



Global GM Crop Area Review

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Glossary of Terms

Term	Description
% GM utilisation	Proportion of the overall crop area that GM represents
Agricultural year	July 1 st – June 30 th to capture both northern and southern hemisphere plantings
Alfalfa	Also known as lucerne. Species <i>Medicago sativa</i>
Brinjal	Also known as aubergine/eggplant. Species <i>Solanum melongena</i>
Canola	Variety of oilseed rape. Species <i>Brassica napus</i>
Cotton	Species <i>Gossypium hirsutum</i>
Cow Pea	Also known as black-eyed pea. Species <i>Vigna unguiculata</i>
F1 Hybrid	First generation hybrid seed/plant that occurs following the successful cross-pollination of one genetically uniform plant variety with another specific genetically uniform variety
Genetic event	Identifying code name given to a specific GM trait
GM adoption	Proportion of the overall crop area that GM represents
Hectare	Unit of area equivalent to 10,000 m ² (1 Ha = 2.471 acres)
Herbicide tolerance	Tolerance to specific herbicide active ingredients
Insect resistance	Resistance to specific insect pests
Maize	Also known as corn. Species <i>Zea mays</i>
Marketing Year	Period designated for reporting of production, marketing, and disposition of a commodity
Rice	Species <i>Oryza sativa</i>
Soybean	Species <i>Glycine max</i>
Stacked gene	Combination of herbicide tolerance and insect resistance traits
Sugarcane	Species <i>Saccharum officinarum</i>
Wheat	Species <i>Triticum aestivum</i>

Key Data

Global GM Crop Area Historical

Year	GM Area (Ha m.)	% Change
2012	163.5	3.5
2013	170.0	4.0
2014	178.6	5.0
2015	176.5	-1.2
2016	179.6	1.7
2017	186.6	3.9
2018	185.9	-0.3
2019	185.7	-0.1
2020	188.8	1.7
2021	195.7	3.6
2022	202.2	3.3

Global GM Crop Area by Crop

Crop	GM Area (Ha m.)	% Change	% Share
Alfalfa	1.1	-2.1	0.5
Brinjal	0.03	80.9	0.0
Canola	9.9	-0.7	4.9
Cotton	25.4	7.9	12.6
Maize	66.2	3.3	32.7
Rice	0.02	Na	0.0
Soybean	98.9	2.6	48.9
Sugar beet	0.5	0	0.3
Sugarcane	0.1	-16.6	0.1
Wheat	0.1	Na	0.1
Total	202.2	3.3	100.0

GM Crop Area by Leading Country

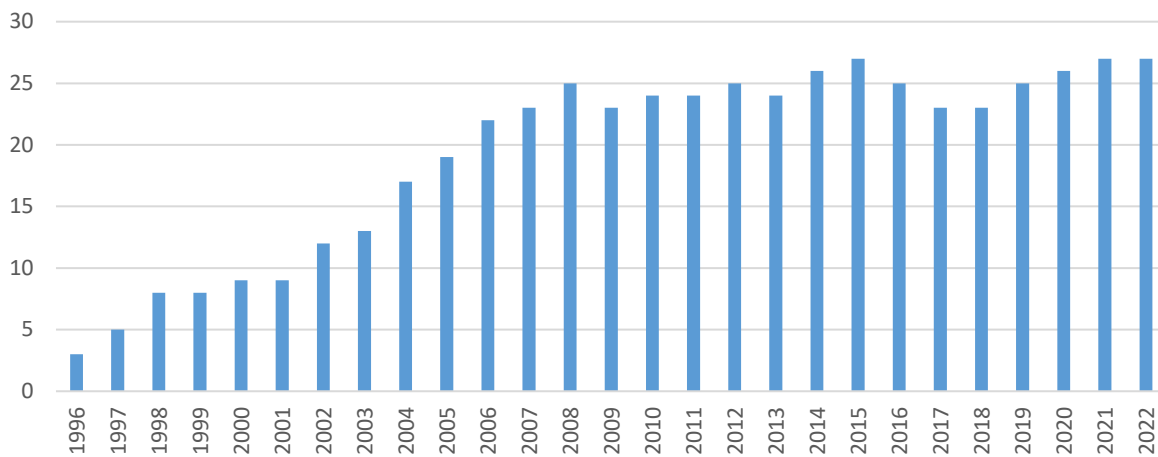
Rank	Country	GM Area (Ha m.)	% Change	% Share
1	USA	74.7	-1.0	36.9
2	Brazil	63.2	10.4	31.3
3	Argentina	23.5	0.4	11.6
4	India	12.4	4.8	6.1
5	Canada	11.3	-3.0	5.6
6	Paraguay	3.7	8.4	1.9
7	South Africa	3.2	8.8	1.6
8	China	2.9	-3.2	1.4
9	Pakistan	1.7	-10.0	0.8
10	Australia	1.5	74.6	0.7
Na	Others	4.2	2.6	2.1
	Total	202.2	3.3	100.0

GM Crop Area in 2022

In 2022, the global area under GM crops increased 3.3% over the previous year to reach 202.2 million hectares, a new record area. 27 countries cultivated a range of 11 different GM crops, with soybean the most widely planted at 98.9 million hectares, followed by maize at 66.2 million hectares. 2022 saw the first plantings of GM rice in the Philippines.

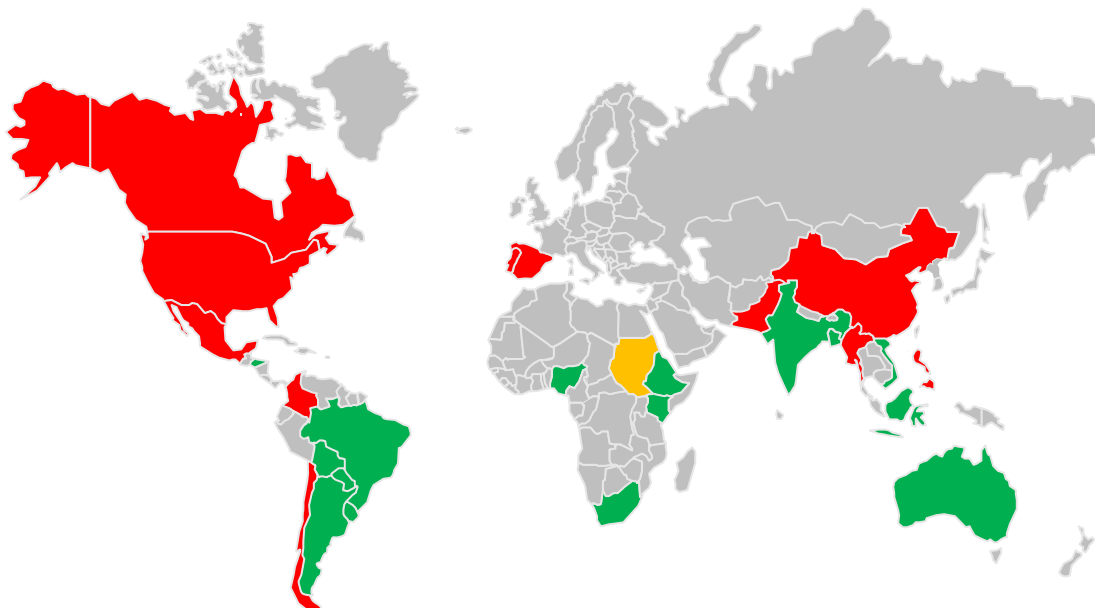
The number of countries cultivating GM crops has varied since the first introduction of GM varieties in 1996, due in part to several European countries ceasing the cultivation of GM maize, as well the end of planting of GM cotton in Burkina Faso. While 27 countries cultivated GM crops in 2022, this was also achieved in 2015.

Number of GM Crop Cultivating Countries by Year



The map below shows the area change in 2022, on a country level basis, compared to the previous year.

Changes in GM Crop Area 2022*



*Green = Growth, Yellow = Static, Red = Decline

202.2 million Hectares (+3.3%)

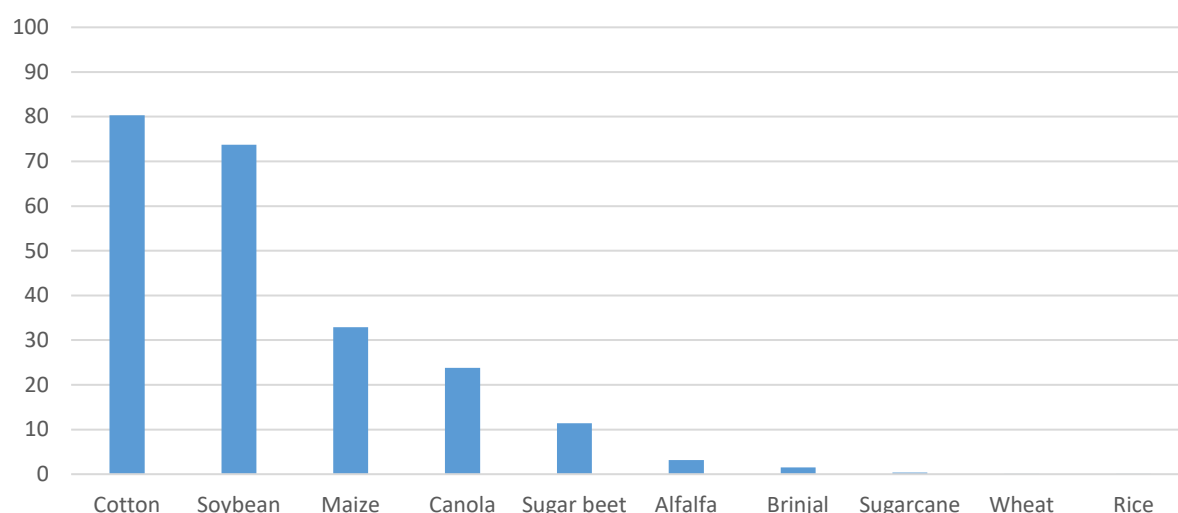
The greatest changes in area, excluding countries cultivating less than 100,000 hectares, were seen in Australia (74.6%), Vietnam (+60.7%), Honduras (+36.8%) and Uruguay (+15.3%), driven by a combination of greater overall planted areas and higher adoption rates. The largest declines in GM area were seen in Spain (-30.0%), Pakistan (-10.0%), Philippines (-5.2%), China (-3.2%) and Canada (-3.0%).

GM Adoption

The table and bar charts below show the rate of global adoption of each crop. Cotton contains the highest rate of GM % utilisation at 80.4% of the world's total cotton area, followed by soybean at 73.7%, maize at 32.9% and canola at 23.8%. Following this the rate of global adoption falls away quickly.

Global Adoption of GM Crops			
Crop	GM Area (Ha m.)	Total Area (Ha m.)	GM % Share
Cotton	25.4	31.6	80.4
Soybean	98.9	134.2	73.7
Maize	66.2	201.2	32.9
Canola	9.9	41.6	23.8
Sugar beet	0.5	4.4	11.4
Alfalfa	1.1	35.0	3.1
Brinjal	0.03	2.0	1.5
Sugarcane	0.1	26.3	0.4
Wheat	0.1	220.6	0.1
Rice	0.02	165.1	0.0
Total	202.2	862.0	23.5

Global Adoption of GM Crops (%)



North America

At the regional level, North America holds the 2nd largest GM crop area after Central and South America, with a total of 86.0 million hectares planted in 2022, a fall of 1.3% from 2021. Prior to 2019, North America was the leading region in terms of GM planted area, however, a combination of severe weather impacting planting in the US and Canada in 2019, and Brazil continually increasing its planted area, has resulted in North America losing its leading position. The USA is the largest GM crop area in North America, with a cultivated area 6.6 times the size of Canada. In North America, maize is the most important GM crop, with the USA typically the world's leading exporter of harvested maize.

