



生技 201

植物 三 生物技術

全球生技作物概況



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→ 世界各地生技作物

餵飽全球人口成為越來越艱鉅的任務，因此農民求助於植物生物技術等農業創新方案，期盼能於日漸匱乏的農地上持續種植出安全且產量豐饒的作物。過去 20 年來全球對生技作物的採用不斷增加，截至 2014 年，已有 28 國的 1800 萬農民種植面積超過 1.81 億公頃的生技作物。

這份資訊圖表彙編旨在說明植物生物技術如何造福全球農民與消費者，以及其對環境的影響。

.....

1800 萬農民 > 28 國 > 2014 年之種植超過 1.81 億公頃

→ 什麼是植物生物技術？

植物生物技術是一種精密複雜的育種技術，讓植物育種專家能精確地將有益性狀結合於植物中。目前核准使用的生技作物係經改良以幫助農民更有效對抗有害雜草，保護作物不受害蟲和疾病侵害，並改善作物的營養品質及保存期限。未來，這些作物將能提供具有更高維生素含量或更長保存時間的糧食，或更能適應氣候變遷條件。

植物生物技術也稱為基因改造（GM）、基因工程（GE）或是基因改造生物（GMO）。包括 Bt 作物在內的抗蟲作物經由生物技術改良後，能產生幫助植物對抗害蟲的蛋白質。Ht 作物則被開發為對特定除草劑具耐受性，以不至於如雜草般被消滅。這些種類的作物不僅能為農民節省時間和金錢，也讓農民在標的雜草防治方面獲得更大的選擇空間。

阿根廷



阿根廷是生技作物的最大生產國之一，其生技作物的總種植面積超過 2430 萬公頃，包括黃豆（2080 萬）、玉米（300 萬）及棉花（50 萬）。阿根廷於 1996 年首度導入植物生物技術。

＝ 阿根廷 ＝

生技

作物：



大豆



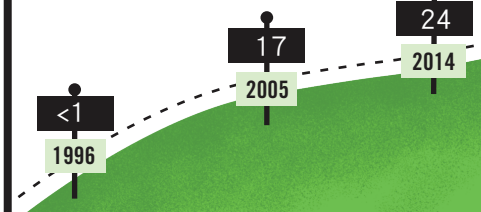
棉花



玉米

總生技作物種植面積：

（單位：百萬公頃）



耕地效益：



農場、家庭與社區效益：



生技作物為阿根廷帶來
182 萬個新增工作機會。

國家效益：

由於阿根廷提高對全球糧食供應的比例，幫助節省糧食成本



→ 生技作物對社區而言是更為安全的糧食。抗蟲生技玉米大幅降低可能傷害人體的危險黴菌毒素含量。

2011 年大豆價格

採用生技	\$13.00/蒲式耳	便宜 14%
未用生技	\$14.70/蒲式耳	

若阿根廷農民未採用基因改造大豆，則全球大豆價格會較 2011 年上漲 14%。



阿根廷自種植生技品種以來，玉米年出口量增加至近三倍。

資料來源：(1) ISAAA: <http://bit.ly/10Liluz> (2) World Mycotoxin Journal: <http://bit.ly/10LipKW> (3) Science Direct: <http://bit.ly/1FaXsqR>
(4) ISAAA: <http://bit.ly/1V5Psch> (5) USDA: <http://1.usa.gov/1LlpqXA> (6) FAO Statistics Division

巴西



巴西是全球最大生技作物生產國之一。2012 年，巴西農民共種植 4220 萬公頃的生技黃豆、棉花和玉米。這些生技品種能幫助農民對抗具毀滅性的雜草與害蟲，卻不對作物造成損害；生物技術已讓巴西成為全球首屈一指的黃豆出口國。

＝ 巴西 ＝

生技

作物



大豆



棉花



玉米

總生技作物種植面積：

(單位：百萬公頃)

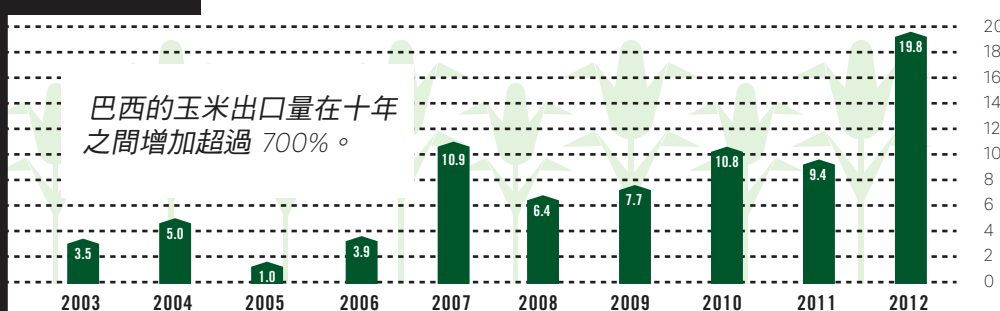


農場、家庭與社區效益：

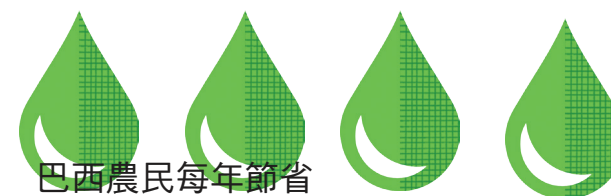
生技作物降低水源、燃料及電力耗用，幫助農民維護永續農業實務。

國家效益：

玉米出口，單位：百萬噸



耕地效益：



巴西農民每年節省

1000 億公升用水。

農民每投資於生技種子一美元，可賺回...



