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INTERNATIONAL SERVICE FOR THE ACQUISITION OF AGRI-BIOTECH APPLICATIONS

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BRIEF 55

EXECUTIVE SUMMARY

GLOBAL STATUS OF COMMERCIALIZED BIOTECH/GM CROPS IN 2019:

Biotech Crops Drive Socio-Economic Development and Sustainable Environment in the New Frontier



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No. 55 – 2019

ISAAA prepares this Brief to provide information and knowledge to the scientific community and society on biotech/GM crops to facilitate a more informed and transparent discussion regarding their potential role in contributing to global food, feed, fiber and fuel security, and a more sustainable agriculture. ISAAA takes full responsibility for the views expressed in this publication and for any errors of omission or misinterpretation.

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EXECUTIVE SUMMARY

Global Status of Commercialized Biotech/GM Crops in 2019:
Biotech Crops Drive Socio-Economic Development and Sustainable Environment in the New Frontier

Table of Contents

Introduction 1

Highlights of the 2019 Adoption of Biotech Crops 2

- Adoption of biotech crops declined slightly in 2019 at 190.4 million hectares worldwide. 2
- The adoption rates of the top five biotech crop-growing countries reached close to saturation. 2
- Biotech crops increased ~112-fold from 1996, with an accumulated biotech area of 2.7 billion hectares making biotechnology the fastest adopted crop technology in the world. 2
- A total of 71 countries adopted biotech crops – 29 countries planted and 42 additional countries imported. 2
- Biotech soybeans covered 48% of the global biotech crop area. 3
- Biotech crops provided more diverse offerings to consumers in 2019. 3
- Stacked IR/HT traits increased by 6%, occupied 45% of the global biotech crop area, and surpassed the area planted to herbicide tolerant traits. 3
- The top five countries (USA, Brazil, Argentina, Canada, and India) planted 91% of the global biotech crop area of 190.4 million hectares. 3
- Ten countries in Latin America grew 83.9 million hectares of biotech crops. 7
- Nine countries in Asia and the Pacific grew 19.5 million hectares of biotech crops 8
- Africa had a 100% increase in biotech crop planting-countries. 9
- Two countries in the European Union continued to plant biotech maize at 111,883 hectares 9

Status of Approved Events for Biotech Crops Used in Food, Feed, Processing, and Cultivation 10

Contribution of Biotech Crops to Food Security, Sustainability, and Climate Change Solutions 10

Economic Gains from Biotech Crops Reached US$225 billion from 1996 to 2018 11

Conclusion 12

Global Status of Commercialized/Biotech GM Crops in 2019:
Biotech Crops Drive Socio-Economic Development and Sustainable Environment in the New Frontier

INTRODUCTION

Safeguarding food security and nutrition is critical in order for countries to overcome problems of hunger and malnutrition. The United Nations estimates that the interplay of current various challenges of high population rate, political instability, degradation of natural resources, forced migration (from farms to urban communities), and the ongoing COVID-19 pandemic will make a significant impact on food security that could raise the hunger and malnutrition problems globally. Actions to be undertaken should be bolder and stronger in terms of multisectoral collaboration involving agriculture, food, health, water and sanitation, accompanied by policy domains on social protection, development planning, and economic policy.

Socio-economic benefits of biotech crops have been documented in the last 23 years (1996-2018) showing that biotech crops have contributed to:

- increasing productivity that contributes to global food, feed, and fiber security;
- supporting self-sufficiency on a nation's arable land;
- conserving biodiversity, precluding deforestation and protecting biodiversity sanctuaries;
- mitigating the challenges associated with climate change; and
- improving economic, health, and social benefits.

These economic benefits, health improvement, and social gains obtained through biotech crop adoption must be made known to the global community so that farmers and consumers can make informed choices on what crops to grow and consume, respectively; to the policymakers and regulators to craft enabling biosafety guidelines for commercialization and adoption of biotech crops; and to the science communicators and the media to facilitate correct and effective dissemination of the benefits and potentials of the technology.

The International Service for the Acquisition of Agri-biotech Applications (ISAAA) strongly espouses the scientific truths behind them with the publication of ISAAA review of biotech/GM crop commercialization, Brief 55. This publication documents the latest information on the subject, the global database on the adoption and distribution of biotech crops since the first year of commercialization in 1996, country situations, and future prospects of the technology. Termed



as the ISAAA Briefs, the annual reports from 1997 to 2015 were authored by Dr. Clive James, and the 1996 report was co-authored with Dr. Anatole Krattiger.