North America GM Crop Area by Country 2022

Country	GM Area (Ha m.)	% Change	% Share
USA	74.7	-1.0	13.2
Canada	11.3	-3.0	86.8
Total	86.0	-1.3	100.0

USA

Area in 2022: 74.7 Ha m. (-1.0%)

GM Crops (year of introduction): Alfalfa (2011), Canola (1999), Cotton (1996), Maize (1996), Soybean (1996), Sugarbeet (2005)

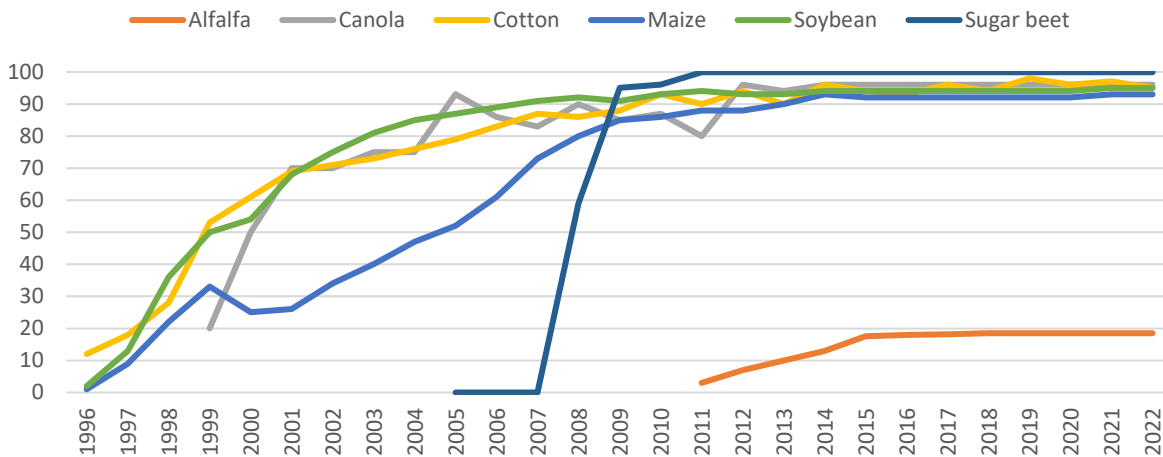
The US GM crop area fell 1.0% in 2022 as a result of declines in maize and alfalfa which were not offset by greater areas of the remaining crops.

USA GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Alfalfa	1.1	-2.1
Canola	0.9	5.9
Cotton	5.3	20.1
Maize	33.3	-5.1
Soybean	33.6	0.3
Sugar beet	0.5	0.0
Total	74.7	-1.0

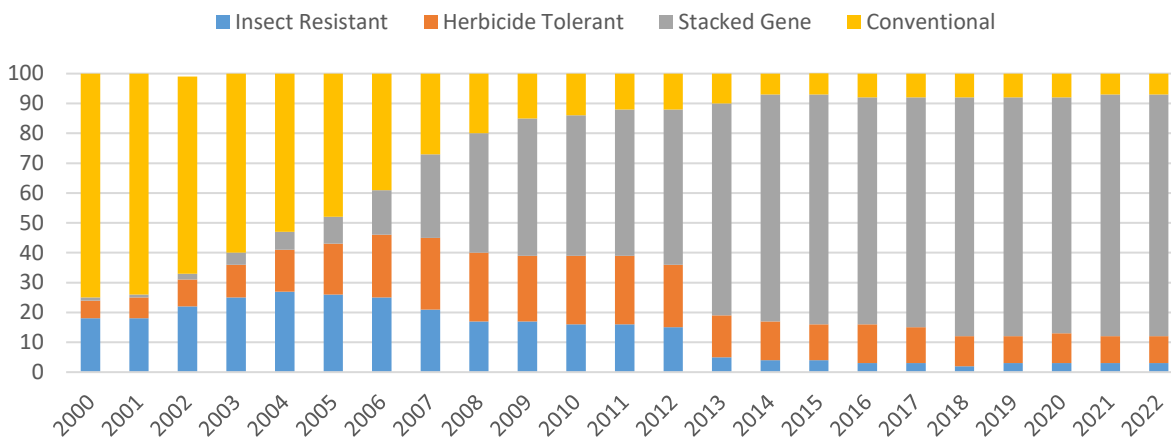
The rate of adoption of GM crop varieties are effectively mature in the USA, with all GM crops apart from alfalfa having greater than 90% adoption in 2022. As a result, US GM crop areas now generally track the changes in total planted areas (conventional + GM). The graph below shows the historical adoption rates of GM crops in the USA.

US GM Adoption by Crop (%)



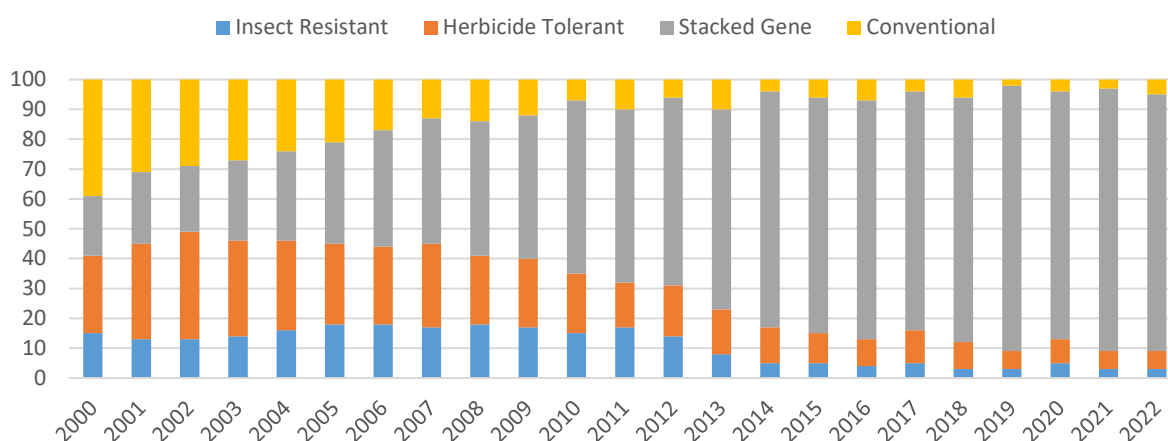
The USA possesses the largest GM maize area in the world at 33.3 million hectares in 2022, forming 50.4% of the global GM maize area. The US first planted GM maize varieties in 1996, and since that time adoption rates have quickly risen. One key trend since 2000 has been the transition away from the use of single traits (insect resistance or herbicide tolerance) towards stacked gene varieties (insect resistance and herbicide tolerance). In 2000, stacked gene varieties formed only 1% of the total US maize area, while in 2022 this has risen to 81%.

US Total Maize Area by Technology (%)



The GM cotton area in the USA reached 5.3 million hectares in 2022, close to record plantings of the crop. Only once has the US GM cotton area been larger when in 2011 the country planted 5.4 million hectares of GM cotton. The USA planted its first GM cotton varieties in 1996, and since 2011 more than 90% of the total US cotton area has been planted with GM varieties. As with maize, the proportion of the US cotton area planted with stacked gene varieties has been growing, forming 20% of the area in 2000 and 86% in 2022.

US Total Cotton Area by Technology (%)



The US cultivates the world's 2nd largest GM soybean area, after Brazil, at 33.6 million hectares in 2022. At this level, the US GM soybean area forms 34.0% of the global GM soybean area. The US planted its first GM soybean varieties in 1996, with adoption rising to mature levels within the first 10 years of commercialisation. Unlike maize and cotton, GM soybean in the USA possesses only herbicide tolerance, however, GM soybean varieties utilise a wider range of herbicide tolerant technologies such as glyphosate, glufosinate, dicamba, 2,4-D and isoxaflutole tolerance traits.

GM canola is only cultivated in the USA, Canada and Australia, with the USA planting 0.9 million hectares in 2022, there are no commercial plantings of GM rapeseed in the world. In the USA, GM varieties possessing either glyphosate or glufosinate herbicide tolerance are cultivated.

The US cultivates small areas of other GM crops including sugar beet and alfalfa. GM sugar beet was launched in 2005, however, due to regulatory issues, GM sugar beet varieties were removed from the market until 2008, where adoption reached 59% of the total US sugarbeet area in its first year of full deployment. GM sugar beet possesses only glyphosate herbicide tolerance. GM alfalfa was the last GM field crop to be commercialised, being deployed in 2005. GM alfalfa commonly utilises glyphosate herbicide tolerance, while some varieties have been modified to contain reduced levels of lignin.

Canada

Area in 2022: 11.3 Ha m. (-3.0%)

GM Crops (year of introduction): Canola (1996), Maize (1998), Soybean (1997), Sugarbeet (2010)

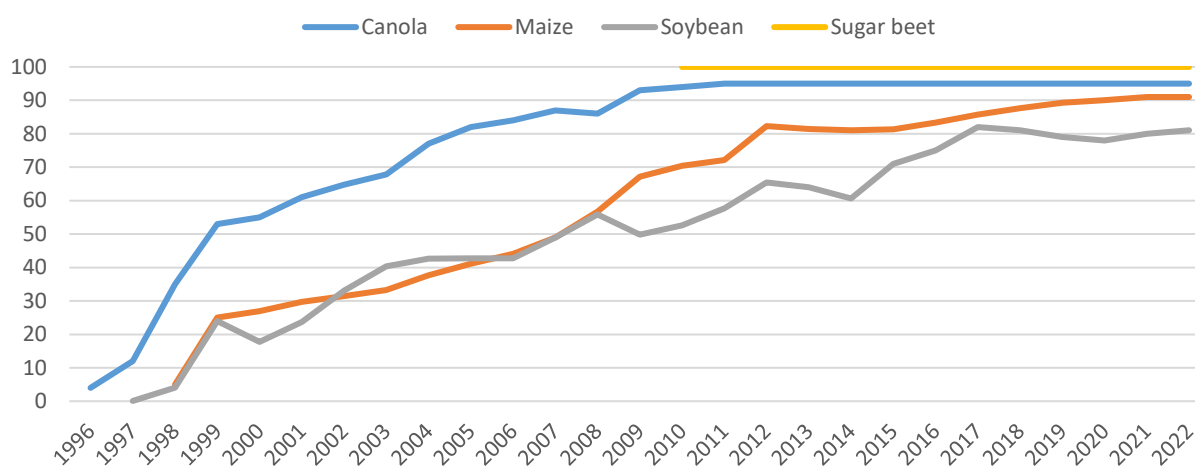
The GM crop area in Canada declined 3.0% in 2022 due to a fall in the overall canola planted area. In 2021, canola production in Canada was impacted by poor weather, and in 2022 growers recognised that with the return of normal weather, yields were likely to significantly improve. As a result, a lower planted area was required to reach the required level of production.

Canada GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Canola	8.2	-4.7
Maize	1.3	4.4
Soybean	1.7	0.4
Sugar beet	0.02	0.0
Total	11.3	-3.0

Canada holds the world largest GM canola area by a significant margin over the USA and Australia, the only other two countries cultivating GM canola. In 2022, Canada planted 8.2 million hectares of GM canola, a fall of 4.7% from the previous year.

Canada GM Adoption by Crop (%)



GM canola was first commercialised in Canada in 1996, and since 2009 % utilisation has remained in excess of 90%. The GM canola area is exclusively herbicide tolerant, with no insect resistance traits utilised. Herbicide tolerance is achieved through the use of either glufosinate or glyphosate tolerance.

Following canola, Canada cultivates significantly smaller areas of its remaining GM crops. In 2022, Canada planted 1.7 million hectares of soybean (+0.4%), 1.3 million hectares of maize (+4.4%), and 0.019 million hectares of sugarbeet (0.0%).

Central and South America

At the regional level, Central and South America possesses the largest GM crop area at 93.3 million hectares in 2022 (2021/22 agricultural year). Plantings increased 7.4% over the previous year, driven by a large rise in area in Brazil. Central and South America overtook North America as the greatest cultivator of GM crops in 2019, due in part to the evolution of the Brazilian GM crop area. Brazil has rapidly expanded its GM crop area to now form almost 68% of the regions GM crop area. Following Brazil, Argentina represents the next leading country in the region, with 25.2% of the GM planted area. After Brazil and Argentina, the size of the GM crop areas in the remaining countries falls away quickly, with 3rd placed Paraguay representing only 4.0% of the regions GM crop area. In Central and South America, soybean is the dominant crop, representing 67.2% of the regions GM crop area.