研究中生技作物：



← 已獲核准正待商業化

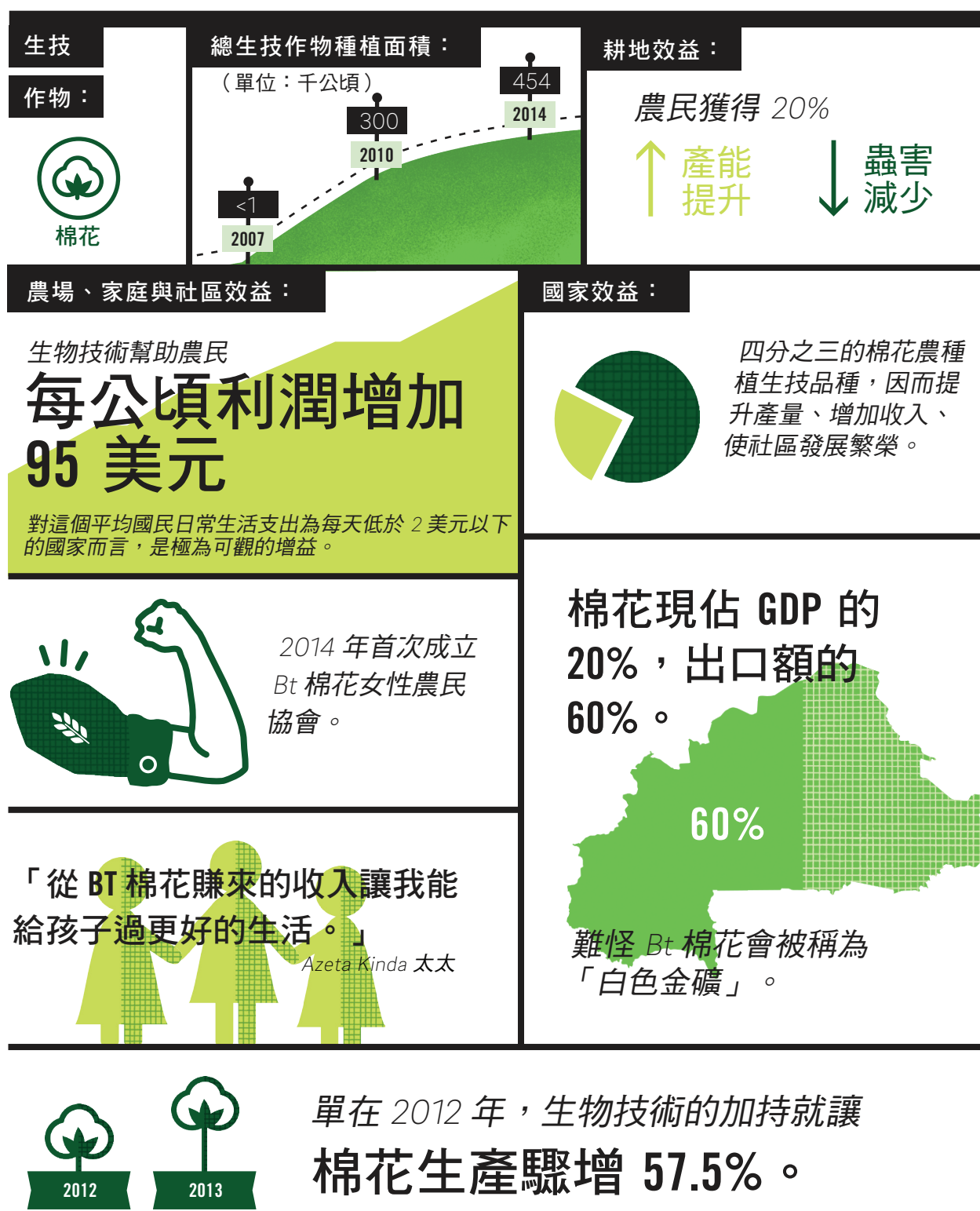
資料來源：(1) ISAAA: <http://bit.ly/1OLiluz> (2) Céleres Ambiental: <http://bit.ly/1LONmuY> (3) Céleres Ambiental: <http://bit.ly/1LONo6a> (4) FAO Statistics Division (5) USDA <http://1.usa.gov/1Pkd00d> (6) Céleres Ambiental: <http://bit.ly/1V5KPV2>

布吉納法索



布吉納法索種植Bt棉花已有八年之久；2014 年共有超過 14.3 萬農民種植 45.4 萬公頃Bt棉花；這種抗蟲棉花品種是許多農民口中的「白色金礦」，並改寫了布吉納法索的農業景況，使該國成為成為其他開發中國家的典範。

布吉納法索



資料來源：(1) ISAAA: <http://bit.ly/1OLiluz> (2) Biotechnology in development: <http://bit.ly/1iIRIKP> (3) ISAAA: <http://bit.ly/1Qtpq1k> (4) United Nations <http://bit.ly/1gGzkj>



「種植 BT 玉米讓我有能力
買房買地、添購農機，
甚至是農地。」

菲律賓邦板牙省馬加朗巴里圖坎
Indalencio Supan

印度



每年有超過 700 萬印度農民選擇種植生技作物。2014 年印度農民創下 1160 萬公頃的種植面積記錄，採用率高達 95%。印度是三個進行生技馬鈴薯田間試驗的國家之一，運用生物技術以提升此大宗作物的產量及品質。

印度

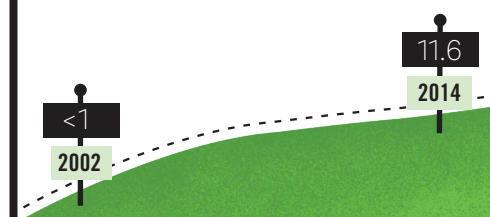
生技

作物：



總生技作物種植面積：

(單位：百萬公頃)