ISAAA dedicates this Brief to Dr. Clive James, Founder and Emeritus Chair of ISAAA, who has painstakingly authored the 20 Annual Reports making it the most credible source of information on biotech crops in the last two decades. We also dedicate this Brief to the late Dr. Randy A. Hautea, former Global Coordinator and *SEAsia*Center Director for more than two decades. They have been great advocates of biotechnology and biotech products and believe that ISAAA can make a difference in enhancing the knowledge and capacities of the global community in order to benefit from the technology, especially the poor and marginalized people of the world.

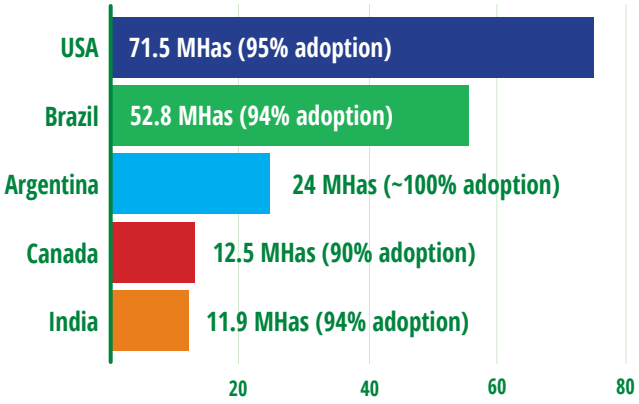
HIGHLIGHTS OF THE 2019 ADOPTION OF BIOTECH CROPS

- **Adoption of biotech crops declined slightly in 2019 at 190.4 million hectares worldwide.**

In the 24th year of commercialization of biotech/GM crops in 2019, 29 countries grew 190.4 million hectares of biotech crops – a slight decline of 1.3 million hectares (3.2 million acres) or 0.7% from 191.7 million hectares in 2018.

- **The adoption rates of the top five biotech crop-growing countries reached close to saturation.**

The average biotech crop adoption rate in the top five biotech crop-growing countries increased anew in 2019 to reach close to saturation, with the USA at 95% (average for soybeans, maize, and canola adoption), Brazil (94%), Argentina (~100%), Canada (90%), and India (94%). Expansion of biotech crop areas in these countries would be through immediate approval and commercialization of new biotech crops and traits for increased production of nutritious food, mitigate problems related to climate change accompanied with the emergence of new pests and diseases.



TOP 5 COUNTRIES THAT PLANTED BIOTECH CROPS IN 2019 (AREA AND ADOPTION RATE)

Source: ISAAA, 2019

- **Biotech crops increased ~112-fold from 1996, with an accumulated biotech area of 2.7 billion hectares making biotechnology the fastest adopted crop technology in the world.**

The global area of biotech crops has increased ~112-fold from 1.7 million hectares in 1996 to 190.4 million hectares in 2019 – this makes biotech crops the fastest adopted crop technology in recent times. An accumulated 2.7 billion hectares or 6.7 billion acres were achieved in 24 years (1996-2019) of biotech crop commercialization.

- **A total of 71 countries adopted biotech crops – 29 countries planted and 42 additional countries imported.**

The 190.4 million hectares of biotech crops were grown by 29 countries – 24 developing and 5 industrial countries. Developing countries grew 56% of the global biotech crop area compared to 44% for industrial countries. An additional 42 countries (16 plus 26 EU countries) imported

biotech crops for food, feed, and processing. Thus, a total of 71 countries have adopted biotech crops.