Central and South America GM Crop Area by Country 2022			
Country	GM Area (Ha m.)	% Change	% Share
Brazil	63.2	10.4	67.8
Argentina	23.5	0.4	25.2
Paraguay	3.7	8.4	4.0
Bolivia	1.4	1.1	1.5
Uruguay	1.2	15.3	1.3
Colombia	0.1	-2.6	0.2
Honduras	0.1	36.8	0.1
Mexico	0.02	-83.2	0.02
Chile	0.01	-5.9	0.01
Total	93.3	7.4	100.0

Brazil

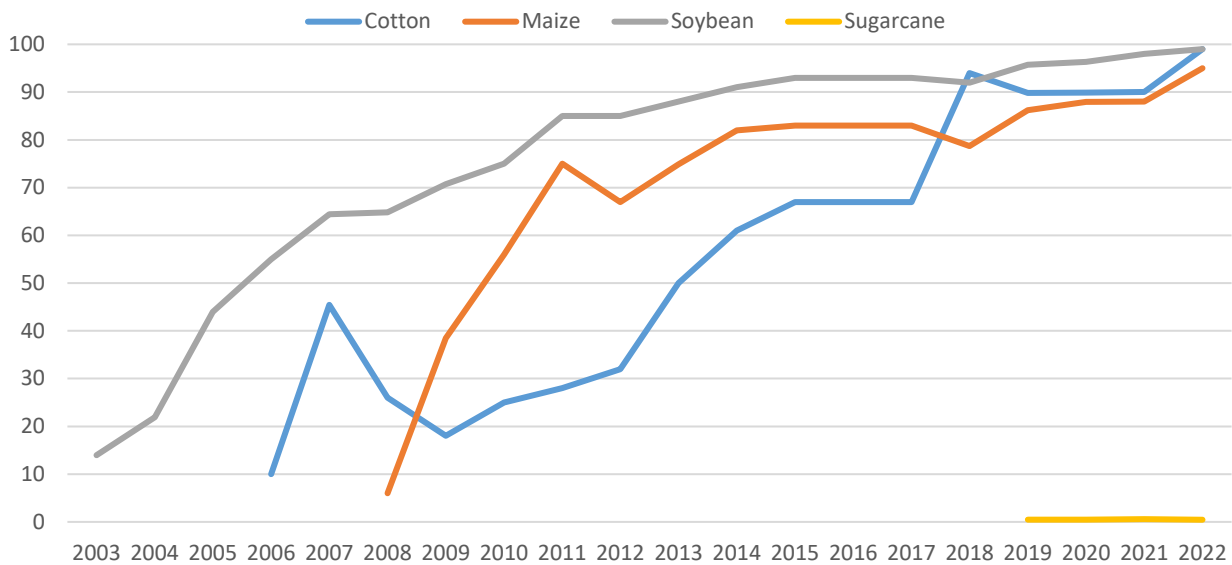
Area in 2022: 63.2 Ha m. (+10.4%)

GM Crops (year of introduction): Cotton (2006), Maize (2008), Soybean (2003), Sugarcane (2019)

The GM crop area in Brazil increased 10.4% in 2022 (2021/22 agricultural year), driven by greater areas of maize and soybean. GM areas of these crops increased through a combination of greater total planted areas and a rise in GM % utilisation.

Brazil GM Crop Area 2022		
Year	GM Area (Ha m.)	% Change
Cotton	1.6	28.4
Maize	20.5	16.9
Soybean	41.1	6.9
Sugarcane	0.04	-24.9
Total	63.2	10.4

Brazil GM Adoption by Crop (%)



Brazil cultivates the worlds largest GM soybean area at 41.1 million hectares in 2022, a rise of 6.2% over the previous year. GM soybean was launched in 2003, six years behind the USA, and adoption steadily increased to reach more than 90% of the country’s total soybean area in 2014. Brazil is the greatest adopter of stacked gene soybeans that possess both herbicide tolerance and insect resistance, which protects against specific lepidopteran insect pests. Stacked gene varieties were first commercialised in 2012 and now form the majority of the soybean area in Brazil.

GM maize was commercialised in Brazil in 2008, more than ten years after the USA. However, since that time adoption rates have increased significantly, with 95% of the total Brazilian maize area being planted with GM varieties in 2022. 2022 saw a large single step increase in % utilisation, rising from 88% in 2021 to the current level of 95%. Brazil cultivates three maize plantings per season, with the majority of GM plantings occurring in the larger second season crop. As with soybean, the majority of GM maize cultivated in the country are varieties that contain stacked gene traits, possessing both herbicide tolerance and insect resistance.

GM cotton was first adopted in Brazil in 2006, however it has only been in recent years that the GM % utilisation rate reached maturity. In 2022, the GM cotton area grew by 28.4% to reach 1.6 million hectares, a record area. Brazil’s total cotton area has been increasing in recent years, now almost double the level cultivated 10 years ago. As a result of strong GM % utilisation (99% in 2022), the area under GM varieties has greatly improved from the overall demand for Brazilian produced cotton. GM cotton varieties grown in Brazil almost entirely possess stacked genes for both herbicide tolerance and insect resistance.

Brazil commercialised GM sugar cane in 2019, however it is cultivated on a small area, only forming 0.5% of the country’s total sugar cane area. GM sugarcane in Brazil is insect resistant, utilising one gene to control key lepidopteran insect pests.

Argentina

Area in 2022: 23.5 Ha m. (+0.4%)

GM Crops (year of introduction): Cotton (1999), Maize (1998), Soybean (1997), Wheat (2022)

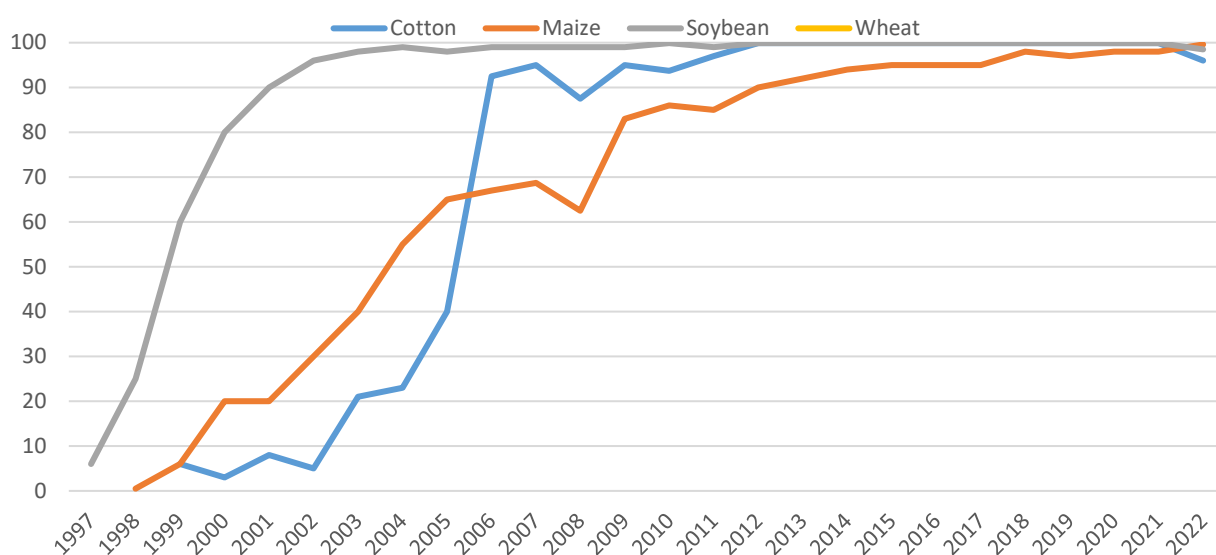
The Argentinean GM crop area in grew 0.4% in 2022, driven by a greater area of cotton and the introduction of GM varieties of wheat. While the area under GM maize rose by 11.0%, this was offset by a 4.4% reduction of the GM soybean area.

Argentina GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	0.5	17.1
Maize	7.1	11.0
Soybean	15.9	-4.4
Wheat	0.05	Na
Total	23.5	0.4

Soybean is the main GM crop in Argentina with 15.9 million hectares planted in 2022, a fall of 4.4% from the previous year. While almost 16 million hectares of GM soybean was planted in 2022, not all of this crop was from a commercial source. As commercial soybean is a non-hybrid crop, growers may save the seed and replant it to generate another crop. The difficulties in controlling intellectual property in the county has led to multinational seed companies either limiting their financial exposure to the Argentinean soybean seed market or exiting it completely. GM Soybean was commercialised in Argentina in 1997 and reached +90% utilisation withing five years. Argentina is the second greatest adopter of stacked gene soybean varieties after Brazil, with commercialisation occurring in 2014, two years after Brazil.

Argentina GM Adoption by Crop (%)



Despite the country planting only 7.1 million hectares of GM maize in 2022 (+11.0%), Argentina is the world's 3rd largest GM maize area after the USA and Brazil. Adoption of GM maize varieties, happened at a slower rate than in other crops, as it took 14 years to reach +90% utilisation. In 2022 almost the entire maize area in Argentina was planted with GM varieties, typically stacked gene varieties.

GM Cotton was first planted in Argentina in 1999, although adoption rates were low in the first 5 years of commercialisation at less than 10%. It was not until 2003 when adoption increased rapidly to reach more than 90% of the total cotton area. As with soybean and maize, the majority of GM cotton cultivated in the country are stacked gene varieties.

Argentina was the first country in the world to launch GM wheat, with 53,000 hectares of HB4 planted in 2022, representing 0.8% of the country's total wheat area. This GM wheat was developed by Argentinian seed company Bioceres to possess glufosinate herbicide tolerance and drought tolerance. HB4 wheat is cultivated in a closed loop system, with seed or flour not being openly offered to growers.

Paraguay

Area in 2022: 3.7 Ha m. (+8.4%)

GM Crops (year of introduction): Cotton (2011), Maize (2012), Soybean (2004)

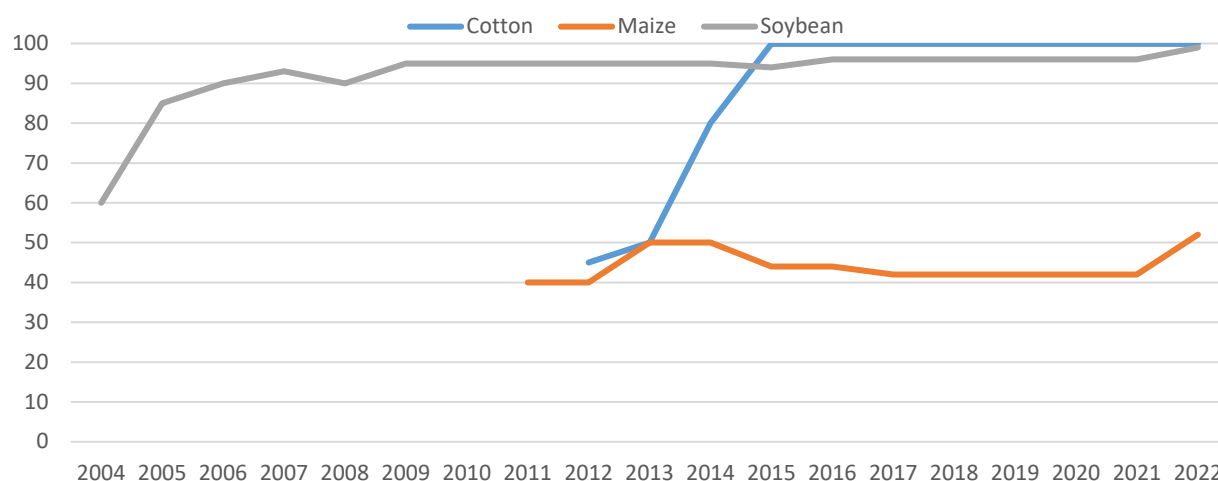
The GM crop area in Paraguay is dominated by soybean at 87% of the country's total GM area. As a result, changes in the country's total GM area is dictated by what is occurring in soybean.

Paraguay GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	0.01	0.0
Maize	0.5	11.4
Soybean	3.3	8.0
Total	3.7	8.4

The GM soybean area in Paraguay grew by 8.0% in 2022, driven by a higher total soybean planted area and a rise in GM % utilisation. GM soybean was launched in 2004 and was adopted strongly in its first year (60% of the total soybean area). The soybean area in Paraguay is comparatively low resulting in lower volumes of GM seed required to facilitate high adoption levels. Soybean production is focussed in the east of the country, mainly along the border with Argentina and Brazil, and as a result the availability of GM seed from both countries was high. GM % adoption reached mature levels in 2006, only two years following first launch and has remained above 90% since that time. As with Brazil and Argentina, the majority of the GM area is planted with stacked gene varieties.

Paraguay GM Adoption by Crop (%)



In 2022, the GM maize area grew by 11.4% to reach 0.5 million hectares, a record area. GM maize was introduced in 2011 with an initial adoption rate of 40.0%, adoption was high in the first year for the same reasons as soybean. It was reported that Paraguay sourced approximately 80.0% of its GM maize seed from Argentina. Since introduction, adoption rates have not increased significantly, with adoption in 2022 at 52.0% of the total Paraguayan maize area. Stacked gene varieties form the majority of the GM maize cultivated.

GM cotton was the last GM crop to be commercialised in Paraguay in 2011. In 2022, almost 11,000 hectares were planted, flat against the previous year. Adoption in the first year of deployment was high at 45.0%, and within four years reached 99.9% of the total cotton area.