國家效益：

印度從棉花進口國變身為全球最大棉花生產與出口國。
印度農民生產全球四分之一的棉花。



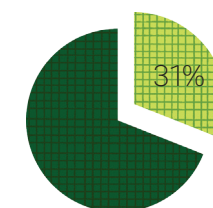
耕地效益：

農民採用生技棉花之後，田地也產生轉變。



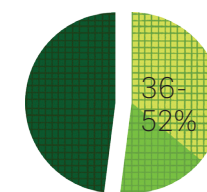
增加收穫

Bt 棉花帶來的產量提升估計為：



節省成本

節省使用作物保護產品成本：



降低人力需求

減少使用殺蟲劑所需的人力成本



農場、家庭與社區效益：

農民心目中種植 Bt 棉花的最大好處：



51% 認為可以減少農作時間



49% 認為更安心



48% 認為降低棉花種植的壓力

Bt 棉花農場
婦女薪資增加



「我能一邊修習大學學位，同時兼顧農場工作。」

印度安得拉邦
Andhra Pradesh, India

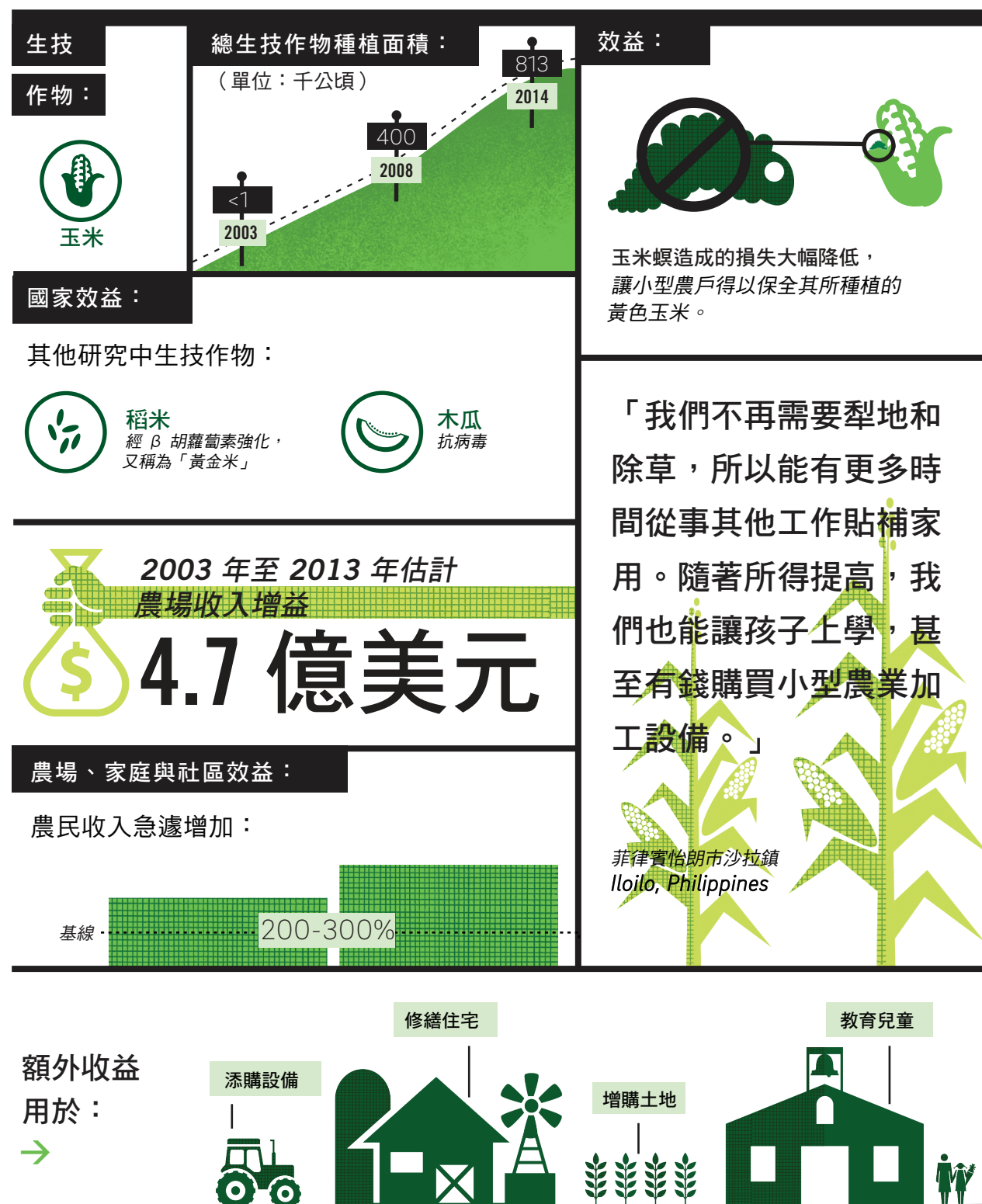
資料來源：(1) ISAAA <http://bit.ly/10Liluz> (2) Agricultural Economics Research Review: <http://bit.ly/1Mm8Q2t>
(3) Agricultural Economics Research Review: <http://bit.ly/1YvntHF> (4) Science Direct: <http://bit.ly/10pV7eg> (5) ISB: <http://1.usa.gov/1KGPWEq>
(6) Farmers First: <http://bit.ly/1NHcMfY>

菲律賓



菲律賓是亞洲首波導入生物技術的國家，2003 年開始種植 Bt 玉米。截至 2014 年，共有 41.5 萬座小型農場種植 81.3 萬公頃的 Bt 玉米。除了 Bt 玉米外，菲律賓另有 75 樣生技作物和產品經核准作為食品、飼料及加工原料，包括苜蓿、油菜、棉花、玉米、馬鈴薯、稻米、黃豆及甜菜。

菲律賓



資料來源：(1) ISAAA Brief 49-2014: <http://bit.ly/1OLiluz> (2) ISB News Report: <http://1.usa.gov/1KGPWEq> (3) ISAAA: CADRES OF CHANGE: <http://bit.ly/1NONfmH> (4) ISAAA: Communication Challenges and Convergence in Crop Biotechnology: <http://bit.ly/1NONk90>

美國



美國是生技農業的先驅，也是在 1996 年率先採用生物技術的國家。美國農民於面積 7310 萬公頃的農地上種植十種生技作物，包括玉米、黃豆、油菜、棉花、南瓜、木瓜、馬鈴薯、苜蓿、甜菜和蘋果 - 生技作物多樣性堪稱全球第一。

美國

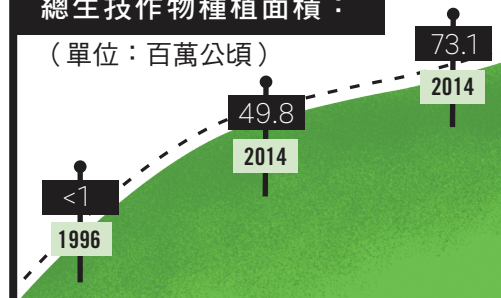
生技

作物：



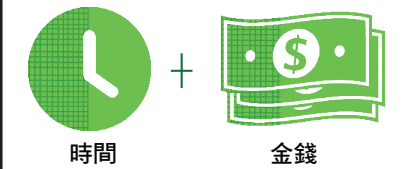
總生技作物種植面積：

(單位：百萬公頃)



效益：

降低耕作除草需求，節省

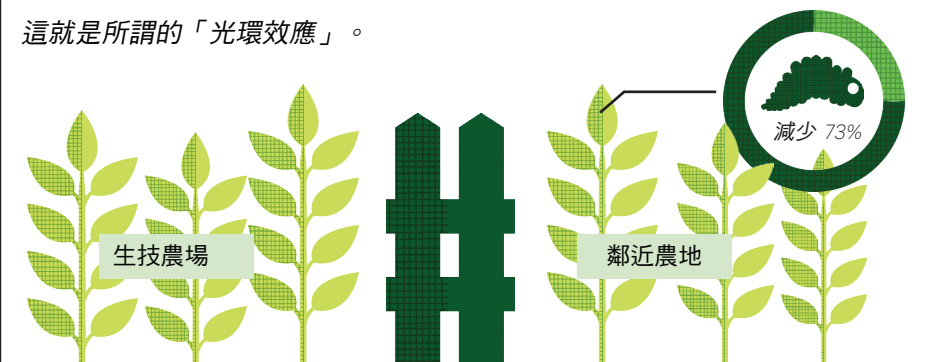


零耕作實務可於
每英畝農地節省
多達 3.9 加侖燃料。



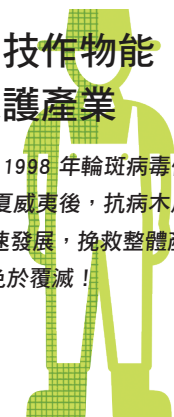
農場、家庭與社區效益：

生技農民甚至能幫助鄰近採取傳統農業方式的農民：
種植抗蟲 Bt 品種能減少歐洲玉米螟的數量，
使得鄰近農地也能將此害蟲數量減少 73%；
這就是所謂的「光環效應」。