- **Biotech soybeans covered 48% of the global biotech crop area.**

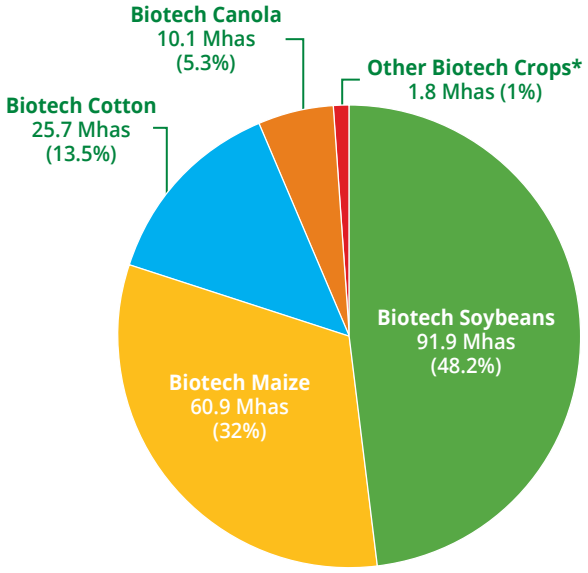
The most adopted biotech crops by the 29 countries were soybeans, maize, cotton, and canola. Soybean was the leading biotech crop with 91.9 million hectares that occupied 48% of the global biotech crop area, with a 4% reduction from 2018. This is followed by maize (60.9 million hectares), cotton (25.7 million hectares), and canola (10.1 million hectares). Based on the global crop area for individual crops, 79% of cotton, 74% of soybeans, 31% of maize, and 27% of canola were biotech crops in 2019.

- **Biotech crops provided more diverse offerings to consumers in 2019.**

Biotech crops have expanded beyond the big four (maize, soybeans, cotton, and canola) to give more choices for many of the world's consumers and food producers. These biotech crops include alfalfa (1.3 million hectares), sugar beets (473,000 hectares), sugarcane (20,000 hectares), papaya (12,000 hectares), safflower (3,500 hectares), potatoes (2,265 hectares), eggplant (1,931 hectares), and less than 1,000 hectares of squash, apples, and pineapple. Additionally, biotech crop researches conducted by public sector institutions involve rice, banana, potato, wheat, chickpea, pigeon pea, and mustard with various economically-important and nutritional quality traits beneficial to food producers and consumers in developing countries.

- **Stacked IR/HT traits increased by 6%, occupied 45% of the global biotech crop area, and surpassed the area planted to herbicide tolerant traits.**

Stacked traits with insect resistance and herbicide tolerance increased by 6% equivalent to 85.1 million hectares and covered 45% of the global



** Biotech sugar beets, potatoes, apples, squash, papaya, and brinjal/ eggplant.*

BIOTECH CROPS IN 2019 (AREA AND ADOPTION RATE)

Source: ISAAA, 2019

area, proof of farmers' preference for smart farming with no-till and reduced insecticide use. Herbicide tolerance in soybeans, canola, maize, alfalfa, and cotton, has consistently been the dominant trait till 2018. In 2019, the area planted to herbicide tolerant crops was reduced to 81.5 million hectares or 43%. Some 12% of the global area was planted to insect tolerant traits. New traits approved for 2019 for import and/or cultivation include: the stacked IR/HT/ HT cotton with glyphosate and isofluxatole, IR/ pyramided HT (glyphosate, glufosinate, dicamba, 2,4-D) and intermediates in maize, IR pyramided (for coleopteran, hemipteran, and lepidopteran)/ HT (glyphosate, glufosinate) and intermediates in maize, salt tolerant and herbicide tolerant soybeans, and insect resistant sugarcane, all in Brazil; Argentine canola with HT and modified oils; and low gossypol cotton in the USA.

- **The top five countries (USA, Brazil, Argentina, Canada, and India) planted 91% of the global biotech crop area of 190.4 million hectares.**

Table 1. Global Area of Biotech Crops in 2019: by Country (Million Hectares)**

Rank	Country	Area (Million Hectares)	Biotech Crops
1	USA*	71.5	Maize, soybeans, cotton, alfalfa, canola, sugar beets, potatoes, papaya, squash, apples
2	Brazil*	52.8	Soybeans, maize, cotton, sugarcane
3	Argentina*	24.0	Soybeans, maize, cotton, alfalfa
4	Canada*	12.5	Canola, soybeans, maize, sugar beets, alfalfa, potatoes
5	India*	11.9	Cotton
6	Paraguay*	4.1	Soybeans, maize, cotton
7	China*	3.2	Cotton, papaya
8	South Africa*	2.7	Maize, soybeans, cotton
9	Pakistan*	2.5	Cotton
10	Bolivia*	1.4	Soybeans
11	Uruguay*	1.2	Soybeans, maize
12	Philippines*	0.9	Maize
13	Australia*	0.6	Coton, canola, safflower
14	Myanmar*	0.3	Cotton
15	Sudan*	0.2	Cotton
16	Mexico*	0.2	Cotton
17	Spain*	0.1	Maize
18	Colombia*	0.1	Maize, cotton
19	Vietnam*	0.1	Maize
20	Honduras*	<0.1	Maize
21	Chile	<0.1	Maize, canola
22	Malawi	<0.1	Cotton
23	Portugal	<0.1	Maize
24	Indonesia	<0.1	Sugarcane
25	Bangladesh	<0.1	Brinjal/Eggplant
26	Nigeria	<0.1	Cotton
27	Eswatini	<0.1	Cotton
28	Ethiopia	<0.1	Cotton
29	Costa Rica	<0.1	Cotton, pineapple
	Total	**190.4**	

*19 biotech mega-countries growing 50,000 hectares, or more, of biotech crops
**Rounded-off to the nearest hundred thousand.