Bolivia

Area in 2022: 1.4 Ha m. (+1.1%)

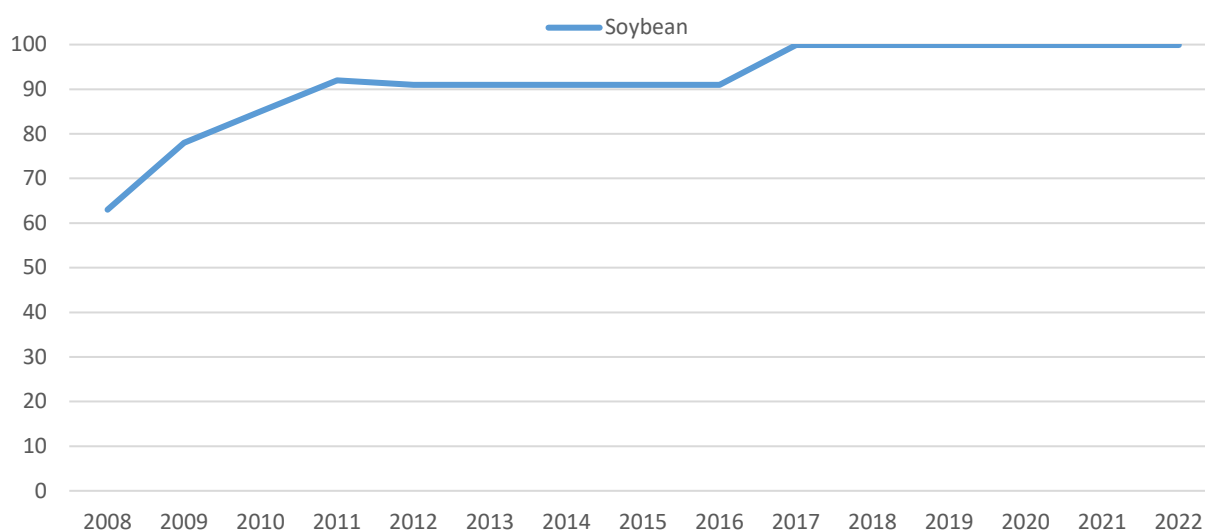
GM Crops (year of introduction): Soybean (2008)

Soybean is the only GM crop cultivated in Bolivia. In 2022, the area increased 1.1% over the previous year, while adoption remained a 99.9% of the total soybean area. GM soybean was launched in 2008 with an initial high adoption rate of 63.0%, with this quickly growing to greater than 90.0%. Unlike Brazil, Argentina and Paraguay, Bolivia does not cultivate stacked gene varieties, instead only planting varieties possessing herbicide tolerance.

Bolivia GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Soybean	1.4	1.1
Total	1.4	1.1

Bolivia GM Adoption by Crop (%)



Uruguay

Area in 2022: 1.2 Ha m. (+15.3%)

GM Crops (year of introduction): Maize (2003), Soybean (2000)

The GM crop area in Uruguay increased by 15.3% in 2022, driven by a rise in the soybean area. Soybean is the dominant GM crop in the country with a planted area of more than seven times the size of its GM maize area.

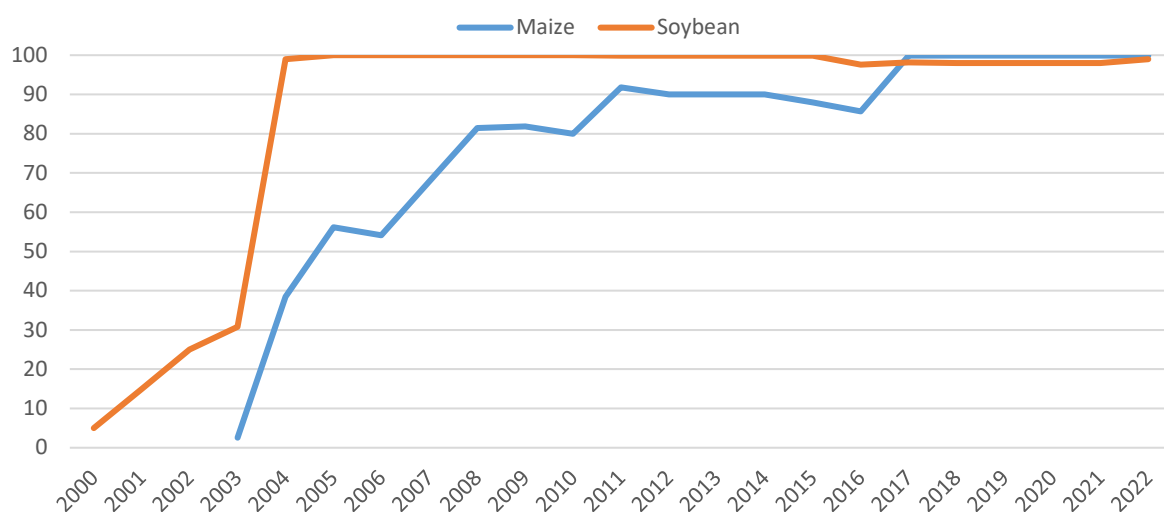
Uruguay GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Maize	0.2	6.3
Soybean	1.1	16.7
Total	1.2	15.3

The Uruguayan GM soybean area increased 16.7% in 2022 to reach 1.1 million hectares, driven by a greater total soybean area and a rise in % utilisation. GM soybean was launched in 2000 and within four years essentially covered the entire Uruguayan soybean area. While Uruguay cultivates stacked gene varieties, these represent less than half of the country's GM soybean area, a different situation to other South American countries that cultivate stacked gene varieties.

GM maize was launched three years after soybean, in 2003. Uruguay cultivates a small total maize area, as a result, despite almost 100% utilisation, GM maize only covered 0.2 million hectares in 2022, a rise of 6.3% over the previous year. Just over half of the GM maize area is planted with stacked gene varieties, with the majority of the remaining area being planted with insect resistant varieties.

Uruguay GM Adoption by Crop (%)



Colombia

Area in 2022: 0.15 Ha m. (-2.6%)

GM Crops (year of introduction): Cotton (20020, Maize (2007)

Colombia cultivated 146,550 hectares of GM crops in 2022, a fall of 2.6% from the previous year. Area decline was a result of a 3.2% fall in the GM maize area, the largest GM crop in the country. Not all of Colombia cultivates GM crops, with adoption focussed in the North of the country at the state level.

Colombia GM Crop Area 2022

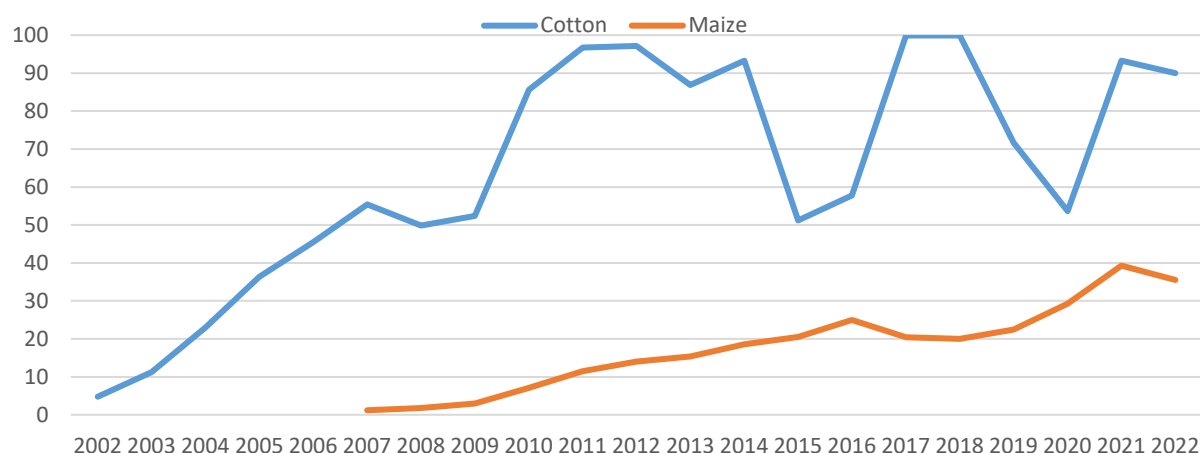
Year	GM Area (Ha m.)	% Change
Cotton	0.01	8.5
Maize	0.14	-3.2
Total	0.15	-2.6

GM maize was first cultivated in Colombia in 2007. Since that time, adoption rates have increased slowly, rising to reach only 35.5% of the country's total maize area. Colombia sources its GM maize seeds from Brazil, as well as smaller volumes from Honduras. In 2022, the majority of the GM maize area was planted with stacked gene varieties.

GM cotton was the first GM crop to be cultivated in the country, and while adoption rates are high, due to the low overall cotton area, GM cotton areas are small at 8,100 hectares in 2022. Stacked gene varieties were first introduced in 2007 and now form the majority of the planted area, with Bollgard and Roundup Ready being the only traits approved for cultivation. Colombia imports its GM cotton seeds from the US. GM % utilisation rates fell in 2015 and 2020 when profitability of production was reportedly pressured. In addition, states such as Bolivar, Cundinamarca, La Guajira and Sucre reportedly halted GM cotton cultivation at this time and have since returned to planting GM varieties.

In 2010, the country approved the cultivation of GM soybean, however, no commercial plantings have yet occurred.

Colombia GM Adoption by Crop (%)



Honduras

Area in 2022: 0.052 Ha m. (+36.8%)

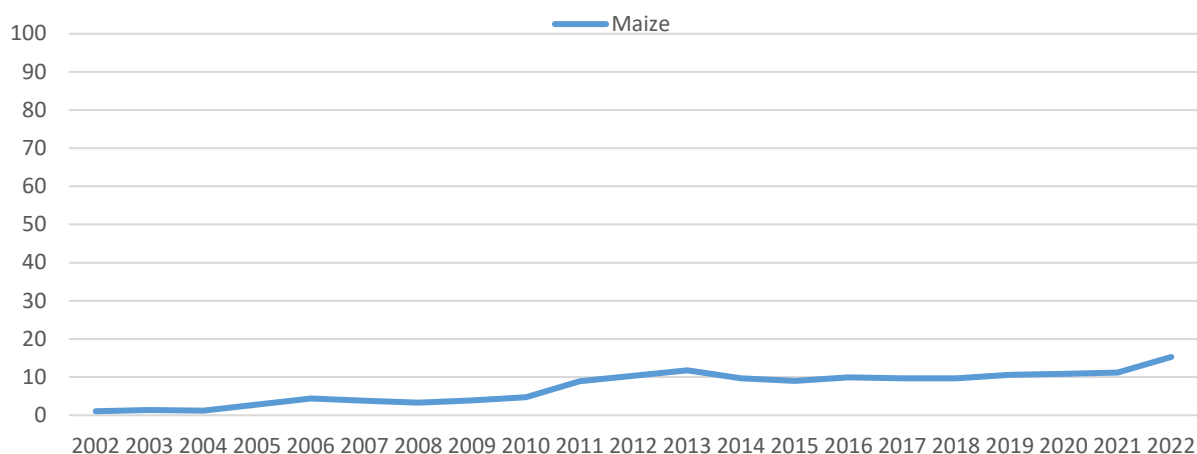
GM Crops (year of introduction): Maize (2007)

Honduras first cultivated GM maize in 2007, although utilisation remains low at 15.3% of the country's total maize area, representing 52,000 hectares in 2022. As with many countries, stacked gene varieties form the majority of the GM planted area.