生技作物能
保護產業

在 1998 年輪斑病毒侵襲夏威夷後，抗病木瓜快速發展，挽救整體產業免於覆滅！



國家效益：



資料來源：(1) ISAAA: <http://bit.ly/10Liluz> (2) World Mycotoxin Journal: <http://bit.ly/10LipKW> (3) Science Direct: <http://bit.ly/1FaXsqR>
(4) ISAAA: <http://bit.ly/1V5Psch> (5) USDA: <http://1.usa.gov/1LlpqXA> (6) FAO Statistics Division

生技作物 全球

生物技術運用國家：

- 1 美國

2 巴西

3 阿根廷

4 印度

5 加拿大

6 中國

7 巴拉圭

8 巴基斯坦

9 南非

10 烏拉圭

11 玻利維亞

12 菲律賓

13 澳大利亞

14 布吉納法索
- 15 緬甸

16 墨西哥

17 西班牙

18 哥倫比亞

19 蘇丹

20 宏都拉斯

21 智利

22 葡萄牙

23 古巴

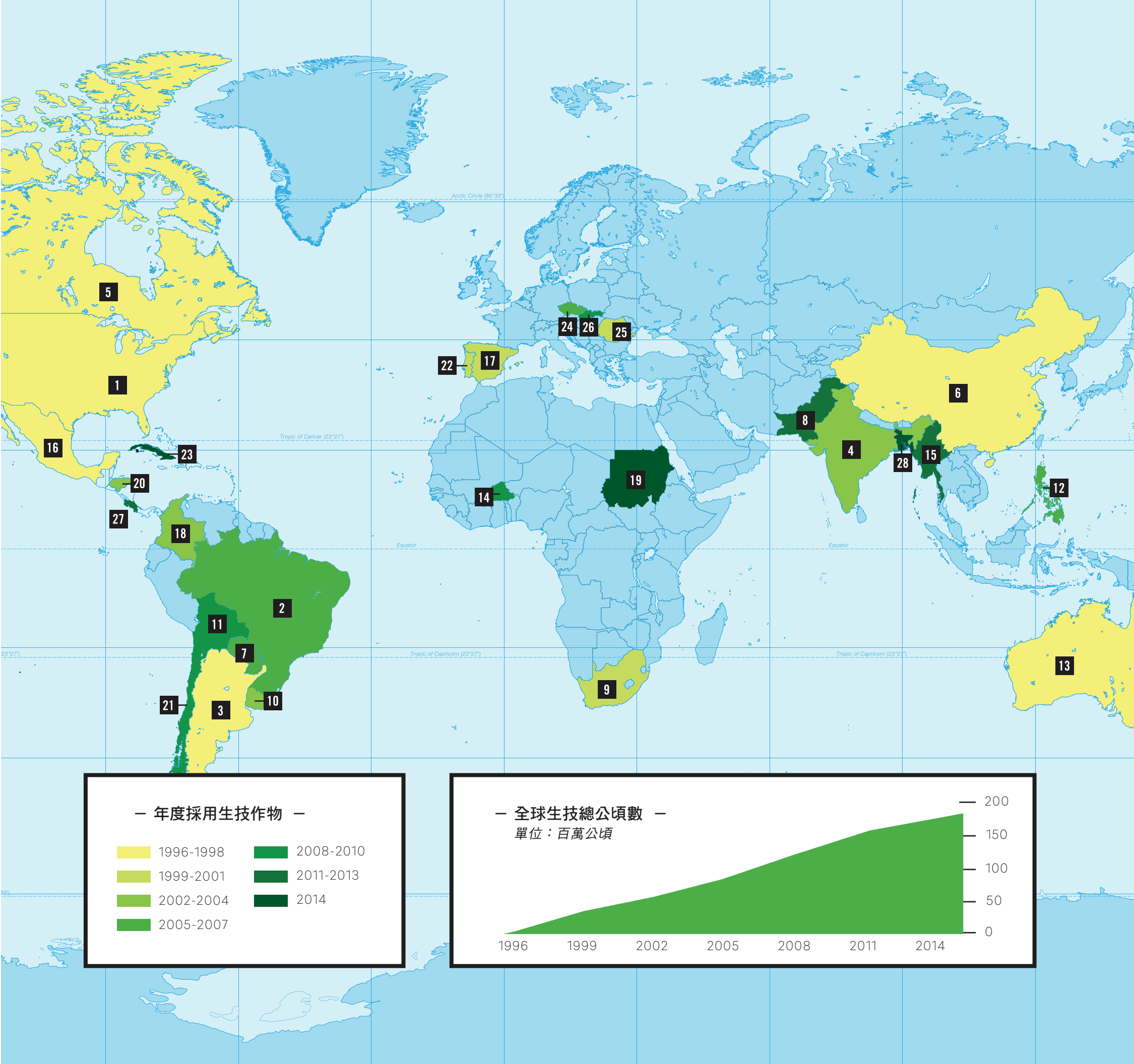
24 捷克

25 羅馬尼亞

26 斯洛伐克

27 哥斯大黎加

28 孟加拉



國際作物永續發展協會在作物保護及植物生物技術的領域中扮演著引領農業創新的角色。進而支持並促成永續農業，協助農民在餵飽成長人口的同時，也關懷地球以及提升農村發展。這個世界需要農民，而農民需要植物科學。成為扶持農民成長的核心就是國際作物永續發展協會引以為傲的使命。



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BIOTECH 201

PLANT BIOTECHNOLOGY

Biotech Crops Around the World



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16		<i>United States</i>
18		<i>Around the Globe</i>



➔ **BIOTECH CROPS AROUND THE WORLD**

As it becomes more challenging to feed the world's population, farmers are turning to agricultural innovations like plant biotechnology so they can continue to grow safe, high-yielding crops on ever-scarcer farmland. Biotech crops have been increasingly adopted across the globe for the past 20 years: as of 2014, 18 million farmers in 28 countries planted more than 181 million hectares.