Source: ISAAA, 2019



Figure 1. Global Map of Biotech Crop Countries and Mega-Countries in 2019

The USA led the biotech crop planting in 2019 at 71.5 million hectares, followed by Brazil (52.8 million hectares), Argentina (24 million hectares), Canada (12.5 million hectares), and India (11.9 million hectares) (Table 1) for a total of 172.7 million hectares, representing 91% of the global area. Thus, biotechnology benefited more than 1.95 billion people in the 5 countries or 26% of the current world population of 7.6 billion.

The US reached an average 95% adoption rate for planting biotech soybeans, maize, and cotton

In 2019, the biotech area in the USA was 71.5 million hectares, covering 38% of the global biotech area, with an average adoption rate of 94% for principal crops, similar to 2018. Biotech crops planted were soybeans (30.43 million hectares, a 3.6 million hectare reduction from 2018), maize (33.17 million hectares), cotton (5.31 million hectares), canola (800,000 hectares), sugar beets (454,100 hectares), alfalfa (1.28 million hectares), potatoes (1,780 hectares), some 1,000 hectares each of papaya and squash, and 265 hectares apples.



In 2019, the US planted 33.17 million hectares biotech maize.

New approvals for biotech crops and traits in the US include USDA commercialization approval for Argentina's HB4 drought tolerant soybeans, following approvals in Argentina in 2018 and Brazil in 2019. Biotech cotton with low gossypol content event TAM66274 received a non-regulated status from USDA APHIS and an FDA approval in 2019, for commercialization and use for human food and animal feed within the USA. Another variety of apple, Arctic®Gala with non-browning trait was approved for commercialization. The non-browning trait has also been successfully introduced to GreenVenus™ Romaine lettuce by Intrexon.

Brazil expanded biotech crop area to reach 52.8 million hectares

Brazil maintains its standing as the second country, after the USA, with the largest biotech crop area planted in 2019. The 52.8 million hectares of biotech crops include 35.1 million hectares soybeans (surpassing the US biotech soybean for the first time), 16.3 million hectares maize, 1.4 million hectares cotton, and some 18,000 hectares insect resistant sugarcane. The 52.8 million hectares was an increase of ~1.6 million hectares or 3% in 2019, at an adoption rate of 94% (1% higher than 2018). Brazil has systematized the process for GM authorization. The procedures were modernized and increased the deadline for decisions by CNTBio. This will allow applicants to submit any additional information on new data to ensure that application complies with the new conditions.

Argentina maintains 100% adoption rate of biotech crops

Argentina ranked third in the top ten countries planting biotech crops in 2019. A minimal increase of 110,000 hectares of biotech crops were planted in Argentina in 2019 at 23.9 (24) million hectares, compared to 23.8 million hectares in 2018 which is 13% of the global total of 190.4

million hectares. The biotech crop area consisted of 17.5 million hectares soybeans, 5.9 million hectares maize, 485,000 hectares cotton, and more than 1,000 hectares of biotech alfalfa (planted for the first time in Argentina), at an average adoption rate of close to 100%. The Argentinian government through the Argentine National Advisory Committee on Agricultural Biotechnology (CONABIA) approved nine biotech applications in 2019: six maize events, two cotton events, and one soybean event. A wheat event containing the HB4 gene that confers drought resistance received full technical approval but awaits commercial approval by the National Direction of Agricultural Food Markets (DNMA) under the Ministry of Agro-Industry.