Honduras GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Maize	0.052	36.8
Total	0.052	36.8

Honduras GM Adoption by Crop (%)



Mexico

Area in 2022: 0.016 Ha m. (-83.2%)

GM Crops (year of introduction): Cotton (1998)

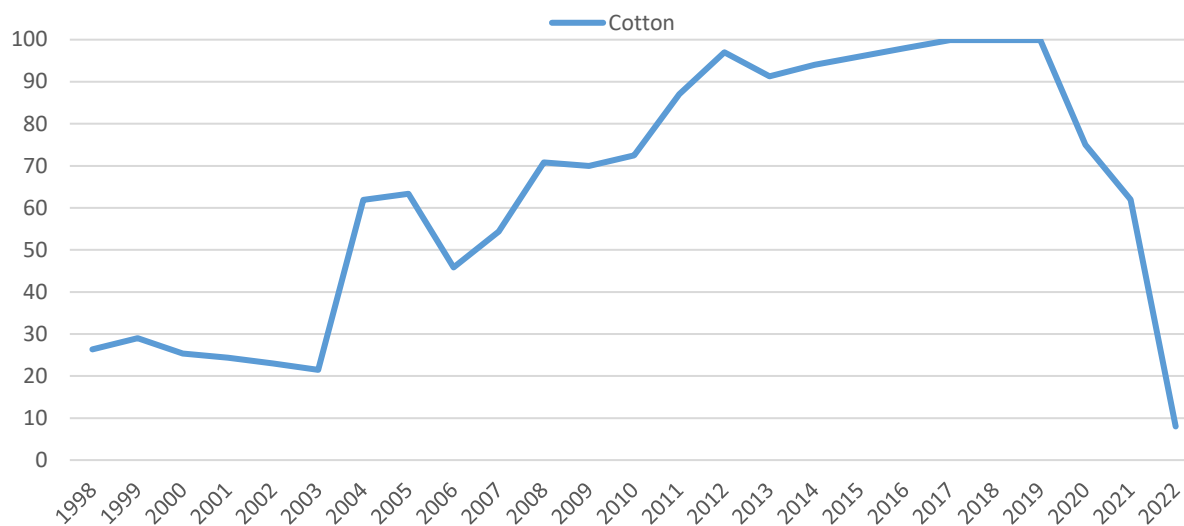
Mexico was one of the first countries to commercialise GM cotton, as far back as 1998. While the country saw peak GM cotton areas of 171,000 hectares in 2014, from 2019 the area has significantly declined.

Mexico GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	0.016	36.8
Total	0.016	36.8

The Mexican government has taken an anti-GM and glyphosate stance, having ceased import approvals for grains containing GM traits in 2018, and phasing out the use of the herbicide glyphosate by 2024. The Mexican and US governments have recently debated Mexico's desire to restrict maize imports from the US that came from GM maize production, however, this position has softened slightly with GM derived grain only to be used only in animal feed. As part of this anti-GM standpoint, the country has also not approved any permit applications for cultivation of cotton since 2019, resulting in the reduced availability of GM cotton seeds and a significant decline in adoption rates.

Mexico GM Adoption by Crop (%)



Chile

Area in 2022: 0.00945 Ha m. (-5.9%)

GM Crops (year of introduction): NA

Chile does not cultivate GM crops commercially, however, the country allows the propagation of GM seeds for export markets. Typically, GM seed stock is imported from the USA, reproduced and multiplied, and then exported to the USA and Canada.

Chile GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Canola	0.0036	48.9
Maize	0.0046	-9.3
Soybean	0.0013	-50.3
Total	0.0095	-5.9

Asia Pacific

The total GM crop area in Asia Pacific is significantly smaller than those in the Americas at 19.4 million hectares in 2022. At present, India forms the majority (63.6%) of the region's GM planted area. At the crop level, cotton is the dominant GM crop with more than 91% of the total GM area.

Asia Pacific GM Crop Area by Country 2022

Country	GM Area (Ha m.)	% Change	% Share
India	12.4	4.8	63.6
China	2.9	-3.2	14.7
Pakistan	1.7	-10.0	8.8
Australia	1.5	74.6	7.5
Philippines	0.6	-5.2	3.3
Myanmar	0.2	-0.1	1.0
Vietnam	0.2	60.7	0.9
Bangladesh	0.0	80.9	0.2
Indonesia	0.0	17.3	0.1
Total	19.4	5.2	100.0

India

Area in 2022: 12.4 Ha m. (+4.8%)

GM Crops (year of introduction): Cotton (2002)

India cultivates the world's largest GM cotton area at 12.4 million hectares in 2022, a rise of 4.8% over the previous year. The first GM cotton varieties were commercialised in 2002, and were mainly Bollgard based varieties, however, since 2015 the country has almost exclusively cultivated varieties containing the Bollgard II trait. India does not commercially cultivate any herbicide tolerant or stacked gene varieties, instead focusing on solely insect resistance.

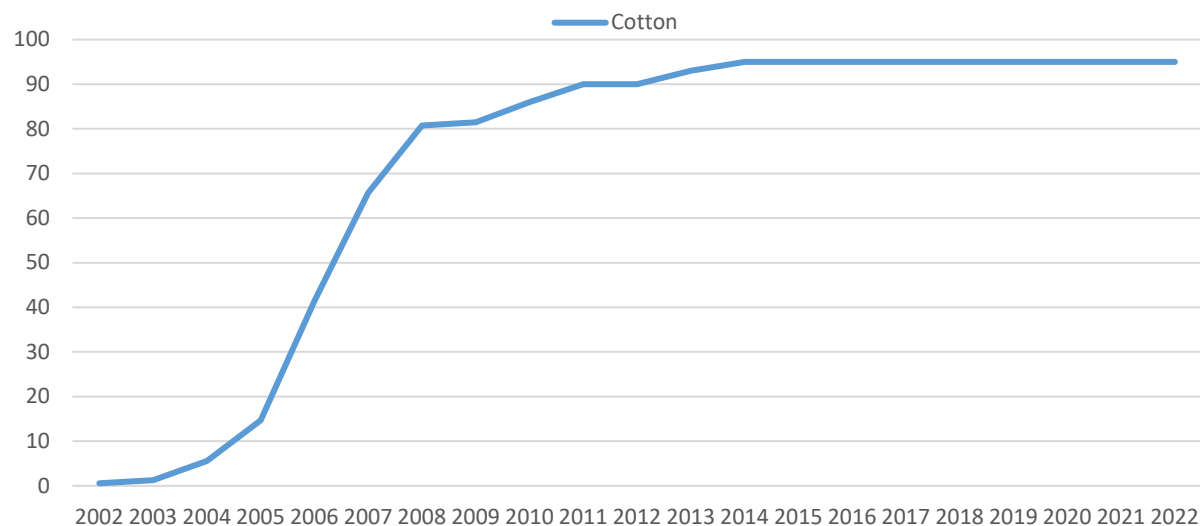
While only GM cotton has been approved for cultivation there are reports of other GM crops being cultivated illegally. Bt brinjal (aubergine/eggplant) seed reportedly arrives from Bangladesh, while herbicide tolerant soybean cultivation may be occurring several states.

India GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	12.4	4.8
Total	12.4	4.8

GM adoption rates reached +90% in the first ten years of commercialisation and have remained at 95% of the total cotton area since 2014.

India GM Adoption by Crop (%)



China

Area in 2022: 2.9 Ha m. (-3.2%)

GM Crops (year of introduction): Cotton (1998)

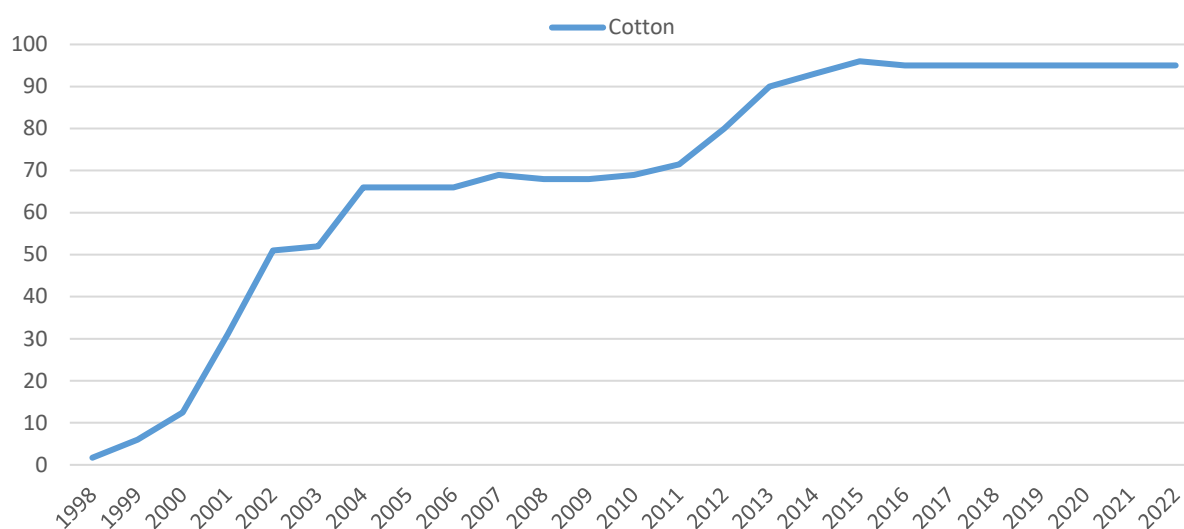
China possesses Asia's second largest GM cotton area after India. The first GM varieties were commercialised in 1998, and since 2013, adoption levels have exceeded 90% of the country's total cotton area. The total cotton area in China has gradually fallen in recent years as the Chinese government has moved to focus cotton cultivation in the west of the country. It is estimated that more than 77% of the country's GM cotton is planted with Bt varieties developed by the Chinese Academy of Agricultural Sciences (CAAS).

China GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	2.9	-3.2
Total	2.9	-3.2

Rates of adoption increased rapidly following commercialisation in 1998, however % utilisation stagnated between 2004 and 2011, before rising again and reaching its current plateau of 95% of the total cotton area.

China GM Adoption by Crop (%)



In recent years China has approved the cultivation of GM maize and soybean, with the first plantings of GM maize occurring in 2023. It is estimated that China will plant 267,000 hectares of GM maize this year, with this figure expected to grow to cover the majority of the country's ~43 million hectares of maize. Once peak adoption has been realised, it is likely that China will cultivate the world's largest GM maize area.

Pakistan

Area in 2022: 1.7 Ha m. (-10.0%)

GM Crops (year of introduction): Cotton (2010)

Pakistan planted 1.7 million hectares of GM cotton in 2022, a fall of 10.0% from the previous year. The area fell as a result of the impact of flooding.

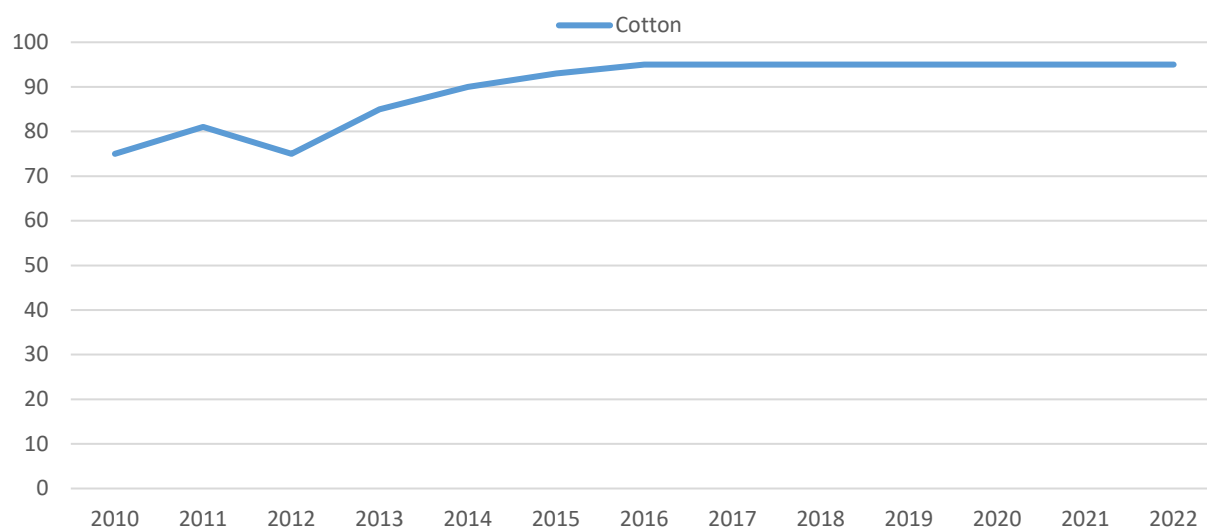
Pakistan GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	1.7	-10.0
Total	1.7	-10.0

Pakistan does not cultivate any varieties possessing herbicide tolerance, instead planting those with only insect resistance. The majority of the GM area is planted Bollgard varieties with a single insect resistance gene, although some dual gene varieties have been developed by the Centre of Excellence in Molecular Biology, University of the Punjab (CEMB). Seed companies are reportedly reluctant to commercialise new GM technology in the country due to lack of IP protection and regulatory uncertainty, leading to technology stagnation.

GM cotton was first launched in 2010, instantly attaining high adoption rates. Since 2016, GM adoption has remained approximately 95% of the country's total cotton area.