This collection of infographics demonstrates how farmers and consumers worldwide benefit from plant biotechnology, as well as the impact of this technology on our environment.

.....

18 MILLION FARMERS > IN 28 COUNTRIES >
PLANTED MORE THAN 181 MILLION HECTARES IN 2014

➔ **WHAT IS PLANT BIOTECHNOLOGY?**

Plant biotechnology is a sophisticated breeding technology that allows plant breeders to precisely introduce beneficial traits into plants. Biotech crops approved for use today have been improved to help farmers fight damaging weeds more efficiently, protect crops from insects and diseases, and improve the nutritional quality and shelf-life of crops. In the future, these crops could offer foods with higher vitamin levels, longer shelf life or the ability to grow even in the face of climate change conditions.

Genetic modification (GM), genetic engineering (GE) and genetically modified organisms (GMO) are a few other terms that are often used to refer to plant biotechnology. Insect-resistant crops, including Bt crops, have been improved through biotechnology to produce proteins that can make the plants more resistant to harmful insects. Ht crops are developed to resist the application of certain herbicides that previously would have destroyed the crop along with the targeted weeds. These types of crops allow farmers to save time and money, and to have more options for targeted weed control.

ARGENTINA



Argentina is one of the top producers of biotech crops and has dedicated more than 24.3 million hectares of acreage to biotech crops like soybeans (20.8 million), maize (3 million), and cotton (0.5 million). Argentina first adopted plant biotechnology in 1996.

≡ ARGENTINA ≡

BIOTECH

CROPS:



SOYBEANS



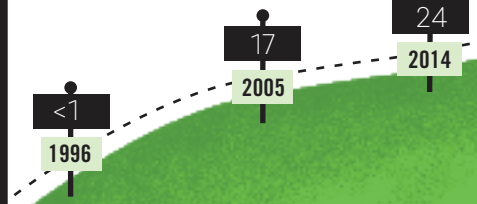
COTTON



MAIZE

TOTAL BIOTECH ACREAGE:

(in millions of hectares)



IN-FIELD BENEFITS:

ARGENTINE FARMS REQUIRE LESS TILLING AND WEEDING thanks to herbicide-tolerant biotech crops.

FARM, FAMILY AND COMMUNITY BENEFITS:



1.82 MILLION NEW JOBS

added to Argentina's economy thanks to biotech crops.

NATIONAL BENEFITS:



because of Argentina's increased contributions to the global food supply.

→ **BIOTECH CROPS ALSO MEAN SAFER FOOD FOR THE COMMUNITY.** Insect-resistant biotech maize contains significantly lower levels of dangerous mycotoxins, that can make people sick.

PRICE OF SOYBEANS IN 2011

WITH BIOTECH

\$13.00/bushel

14% cheaper

WITHOUT BIOTECH

\$14.70/bushel

If Argentine farmers had not adopted GM soybeans, the global price of soybeans would have been 14% higher in 2011.



Argentina has nearly **TRIPLED ITS ANNUAL EXPORTS** of maize since embracing biotech varieties.

SOURCES: (1) ISAAA: <http://bit.ly/10Liluz> (2) World Mycotoxin Journal: <http://bit.ly/10LipKW> (3) Science Direct: <http://bit.ly/1FaXsqR> (4) ISAAA: <http://bit.ly/1V5Psch> (5) USDA: <http://1.usa.gov/1LlpqXA> (6) FAO Statistics Division

BRAZIL



Brazil is one of the largest producers of biotech crops in the world. In 2012, Brazilian farmers grew 42.2 million hectares of biotech soybeans, cotton and maize. These biotech varieties help farmers fight devastating weeds and insects, without harming their crops. Brazil has become one of the world's largest soybean exporters thanks to biotechnology.

BRAZIL

BIOTECH

CROPS:



SOYBEANS



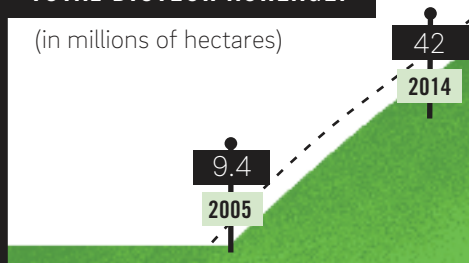
COTTON



MAIZE

TOTAL BIOTECH ACREAGE:

(in millions of hectares)

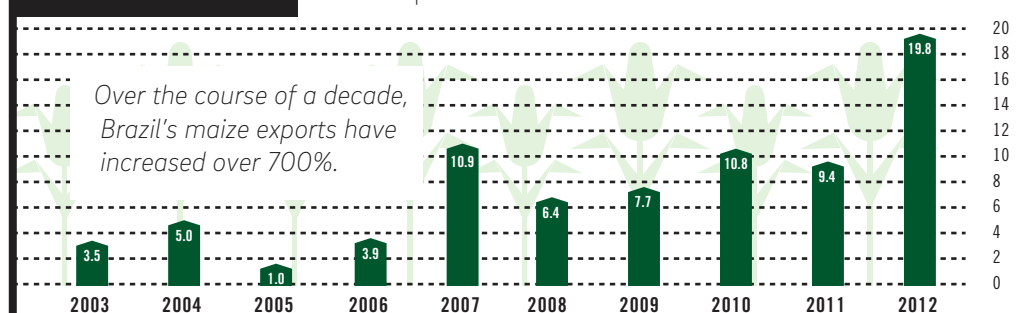


FARM, FAMILY & COMMUNITY BENEFITS:

BIOTECH FARMERS ARE USING LESS WATER, FUEL, AND ELECTRICITY, enabling farmers to use sustainable agricultural practices.

NATIONAL BENEFITS:

Maize exports in millions of tonnes



Over the course of a decade, Brazil's maize exports have increased over 700%.

IN-FIELD BENEFITS:

100 BILLION LITRES OF WATER are saved by Brazilian farmers every year.

For every \$1 that farmers invest in biotech seeds, they make back...



BIOTECH CROPS BEING RESEARCHED:



CITRUS



RICE



SUGERCANE



SORGHUM



BEAN

← Approved and waiting for commercialization.