Canada had a 23% increase in biotech sugar beets area

Biotech crop area in Canada declined slightly in 2019 by ~2% from 12.75 million hectares in 2018 to 12.46 million hectares due to reduction in planted areas of total and biotech soybeans. The decrease in soybean area was due to the unstable weather conditions during the planting season. Areas planted to biotech maize, canola, and alfalfa had marginal increases, while sugar beets reached its highest increase of 23%. Innate® potato was planted in only 40 hectares in 2019. The average adoption rate of 90% in 2019 was a decrease of 2% from 2018. New and upcoming biotech crops and events in Canada include: (a) Roundup Ready tolerant Truflex™ canola launched on 404,000 hectares; and (b) approval of two varieties of high oleic acid soybeans. Biotech Golden Rice with provitamin A Event GR2E was given approval by Health Canada (HC) in 2019. This decision coincides with the approval from Food Standards Australia New Zealand (FSANZ) in 2017. The Canadian Food Inspection Agency (CFIA) and HC approved the use for feedstock of one Bayer CropScience cotton product.

India hit 94% adoption rate of IR (Bt) cotton

The IR (Bt) cotton adoption rate in India has almost stabilized in the past five years at more or less



Argentina planted biotech alfalfa for the first time in 2019.

95%. The 94% adoption rate in 2019 by more than 6 million farmers who planted 11.9 million hectares of biotech cotton reflects the continuing confidence of the farmers and the benefits they obtain from the technology. Thus, they are in need of other biotech crops that will provide them profit and help improve their living status. This caused some farmer groups to plant unauthorized stacked trait IR(Bt)/HT cotton in major cotton growing areas in Central and Southern zones in Kharif 2017 and numerous protests to push for the approval of the stacked trait cotton event. In addition, the widening spread of fall armyworm infestations prompted the government to strategize on its control, which can be solved by pyramided insect resistant crops.

- **Ten countries in Latin America grew 83.9 million hectares of biotech crops.**

Ten countries in Latin America planted biotech crops in 2019 including Brazil (52.8 million hectares), Argentina (24 million hectares), Paraguay (4.1 million hectares), Bolivia (1.4 million hectares), Uruguay (1.2 million hectares),



In 2019, 18 countries planted biotech cotton including USA, Brazil, Argentina, India, Paraguay, China, South Africa, Pakistan, Australia, Myanmar, Sudan, Mexico, Colombia, Malawi, Nigeria, Eswatini, Ethiopia, and Costa Rica.

Mexico (223,000 hectares), Colombia (101,188 hectares), Chile (41,093 hectares), Honduras (37,386), and Costa Rica (297 hectares) for a total of 83.9 million hectares, covering 44% of the 190.4 million hectare global biotech areas. The increases in biotech crop area in most of the Latin American countries compensated for the losses from the extensive drought incidence of 2017 and 2018. In addition, enabling regulations; profitability, high prices, and high market demand in the local and international market; availability of new seed technologies for maize, soybeans, and cotton; subsidized credit for farmers and foreign investments from the industry; favorable weather; and improved agronomic practices with efficient fertilizer applications encouraged the farmers in Brazil, Argentina, Paraguay, Mexico, Colombia, and Honduras to plant biotech crops. In Bolivia, the increase in biotech soybean area was due to favorable conditions in 2019, after two years of extreme drought. Moreover, the Bolivian government gave its support to soybean producers by granting the approval to cultivate two new genetically engineered soybean events to boost their biofuel production. In the future, the adoption of drought tolerant soybeans will be useful to overcome the drought incidences in the Latin American countries.

- **Nine countries in Asia and the Pacific grew 19.5 million hectares of biotech crops**

Biotech countries in the Asia and Pacific region were led by India with the largest area of biotech crops at 11.9 million hectares cotton, followed by China (3.2 million hectares cotton and papaya), Pakistan (2.5 million hectares cotton), Philippines (875,000 hectares biotech maize), Australia (614,446 hectares cotton, canola, and safflower), Myanmar (300,000 hectares cotton), Vietnam (92,000 hectares maize), Indonesia (2,000 hectares drought tolerant sugarcane), and Bangladesh (1,931 hectares eggplant). This region planted 19.5 million hectares in 2019, which indicates a 2% increase from 19.1 million hectares in 2018. This area also covered 10.2% of the 190.4 million hectares global biotech crops. The favorable global cotton price has positively impacted biotech cotton adoption in India and China, while public acceptance of clean and hazard free production of biotech eggplant motivated more farmers in Bangladesh. In Vietnam, the high price of imported maize and increasing fall army worm incidence increased the biotech maize area. The planting of drought tolerant sugarcane in Indonesia is only limited to government-owned farms, thus limiting its potential to contribute to the country's sugar industry. Australia's extended extreme drought during the growing season in 2019 affected canola and cotton (biotech and total) area. Australia's cotton planted area was the smallest on record, but the adoption rate of biotech canola went up due to better weed control and higher profit. There was a minimal decrease in Bt cotton area planted in Myanmar. New biotech cotton varieties and the approval of the new Biosafety Framework could increase the area planted in the future.