Pakistan GM Adoption by Crop (%)



Australia

Area in 2022: 1.5 Ha m. (+74.6%)

GM Crops (year of introduction): Canola (2008), Cotton (1996)

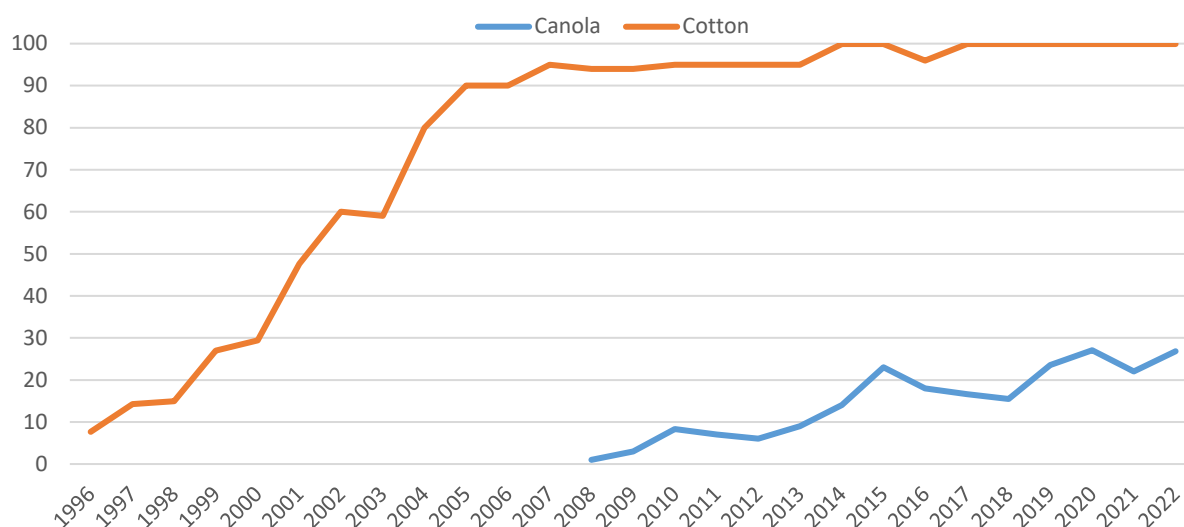
Australia planted 1.5 million hectares of GM crops in 2022, with 56.6% planted with canola. However, in 2022 the GM cotton area more than doubled.

Australia GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Canola	0.8	53.1
Cotton	0.6	113.7
Total	1.5	74.6

Australia planted its first GM canola products in 2008 following the lifting of cultivation restrictions in New South Wales and Victoria. This was followed in 2010 by Western Australia and 2020 by South Australia. Western Australia now represents the state with the largest GM canola area, with over 70% of the country's total GM canola area. In the 14 years since first commercialisation, national adoption has remained below 30%, primarily due to the competition from the high utilisation of non-GM herbicide tolerant technologies such as Clearfield (imidazolinone tolerance).

Australia GM Adoption by Crop (%)



Almost the entire Australian cotton area is planted with GM varieties, with 99.9% adoption effectively since 2014. Bayer's Bollgard 3 XtendFlex forms the majority of the GM planted area, with the remainder planted with Roundup Ready and Liberty Link varieties.

Philippines

Area in 2022: 0.64 Ha m. (-5.2%)

GM Crops (year of introduction): Maize (2004), Rice (2022)

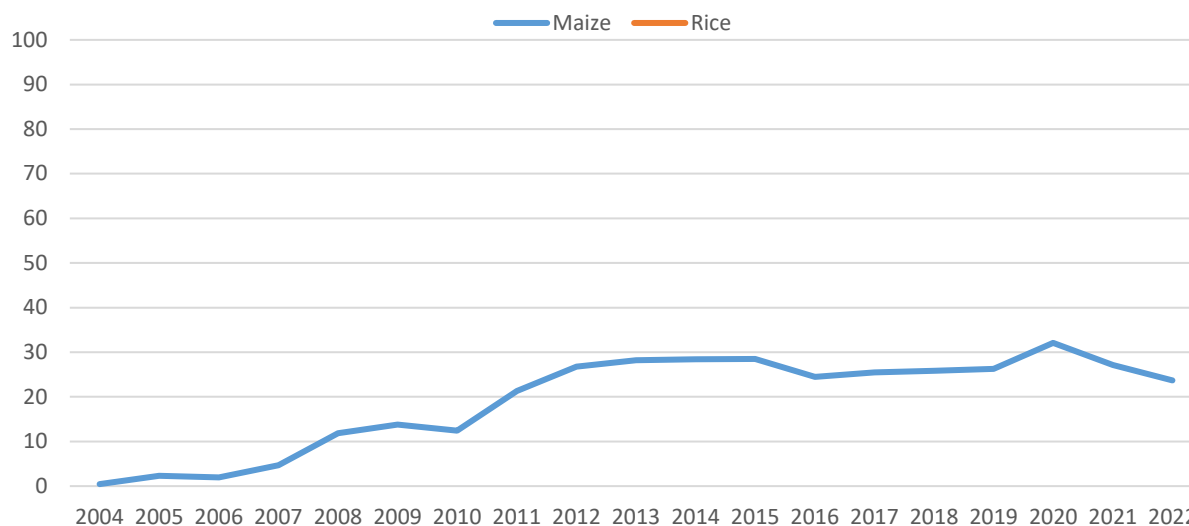
The planted area of GM crops in the Philippines declined by 5.2% in 2022 as a result of a fall in the country's total maize area and a decline in % utilisation of GM maize varieties. However, this fall in area was partially offset by the first plantings of GM rice. In 2022, GM brinjal (aubergine/eggplant) was approved for cultivation, however, no commercial planting has yet occurred.

Philippines GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Maize	0.61	-10.9
Rice	0.04	Na
Total	0.64	-5.2

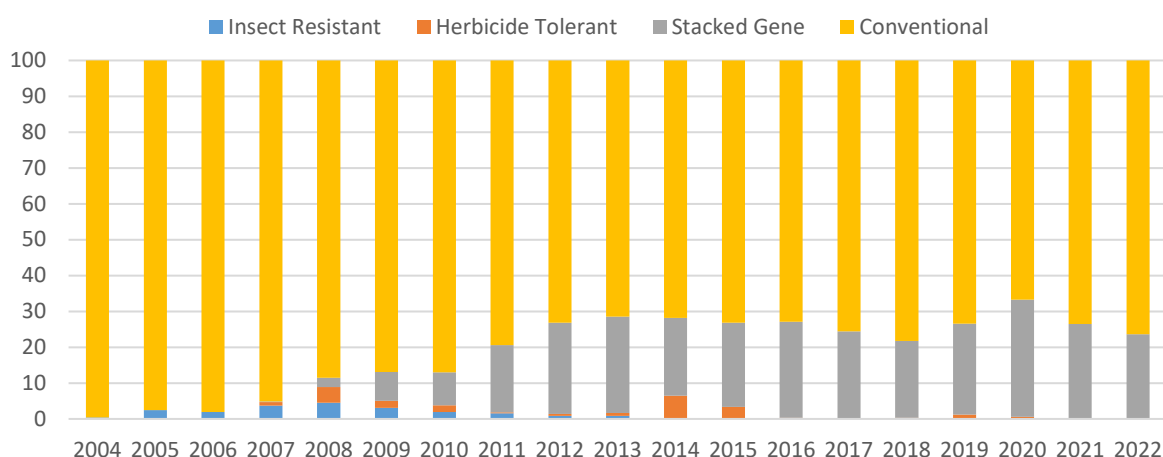
The first GM rice variety in the world to be commercialised was Golden Rice in the Philippines in 2022. Golden Rice possesses elevated levels of beta-carotene, a precursor of vitamin A, through the expression of *crt1* and *psy1* genes. Golden rice was developed by the International Rice Research Institute (IRRI) and deployed on 38,000 hectares (seed production and commercial harvest) in its first year of cultivation. At this level, Golden Rice was planted on only 0.8% of the country's total rice area.

Philippines GM Adoption by Crop (%)



The first commercial plantings of GM maize occurred in 2004 on an initial area of 10,000 hectares. Prior to 2007, only insect resistant varieties were cultivated, however, in that year the first herbicide tolerant and stacked gene varieties were planted. Since 2007, stacked gene varieties have become the dominant GM technology, covering more than 99% of the GM area in 2022. To date, GM maize adoption rates typically remain below 30%, with 2020 being the only year where adoption was above this level.

Philippines Total Maize Area by Technology (%)



Myanmar

Area in 2022: 0.18 Ha m. (-0.1%)

GM Crops (year of introduction): Cotton (2006)

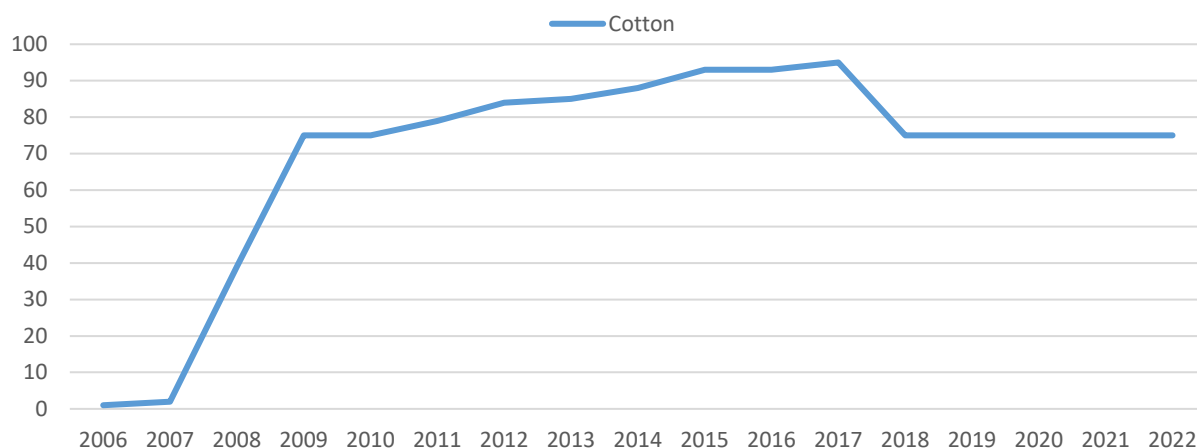
Myanmar cultivated GM cotton, its only approved GM crop, on 183,750 hectares in 2022. The country only cultivates insect resistant varieties, typically those developed locally, with the remainder of the area planted with varieties sourced from India.

Myanmar GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	0.18	-0.1
Total	0.18	-0.1

Adoption rates of GM cotton peaked in 2017 when the crop represented 95% of the country's total cotton area. However, since that time % utilisation has fallen to a new plateau of 75%.

Burma GM Adoption by Crop (%)



Vietnam

Area in 2022: 0.18 Ha m. (+60.7%)

GM Crops (year of introduction): Maize (2015)

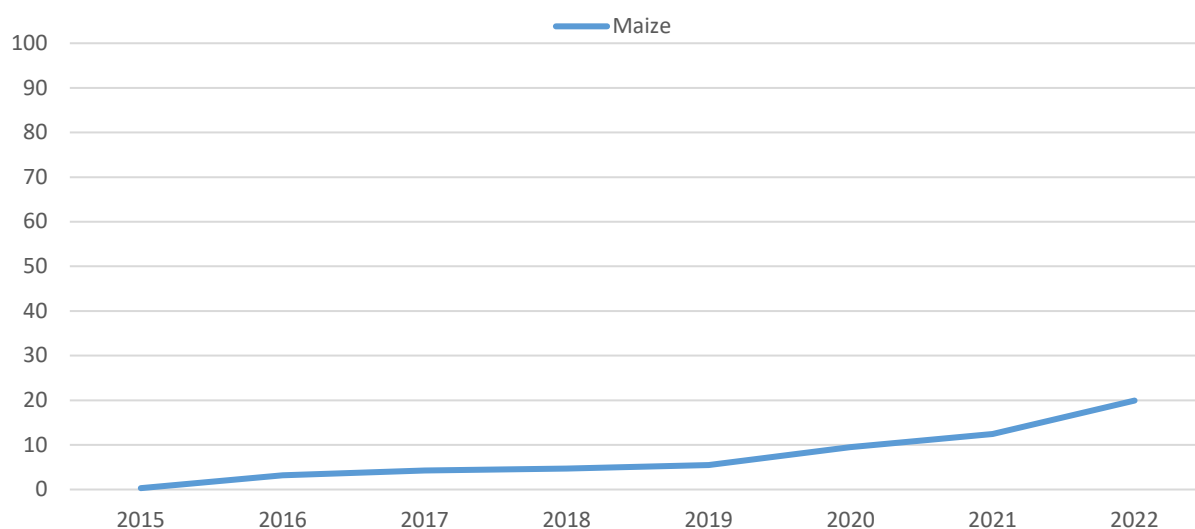
Vietnam planted a record GM maize area in 2022, at 180,000 hectares, representing 19.9% of the country's total maize area. The majority of the GM maize area is planted with stacked gene varieties.