→ **BRAZILIAN FARMERS GROW MORE FOOD ON EVERY HECTARE THAN EVER BEFORE, KEEPING NATURAL HABITATS LIKE THE RAINFOREST FROM BEING CONVERTED TO FARMLAND.**

BURKINA FASO



Burkina Faso has grown Bt cotton for eight years; in 2014, over 143,000 farmers grew 454,000 hectares of the crop. Nicknamed 'white gold' by many farmers, these insect-resistant cotton varieties have transformed Burkina Faso's agriculture sector, which is becoming a model for other developing countries.

≡ BURKINA FASO ≡

BIOTECH

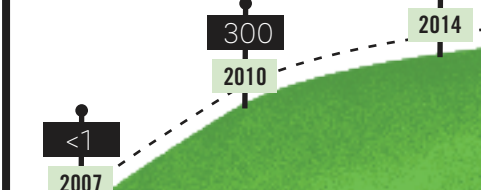
CROPS:



COTTON

TOTAL BIOTECH ACREAGE:

(in thousands of hectares)



IN-FIELD BENEFITS:

Farmers saw 20%

↑ HIGHER YIELDS

↓ INSECT DAMAGE

FARM, FAMILY & COMMUNITY BENEFITS:

With biotechnology, farmers have

INCREASED PROFITS BY \$95/ HECTARE

an incredible gain in a country where the average person lives on < \$2 a day.

NATIONAL BENEFITS:



3/4th of all cotton farmers are growing biotech and are seeing higher yields, improved incomes and growing communities



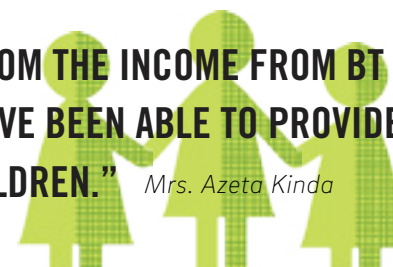
The first Bt cotton women farmer's association was formed in 2014.

COTTON NOW ACCOUNTS FOR 20% OF GDP AND 60% OF EXPORTS.

60%

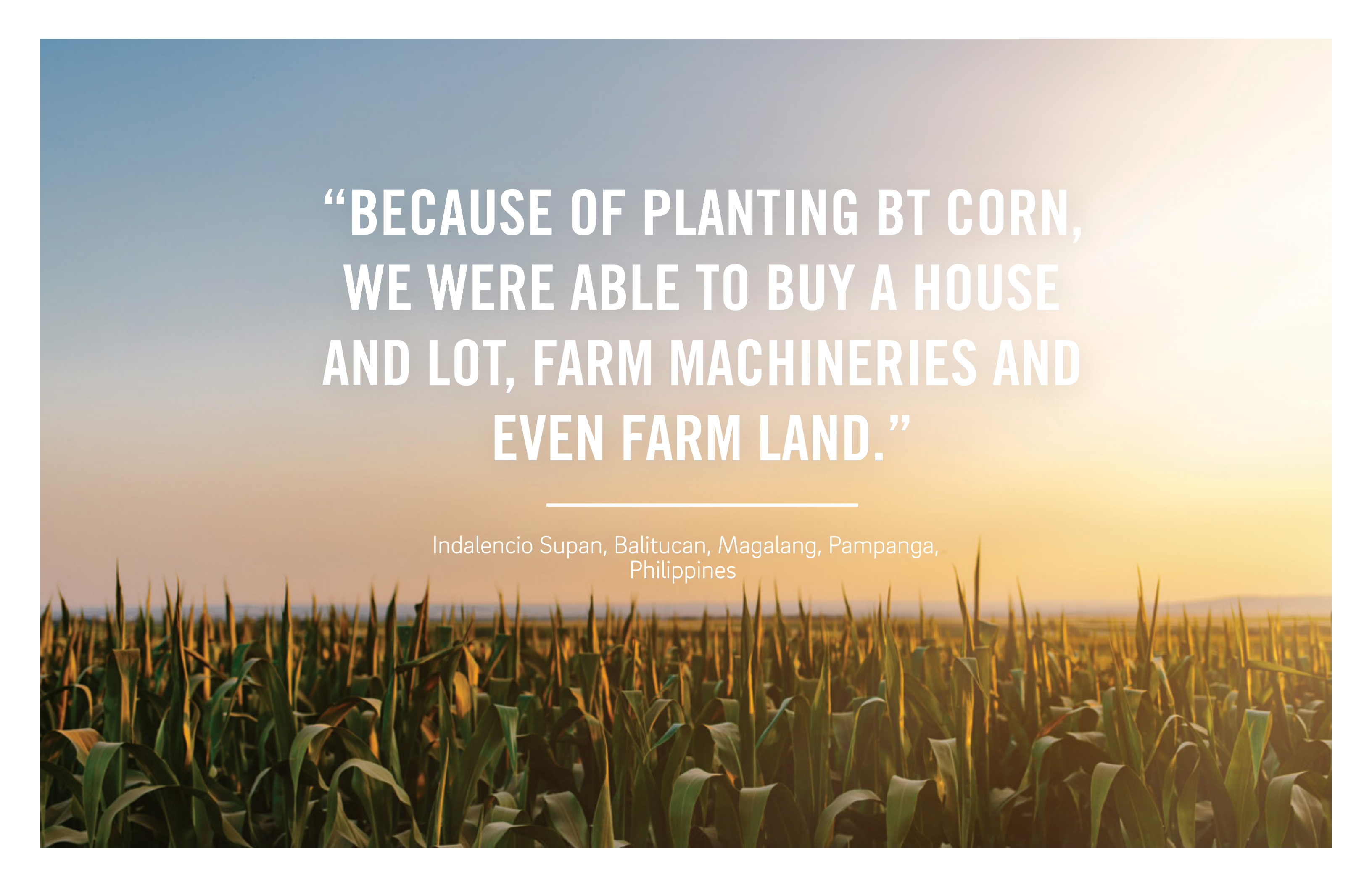
No wonder Bt cotton has become known as "white gold."

"FROM THE INCOME FROM BT COTTON, I HAVE BEEN ABLE TO PROVIDE FOR MY CHILDREN." Mrs. Azeta Kinda



COTTON PRODUCTION SKYROCKETED BY 57.5% in 2012 alone, thanks to biotech.

SOURCES: (1) ISAAA: <http://bit.ly/1OLiluz> (2) Biotechnology in development: <http://bit.ly/1iIRIKP> (3) ISAAA: <http://bit.ly/1Qtpq1k> (4) United Nations: <http://bit.ly/1gGzkjT>

A photograph of a cornfield at sunset. The sun is low on the horizon, creating a warm, golden glow that fills the sky and reflects off the leaves of the corn plants. The corn plants are in the foreground, their green leaves and yellowing tassels clearly visible. The background shows a vast field stretching to the horizon under the soft light of the setting sun.