- **Africa had a 100% increase in biotech crop planting-countries.**

The African continent remains the region with the biggest potential to reap from the benefits associated with modern agricultural biotechnology. There has been increased awareness and appreciation of GM crops among African farmers in 2019. Thus, the African continent doubled the number of countries planting biotech crops from three in 2018 to six in 2019. The countries in descending order of biotech crop area were South Africa (2.7 million hectares for maize, soybeans, and cotton), IR/Bt cotton in Sudan (236,200 hectares), Malawi (6,000 hectares), Nigeria (700 hectares), Eswatini (401 hectares), and Ethiopia (311 hectares) for a total of 2.9 million hectares, 1.54% of the global biotech crop area of 190.4 million hectares. The approval of Nigeria's Bt cowpea resistant to pod borers was a major milestone in 2019. Moreover, Kenya approved the commercialization of biotech cotton in 2019 for cultivation in 2020. Other African countries continued to transition from confined field trials to the environmental release phase: Mozambique for drought tolerant maize and Kenya for Bt maize and cassava brown streak disease resistant cassava. The countries that improved their biosafety regulation to facilitate biotech crop development and adoption are Ghana and Niger. A number of countries also endorsed the trade of biotech crops and vouched for their food safety including Zambia.

- **Two countries in the European Union continued to plant biotech maize at 111,883 hectares**

The acceptance of biotech crops for cultivation in the EU has not improved in the last 24 years. Two countries planted biotech maize, because of the infestation brought by the European corn borer. Since 2016, only Spain and Portugal planted biotech Bt maize. In 2019, 107,130 hectares and 4,753 hectares were planted by Spain and



Portugal, respectively, for a total of 111,883 hectares, 7.5% less than the biotech maize area of 120,980 hectares in 2018. There was less motivation to plant biotech maize since the market calls for non-biotech raw materials. Imports of feedstocks from Argentina, Brazil, and the United States were mostly biotech. There were imports of more than 30 million metric tons (MT) of soybeans and soybean products (90-95% biotech), 10 to 20 million MT of maize products (20 to 25% biotech), and 2.5 to 5 million MT of rapeseed products (close to 25% biotech) per year, mainly for feed. This situation is expected to continue as there is no change in the EU regulation, there is no approval for cultivation in sight, and movement against biotech crops is still strong. At the beginning of 2018, six biotech crops were authorized for entry into the EU for food and feed uses including four soybean events, one oilseed rape, and one renewal for maize. Before the end of 2019, two new varieties of maize and renewal of three existing authorizations for maize and sugar beets were approved for food and feed uses.

STATUS OF APPROVED EVENTS FOR BIOTECH CROPS USED IN FOOD, FEED, PROCESSING, AND CULTIVATION

A total of 72 countries (29 planting and 43 non-planting + EU 26, counted as one) have issued regulatory approvals for genetically modified or biotech crops for consumption either as human food, animal feed, as well as for commercial cultivation. Since 1992, there have been 4,485 approvals granted by regulatory authorities to 403 biotech events from 29 biotech crops, excluding carnation, rose, and petunia.

Of these approvals, 2,115 were for food, either for direct use or for processing, 1,514 were for feed use, for direct use or processing, while 856 were for environmental release or cultivation. The USA had the highest number of GM events approved (single traits only) followed by Japan (not including intermediate events from approved stacked and pyramided events), Canada, Brazil, and South Korea in the top five.

Maize still has the most number of approved events (146 events in 35 countries), followed by cotton (66 events in 27 countries), potato (49 events in 13 countries), soybeans (38 events in 31 countries), and canola (38 events in 15 countries).

