pone.0111629.
7. CBAN. 2015. Where in the world are GM crops and foods? Canada Biotechnology Action Group, Ontario, Canada.

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