Vietnam GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Maize	0.18	60.7
Total	0.18	60.7

Since first introduction in 2015, the adoption of GM maize varieties has steadily increased to reach almost 20% of the country's overall maize area. The rate of adoption increase has been exacerbated by a reduction in the overall maize planted area, falling from 1.18 million hectares in 2015 to 0.9 million hectares in 2022. In addition, adoption of GM varieties has been stifled by the 2021 ban on the use of glyphosate, a key component of the Round Ready cropping system.

Vietnam GM Adoption by Crop (%)



Bangladesh

Area in 2022: 0.03 Ha m. (+80.9%)

GM Crops (year of introduction): Brinjal (2014)

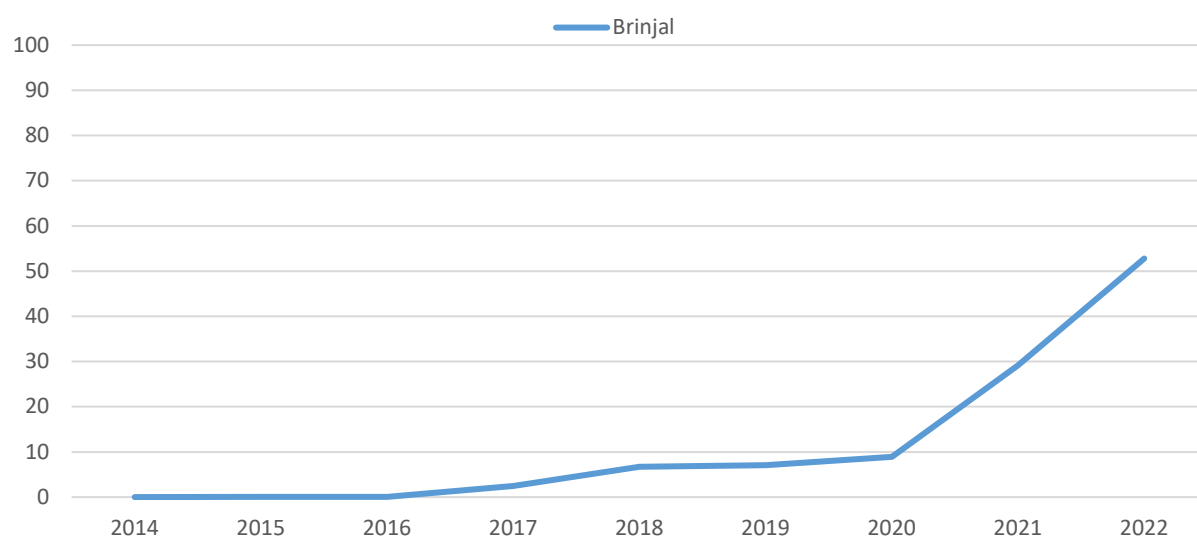
Bangladesh first planted GM varieties of brinjal in 2014. The crop possesses insect resistance to protect against crop damage by pests such as the Brinjal Fruit and Shoot Borer (*Leucinodes orbonalis*). It was reported that over 65,000 farmers in the country planted GM brinjal in 2022 on an area of 28,200 hectares, a rise of approximately 12,600 hectares (+80.9%) over the previous year.

Bangladesh GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Brinjal	0.03	80.9
Total	0.03	80.9

GM Brinjal was first commercialised in 2015, however, until 2020 adoption rates were below 10% of the total brinjal area. It was not until 2021 that adoption rates gained momentum and increased to 29.2%, with this rate of adoption growth continuing into 2022, when GM brinjal represented 52.8% of the total area.

Bangladesh GM Adoption by Crop (%)



Indonesia

Area in 2022: 0.02 Ha m. (+17.3%)

GM Crops (year of introduction): Maize (2022), Sugarcane (2019)

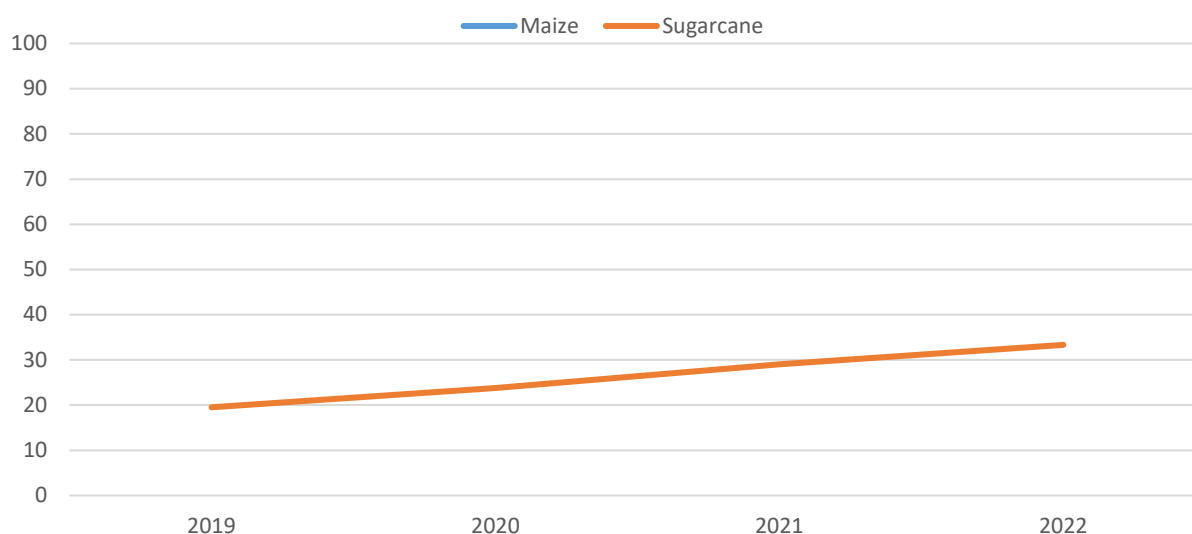
Indonesia is a recent adopter of GM crop technology having commercialised its first GM sugarcane variety in 2019 and GM maize in 2022. GM potato was authorised for cultivation in 2018, however, to date no commercial plantings have taken place.

Indonesia GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Maize	0.00025	Na
Sugarcane	0.01500	15.4
Total	0.01525	17.3

GM sugarcane in Indonesia was developed by the state-owned sugar plantation company PT Perkebunan Nusantara. The crop utilises either the EcBetA or RmBetA gene to promote drought tolerance. A driver of area development in 2022 was the certification of GM sugarcane for general commercialisation.

Indonesia GM Adoption by Crop (%)



Utilisation of GM maize is low at 0.01% of the country's total maize area in 2022, its first year of cultivation. It is reported that Bayer and Syngenta are preparing to locally produce F1 hybrids for cultivation beyond 2023 as the Ministry of Agriculture prohibits the importation of F1 seeds.

Europe

At the regional level, Europe holds the world's smallest GM area at only 71,112 hectares in 2022. The majority of this area is in Spain, where 95.1% of the regions GM maize is cultivated. Historically, a number of European countries cultivated GM maize, however, only Spain and Portugal remain.

Historical European Cultivators of GM Maize

Country	First Planting	Final Planting
Czech Republic	2005	2016
France	2004	2008
Germany	2004	2008
Poland	2006	2012
Romania	3007	2015
Slovakia	2006	2016

Europe GM Crop Area by Country 2022

Country	GM Area (Ha m.)	% Change	% Share
Spain	0.0676	-30.0	95.1
Portugal	0.0035	-18.8	4.9
Total	0.0711	-29.5	100.0

Spain

Area in 2022: 0.0676 Ha m. (-30.0%)

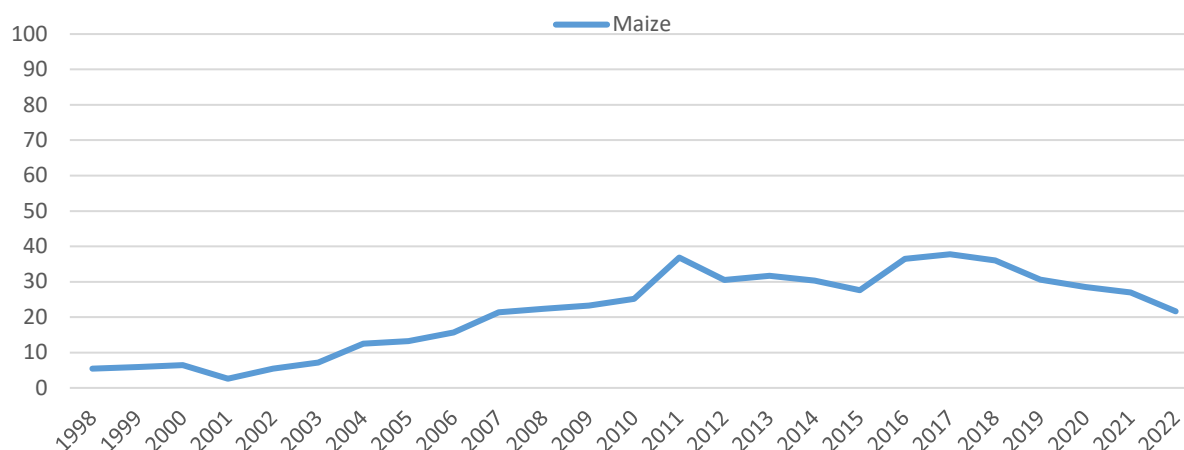
GM Crops (year of introduction): Maize (1998)

Spain first planted GM maize in 1998, predominantly in Ebro River basin (autonomous regions of Aragon, Catalonia, and Navarra), where European Corn Borer pressure is elevated. Spain cultivates only insect resistant varieties that possess the MON 810 genetic event.

Spain GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Maize	0.0676	-30.0
Total	0.0676	-30.0

Spain GM Adoption by Crop (%)



Portugal

Area in 2022: 0.0035 Ha m. (-18.8%)

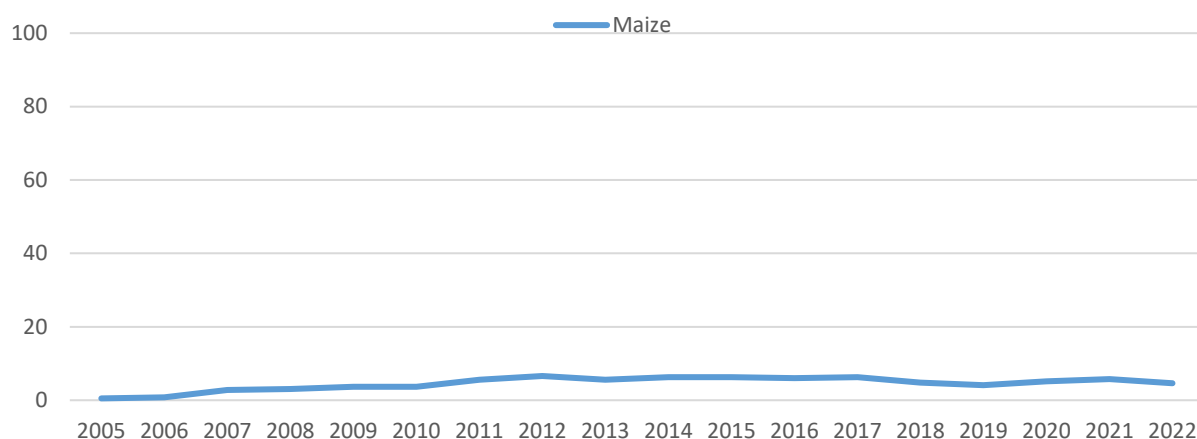
GM Crops (year of introduction): Maize (2005)

In a similar situation to Spain, Portugal only cultivates varieties of GM maize that contain the MON 810 insect resistance genetic event. GM maize cultivation is focussed in the region of Alentejo in the county's centre-south, where approximately 60% of the GM area occurs. First plantings of GM maize in Portugal took place in 2005, and since that time adoption rates have not significantly increased. In 2022, only 4.7% of the country's total maize area was planted with GM varieties.

Portugal GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Maize	0.0035	-18.8
Total	0.0035	-18.8

Portugal GM Adoption by Crop (%)



Rest of World

The rest of world region planted 3.4 million hectares of GM crops in 2022, a rise of 8.4% over the previous year. South Africa is the driver of the region's GM cultivation as it represents more than 90% of the GM planted area. From 2008 to 2015, Burkina Faso cultivated GM cotton, however, plantings ended as it was reported that the varieties containing GM traits were not yielding enough. Since 2012 other countries in the region have begun GM crop cultivation and Africa now represents a region of GM cultivation potential.