The top ten events with the highest number of approvals in different countries include: herbicide tolerant maize event NK603 (61 approvals in 28 countries + EU 28 as one) still has the highest number of approvals. It is followed by herbicide tolerant soybean GTS 40-3-2 (57 approvals in 28 countries + EU 28 as one), insect resistant maize MON810 (55 approvals in 27 countries + EU 28), herbicide tolerant and insect resistant maize TC1507 (55 approvals in 27 countries + EU 28), herbicide tolerant and insect resistant maize Bt11 (54 approvals in 26 countries + EU 28), insect resistant maize MON89034 (51 approvals in 25 countries + EU 28), herbicide tolerant maize GA21 (50 approvals in 24 countries + EU 28), herbicide and insect resistant maize MON88017 (45 approvals in 24 countries + EU 28), herbicide tolerant soybean A2704-12 (45 approvals in 25 countries + EU 28).

Table 2. Top Ten Countries which Granted Food, Feed and Cultivation/Environment Approvals*

Rank	Country	Number of Approvals			
		Food	Feed	Cultivation	Total
1	USA**	183	178	178	539
2	Japan*	186	177	130***	493
3	Canada	147	138	144	429
4	Brazil	111	111	106	328
5	South Korea	157	148	0	305
6	Philippines	116	114	14	244
7	Mexico	188	29	14	231
8	Argentina	77	69	75	221
9	European Union	100	101	4	205
10	Australia	118	18	39	175
	Others	732	431	152	1,315
	Total	**2,115**	**1,514**	**856**	**4,485**

*For Japan, data is collected from Japan Biosafety Clearing House (JBCH, English and Japanese) as well as the website of the Ministry of Health, Labor and Welfare (MHLW). However, intermediate events derived from an approved pyramided event recorded in JBCH are not included in our database if they do not appear in MHLW. Also, expired approvals are included in our database from 1992 while JBCH's records starts in 2004.
**USA only approves individual events.
***While cultivation approvals are granted in Japan, there are no current GM planting done.

Source: ISAAA, 2019

CONTRIBUTION OF BIOTECH CROPS TO FOOD SECURITY, SUSTAINABILITY, AND CLIMATE CHANGE SOLUTIONS

Biotech crops are being adopted globally because of the enormous benefits to the



In 2019, the herbicide tolerant maize event NK603 has the highest number of approvals, 61 in 28 countries.

environment, health of humans and animals, and contributions to the improvement of socio-economic conditions of farmers and the general public. Global economic gains contributed by biotech crops in the last 23 years (1996-2018) have amounted to US$224.9 billion economic benefits to more than 16 to 17 million farmers, 95% of whom come from developing countries.

Biotech crops contributed to food security, sustainability and climate change solutions by:

- **increasing crop productivity** by 822 million tons valued at US$224.9 billion in 1996-2018; and 86.9 million tons valued at US$18.9 billion in 2018 alone;
- **conserving biodiversity** in 1996 to 2018 by by saving 231 million hectares of land and 24.3 million hectares of land in 2018 alone;
- **providing a better environment**
  - by saving on 776 million kg. a.i. of pesticides in 1996-2018 and by 51.7 million kg in 2018 alone from being released into the environment;
  - by saving on pesticide use by 8.3% in 1996-2018, and by 8.6% in 2018 alone;
  - by reducing EIQ (Environmental Impact Quotient) by 18.3 % in 1996-2018, and by 19% in 2018 alone.
- **reducing CO2 emissions** in 2018 by 23 billion kg, equivalent to taking 15.3 million cars off the road for one year; and
- **helping alleviate poverty through uplifting the economic situation** of 16-17 million small farmers, and their families totaling >65 million people, who are some of the poorest people in the world (Brookes, 2020).

Thus, biotech crops can contribute to a "sustainable intensification" strategy favored by many science academies worldwide, which allows productivity and production to be increased on the current 1.5 billion hectares only of global cropland, thereby saving forests and biodiversity. Biotech crops are essential but are not a panacea, and adherence to good farming practices such as rotations and resistance management, are a must for biotech crops as they are for conventional crops.

ECONOMIC GAINS FROM BIOTECH CROPS REACHED US$225 BILLION FROM 1996 TO 2018

A total of US$224.9 billion economic benefits was gained by countries planting biotech crops from 1996 to 2018. The highest gain was obtained by the USA (US$95.9 billion), Argentina (US$28.1 billion), Brazil (US$26.6 billion), India (US$24.3billion), China (US$23.2 billion), Canada (US$9.7 billion), and others (US$23.2 billion) for a total of US$224.9 billion. For 2018 alone, six countries gained the most economically from biotech crops, they were the USA (US$ 7.8 billion), Brazil, (US$3.8 billion), Argentina (US$2.4 billion), India (US$1.5 billion), China (US$1.5 billion), Canada (US$ 0.9 billion), and others (US$1 billion) for a total of US$18.9 billion (Brookes, 2020).