**“BECAUSE OF PLANTING BT CORN,
WE WERE ABLE TO BUY A HOUSE
AND LOT, FARM MACHINERIES AND
EVEN FARM LAND.”**

Indalencio Supan, Balitucan, Magalang, Pampanga,
Philippines

INDIA



Each year, over seven million Indian farmers choose to grow biotech crops. In 2014, Indian farmers cultivated a record 11.6 million hectares, with a 95% adoption rate. India is one of three countries running field trials of biotech potato, which could yield higher productivity and increased quality of this staple crop.

INDIA

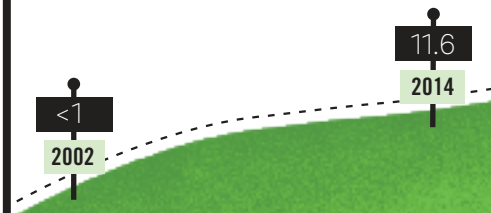
BIOTECH

CROPS:



TOTAL BIOTECH ACREAGE:

(in millions of hectares)



NATIONAL BENEFITS:

INDIA HAS GONE FROM AN IMPORTER TO THE WORLD'S LARGEST PRODUCER AND EXPORTER OF COTTON.
Indian farmers produce 1/4 of global cotton.



IN-FIELD BENEFITS:

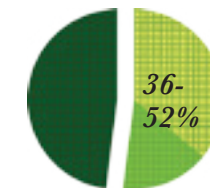
After farmers adopt biotech cotton, their fields transform.



HARVESTS GROW
yield improved with Bt cotton by an estimated:



COSTS FALL
reduction of costs for crop protection applications ranged:



LESS LABOR NEEDED
costs decreased with reduced need for insecticide applications



FARM, FAMILY AND COMMUNITY BENEFITS:

Top benefits of growing Bt cotton according to farmers:



51% say less time in the field



49% say peace of mind



48% say less tension from cotton cultivation

55%

higher wages for women on Bt cotton farms



“I HAVE BEEN ABLE TO STUDY FOR A COLLEGE DEGREE WHILE WORKING ON THE FARM AS WELL.”

Srinivasa Reddy
Andhra Pradesh, India

SOURCES: (1) ISAAA <http://bit.ly/1OLiluz> (2) Agricultural Economics Research Review: <http://bit.ly/1Mm8Q2t> (3) Agricultural Economics Research Review: <http://bit.ly/1YvntHF> (4) Science Direct: <http://bit.ly/1OpV7eg> (5) ISB: <http://1.usa.gov/1KGPWEq> (6) Farmers First: <http://bit.ly/1NHcMFY>

PHILIPPINES



The Philippines were one of the first in Asia to embrace biotechnology, planting Bt maize in 2003. As of 2014, 813,000 hectares have been grown on 415,000 small farms. In addition to Bt maize, there are 75 biotech crops and products approved as food, feed and for processing in the country; these include alfalfa, canola, cotton, maize, potato, rice, soybean, and sugar beet.

PHILIPPINES

BIOTECH

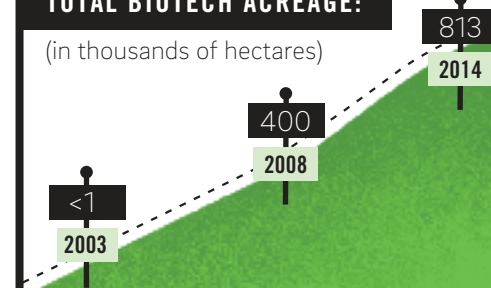
CROPS:



MAIZE

TOTAL BIOTECH ACREAGE:

(in thousands of hectares)



NATIONAL BENEFITS:

Other biotech crops being researched:



RICE

fortified with beta-carotene, also known as Golden Rice



PAPAYA

virus-resistant

IN-FIELD BENEFITS:



THERE IS SIGNIFICANT REDUCTION IN LOSSES TO CORN BORERS, which plague yellow corn and can devastate a smallholder farmer's crop.



FARM, FAMILY AND COMMUNITY BENEFITS:

Farmers have seen their income skyrocket by:



“WE NO LONGER NEED TO PLOW AND WEED, HENCE, WE HAVE MORE TIME TO FIND OTHER MEANS OF LIVELIHOOD. BECAUSE OF HIGHER INCOME...WE CAN ALSO SEND OUR CHILDREN TO SCHOOL AND WE CAN EVEN INVEST IN POST HARVEST EQUIPMENT.”

Delson Sonza of Sara Iloilo, Philippines

ADDITIONAL PROFITS HAVE BEEN USED TO:



SOURCES: (1) ISAAA Brief 49-2014: <http://bit.ly/10Liluz> (2) ISB News Report: <http://1.usa.gov/1KGPWEq> (3) ISAAA: CADRES OF CHANGE: <http://bit.ly/1NONfmH> (4) ISAAA: Communication Challenges and Convergence in Crop Biotechnology: <http://bit.ly/1NONk90>

UNITED STATES



The United States is a pioneer of biotech agriculture, and was one of the first countries to adopt the technology in 1996. United States farmers grow ten types of biotech crops on 73.1 million hectares of land, including maize, soybeans, canola, cotton, squash, papaya, potato, alfalfa, sugar beets and apples – a larger variety of biotech crops than any other country.

UNITED STATES

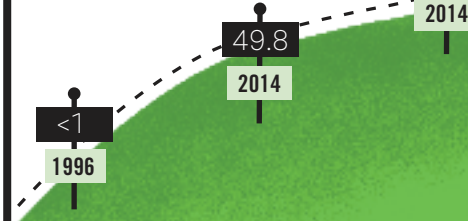
BIOTECH

CROPS:



TOTAL BIOTECH ACREAGE:

(in millions of hectares)



IN-FIELD BENEFITS:

Less tilling and weeding saves



NO-TILL PRACTICES CAN
SAVE UP TO 3.9 GALLONS
OF FUEL PER ACRE.



FARM, FAMILY AND COMMUNITY BENEFITS:

BIOTECH FARMERS CAN EVEN HELP THEIR CONVENTIONAL NEIGHBORS!