Rest of World GM Crop Area by Country 2022			
Country	GM Area (Ha m.)	% Change	% Share
South Africa	3.195	8.8	93.3
Sudan	0.216	0.0	6.3
Ethiopia	0.009	25.4	0.3
Kenya	0.004	663.6	0.1
Total	3.424	8.4	100.0

South Africa

Area in 2022: 3.195 Ha m. (+8.8%)

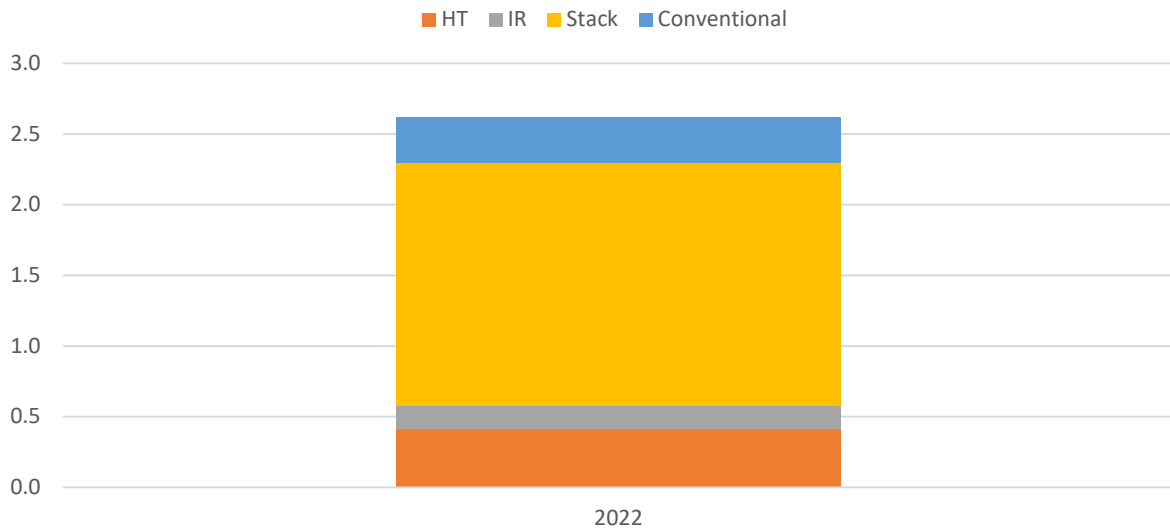
GM Crops (year of introduction): Cotton (1997), Maize (1999), Soybean (2001)

South Africa possesses the world's 7th largest GM crop area at 3.2 million hectares in 2022. Within this, maize forms the bulk of the country's GM area, 72.0% of South Africa's total.

South Africa GM Crop Area 2022		
Year	GM Area (Ha m.)	% Change
Cotton	0.02	1.1
Maize	2.3	7.8
Soybean	0.9	11.8
Total	3.2	8.8

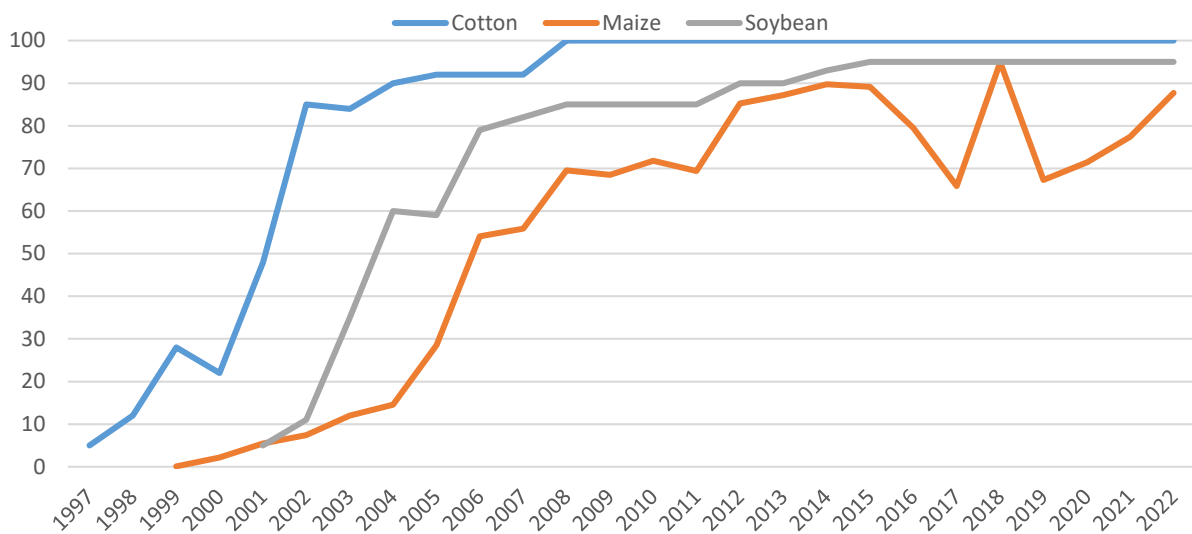
GM maize was first planted in 1999 on an initial 0.1% of the country's total maize area. It was not until 2019 that adoption rates exceeded 90%, but since that time % utilisation has marginally declined to 87.7% in 2022. 65.8% of the country's total maize area is planted with stacked gene varieties, with solely herbicide tolerant varieties forming the next largest group with 15.8% of the total area. Conventional varieties that do not possess any GM traits represent approximately 12.3% of the total area, while solely insect resistant varieties are planted on roughly 6.1% of the country's total maize area.

South Africa Total Maize Area by Technology (%)



GM soybean was first cultivated in South Africa in 2001. In the 20 years since commercialisation, GM plantings now represent 95.0% of the country's total soybean area. In 2022, almost 0.9 million hectares of GM soybean was cultivated, a rise of 11.8% over the previous year. The GM area is exclusively planted with Roundup Ready (glyphosate tolerant) varieties.

South Africa GM Adoption by Crop (%)



GM cotton was planted on a small area in South Africa at 0.02 million hectares in 2022, an increase of 1.1% over the previous year. GM Cotton was introduced in 1997 when solely insect resistant varieties were utilised, however in 2022 stacked gene varieties formed the majority of the total cotton area at approximately 90%.

Sudan

Area in 2022: 0.216 Ha m. (0.0%)

GM Crops (year of introduction): Cotton (2012)

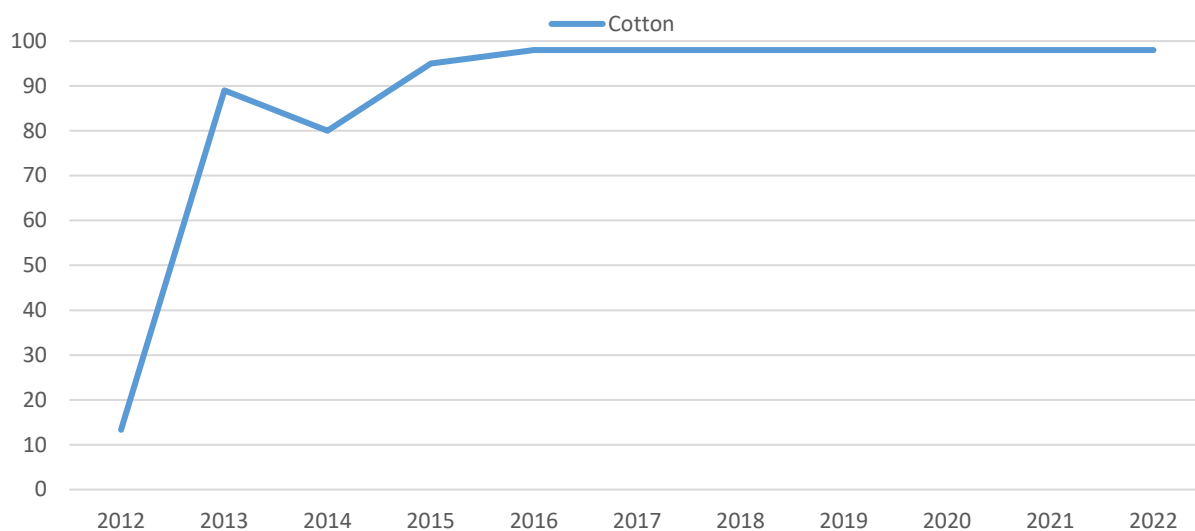
Sudan has only cultivated GM cotton for the past 10 years. During which adoption rates have increased to reach 98.0% of the country's total cotton area. During the first year of commercialisation, % utilisation was 13.3%, however, this quickly jumped to 98% within four years.

Sudan GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	0.2160	0.0
Total	0.2160	0.0

The Sudan GM cotton area is planted with solely insect resistant varieties, typically containing Bayer's Bollgard trait.

Sudan GM Adoption by Crop (%)



Ethiopia

Area in 2022: 0.0089 Ha m. (+25.4%)

GM Crops (year of introduction): Cotton (2012)

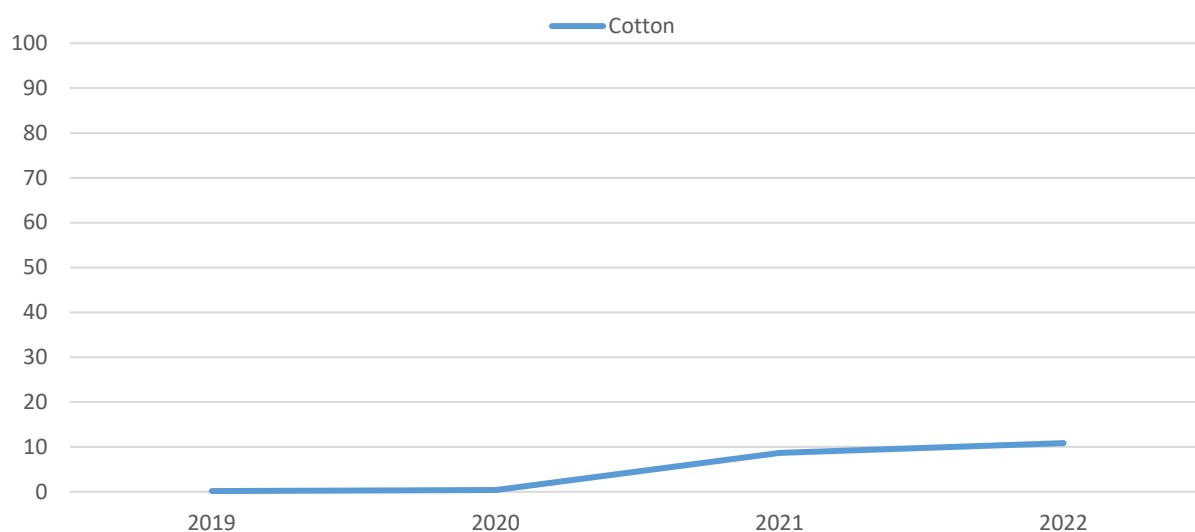
Ethiopia has only recently begun the cultivation of GM cotton, with first plantings occurring in 2019. Despite the large percentage increase in 2022, GM plantings were only 8,900 hectares, representing 10.9% of the country's total cotton area. The Ethiopian government authorised the use of seeds sourced from India, typically JK Agri Genetics, however, since that time there has reportedly been greater use of seeds purchased from uncertified sources on the Ethiopian border.

Ethiopia GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	0.0089	25.4
Total	0.0089	25.4

In a similar situation to Sudan, Ethiopia's GM cotton area is planted with solely insect resistant varieties.

Ethiopia GM Adoption by Crop (%)



Kenya

Area in 2022: 0.004 Ha m. (+663.6%)

GM Crops (year of introduction): Cotton (2020)

Kenya planted its first commercial varieties of GM cotton in 2020. In the two years since plantings have increased to 4,000 hectares, representing 21.3% of Kenya's total cotton area in 2022. Kenya's government has signalled that it plans to increase the level of cultivation to over 16 million hectares by 2024.

Kenya GM Crop Area 2022

Year	GM Area (Ha m.)	% Change
Cotton	0.004	663.6
Total	0.004	663.6

Nigeria

Nigeria has begun the cultivation of GM cotton and cowpea. However, GM cotton is still reportedly in its trial phase, while GM cowpea began commercial plantings in 2022. Data from Nigeria is presently difficult to attain and AgbioInvestor is progressing with gaining this data.

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