CONTRIBUTION OF BIOTECH CROPS TO FOOD SECURITY, SUSTAINABILITY, AND CLIMATE CHANGE SOLUTIONS



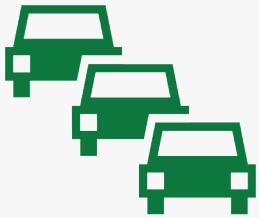
INCREASE CROP PRODUCTIVITY
US$225 BILLION
FARM INCOME GAINS IN 1996-2018 GENERATED GLOBALLY BY
BIOTECH CROPS



CONSERVE BIODIVERSITY
IN 1996-2018, PRODUCTIVITY GAINED THROUGH BIOTECHNOLOGY SAVED
231 MILLION HECTARES
OF LAND FROM PLOWING AND CULTIVATION



PROVIDE A BETTER ENVIRONMENT
DECREASED USE OF CROP PROTECTION PRODUCTS BY
776 MILLION KGS
A GLOBAL REDUCTION OF 8.6% IN 1996-2018



REDUCE CO2 EMISSIONS
SAVED **23 BILLION KGS CO2** EQUIVALENT TO REMOVING
15.3 MILLION CARS
OFF THE ROAD FOR 1 YEAR



HELP ALLEVIATE POVERTY AND HUNGER
BIOTECH CROPS UPLIFTED THE LIVES OF
17 MILLION FARMERS
AND THEIR FAMILIES TOTALING
>65 MILLION PEOPLE



Source: Brookes and Barfoot, 2020

CONCLUSION

The Global Food Insecurity Report of 2019 revealed that the targets of the United Nations (UN) Millennium Development Goals (MDG) that ended in 2015 were not achieved, and that more than 820 million people in the world were still hungry in 2018 which makes it difficult to achieve the Zero Hunger target by 2030. The State of Food Security and Nutrition in the World 2019 also showed that the decline in hunger the world had enjoyed for over a decade was at an end, and that hunger is again on the rise. The global level of the prevalence of undernourishment has stabilized; unfortunately, the absolute number of undernourished people continues to slowly rise.

Regional details show that in almost all African subregions, the highest prevalence of undernourishment is close to 20%, This is followed by Asia especially the Western Asian region which shows a continuous increase since 2010 of more than 12% of its population. Hunger is also slowly rising in Latin America and the Caribbean at close to 7%. It is discouraging to note that over 2 billion people do not have regular access to safe, nutritious, and sufficient food, including 8% of the population in Northern America and Europe. The economic slowdowns and downturns have greatly impacted the likelihood of severe food insecurity and undernutrition, and this effect is 20% higher for low-income countries. Moreover, climate change is heavily affecting food production

globally. Overall, year-to-year changes in climate factors during the growing season of maize, rice, soybeans, and spring wheat could account for 20%-49% of yield fluctuations.

Thus, in the 24th year of biotech crop commercialization (cultivation and import for food, feed, and processing), the 190.4 million hectares could contribute to the alleviation of these problems. The accumulated biotech crop area from 1996 to 2019 of 2.7 billion hectares (6.7 million acres) continues to provide food, feed, and shelter to the 7.7 billion global population. Moreover, there were accumulated (1996-2018) economic benefits of US$229.4 billion to 18 million farmers and their families, 95% of whom are small farmers. New biotech crops and traits were made available for consumers to sustain ample and nutritious food and for farmers with agronomic traits to mitigate climate change related-biotic and abiotic agricultural problems.

Public acceptance and enabling policies in the government are key for agricultural, socio-economic, and environmental benefits of biotech crops to reach the poor and the hungry. More importantly, a regional regulatory harmonization that facilitate data transportability would expedite biosafety decision-making. Ensuring that these benefits will continue now and in the future depends also on the diligence and forward-looking regulatory steps based on science, critically looking at the benefits instead of risks, agricultural productivity with a sense of environmental conservation and sustainability, and most importantly taking into consideration the millions of hungry and impoverished populace in need of resources.

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EXECUTIVE SUMMARY

ISAAA Brief 55

Global Status of Commercialized Biotech/GM Crops in 2019: Biotech Crops Drive Socio-Economic Development and Sustainable Environment in the New Frontier

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