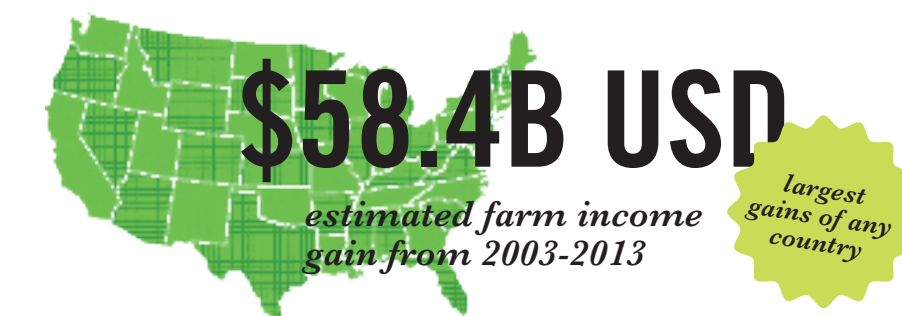
Farmers growing insect-resistant Bt varieties reduced European corn borer populations so much that nearby farms saw as much as 73% fewer of the devastating insects. This is known as the "halo effect."



NATIONAL BENEFITS:

BIOTECH CROPS CAN PROTECT INDUSTRIES

After the devastating ringspot virus invaded Hawaii in 1998, disease-resistant papayas were quickly developed and saved the entire industry from being wiped out!

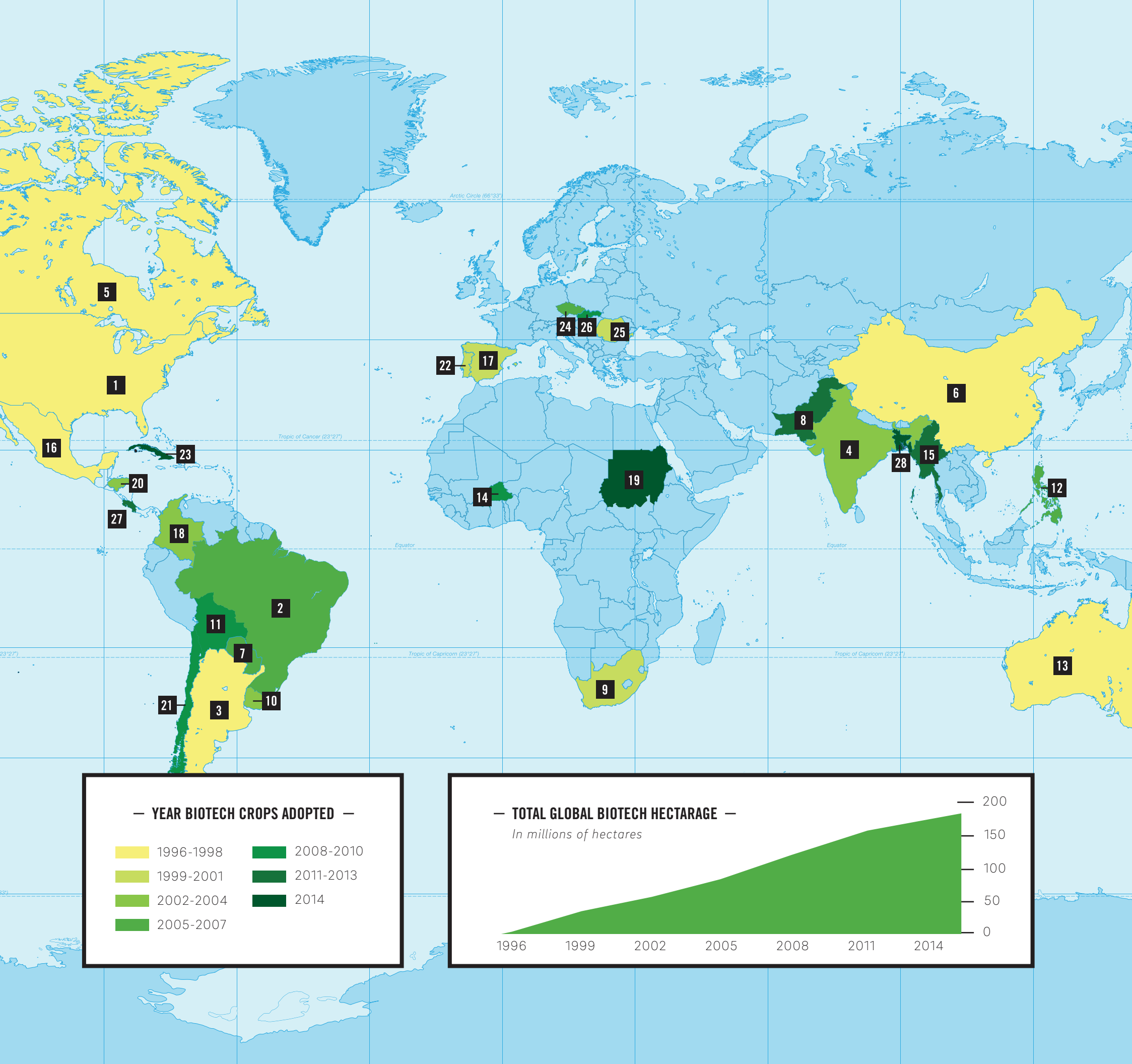


SOURCES: (1) ISAAA: <http://bit.ly/10Liluz> (2) World Mycotoxin Journal: <http://bit.ly/10LipKW> (3) Science Direct: <http://bit.ly/1FaXsqR> (4) ISAAA: <http://bit.ly/1V5Psch> (5) USDA: <http://1.usa.gov/1LpqXA> (6) FAO Statistics Division

BIOTECH CROPS AROUND THE GLOBE

Countries utilizing biotechnology:

- | | |
|-----------------|-------------------|
| 1 United States | 15 Myanmar |
| 2 Brazil | 16 Mexico |
| 3 Argentina | 17 Spain |
| 4 India | 18 Colombia |
| 5 Canada | 19 Sudan |
| 6 China | 20 Honduras |
| 7 Paraguay | 21 Chile |
| 8 Pakistan | 22 Portugal |
| 9 South Africa | 23 Cuba |
| 10 Uruguay | 24 Czech Republic |
| 11 Bolivia | 25 Romania |
| 12 Philippines | 26 Slovakia |
| 13 Australia | 27 Costa Rica |
| 14 Burkina Faso | 28 Bangladesh |



CROPLIFE INTERNATIONAL AND ITS GLOBAL NETWORK ARE THE VOICE AND LEADING ADVOCATES FOR THE PLANT SCIENCE INDUSTRY.

Croplife International champions the role of agricultural innovations in crop protection and plant biotechnology in supporting and advancing sustainable agriculture; helping farmers feed a growing population while looking after the planet; and progressing rural communities. The world needs farmers, and farmers need plant science. CropLife International is proud to be at the heart of helping farmers grow.



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