BIOTECH COUNTRY **FACTS & TRENDS**

Pakistan

In 2015, the adoption of insect resistant Bt cotton varieties in Pakistan increased to 93%.

In 2015, Pakistan achieved a 93% adoption rate of Bt cotton, or 2.9 million hectares of the national total area planted to cotton which is 3.2 million hectares.

The Seed Amendment Act was enacted in Pakistan in 2015 to strengthen the legislation of its seed sector. This Act amends the Seed Act of 1976 (XXIX of 1976), which aims to fulfill the requirements of modern seed industries, and boost the development, certification, registration, and commercialization of improved open pollinated varieties and hybrid seeds in Pakistan.

Around 750,000 small, resource-poor farmers in Pakistan planted and benefited from Bt cotton in 2015.

It is estimated that the economic gains from Bt cotton in Pakistan for 2010 to 2014 was US$1.9 billion, and US$299 million for 2014 alone.

COUNTRY PROFILE

Population: 188.9 million
GDP: US$225 billion
GDP per Capita: US$1,260
Agriculture as % GDP: 24%
Agricultural GDP: US$54.0 billion
% employed in agriculture: 44%
Arable Land (AL): 21.6 million hectares
Ratio of AL/Population*: 0.4

Major crops:
- Cotton
- Sugarcane
- Maize
- Wheat
- Rice

Commercialized Biotech Crop: Bt Cotton
Total biotech crop area and (%) increase in 2015:
2.9 Million Hectares (0%)
Increased farm income, 2010-2014: US$1.9 billion

*Ratio: % global arable land / % global population

BIOTECH CROP ADOPTION

Around 30 open pollinated and 2 hybrid Bt cotton varieties were approved for planting in 4 cotton growing provinces of Pakistan from 2010 to 2014.

In 2015, the Technical Advisory Committee (TAC) recommended the release of 21 Bt cotton varieties to the National Biosafety Committee (NBC) of the Ministry of Climate Change, the administrative agency of the biosafety regulation in Pakistan. However, the statutory authority of NBC was challenged

in the Lahore High Court in the wake of the 18th Amendment of the Constitution and therefore has not approved new Bt cotton varieties in 2015.

These 21 new Bt cotton varieties are likely to be approved later to provide farmers with a choice of high yielding Bt cotton varieties with tolerance to cotton leaf curl virus (CLCV) and other sucking pests.

BENEFITS FROM BT COTTON IN PAKISTAN

The results of a 2012 study conducted by Hina Nazli and colleagues indicate a positive impact of Bt cotton on the wellbeing of farmers in Pakistan.

Also in 2012, Kouser and Qaim on their research study "Valuing a financial, health and environmental benefits of Bt cotton in Pakistan", concluded that Bt cotton adoption results in significantly lower chemical pesticide use, higher yields, and higher gross margins, which is consistent with the results from other countries.

The study noted that the lower pesticide use brings about significant health advantages in terms of reduced incidence of acute pesticide poisoning, and environmental advantages in terms of higher farmland biodiversity and lower soil and groundwater contamination.

The authors noted that "These positive externalities are valued at US$79 per acre (US$195/hectare), which adds another 39% to the benefits in terms of higher gross margins. Adding up financial and external benefits results in total benefits of US$284 per acre (US$701/hectare), or US$1.7 billion for the entire Bt cotton area in Pakistan."

Nasir et al. (2015) published the study "Estimation of Cost Benefit Ratio of Bt Cotton Growers in District Khanewl-Pakistan in 2015", which reveals that large farmers of Khanewal district earned more net revenue and gross margin compared with medium and small farmers of Khanewal district because more inputs induced profitability.

Also in 2015, Noonari et al. published the research study "Comparative Economics Analysis of Bt Cotton v/s Conventional Cotton Production in Khairpur District, Sindh, Pakistan, which demonstrates that higher profit was observed in cultivating Bt cotton than conventional cotton.

FUTURE PROSPECTS

In recent years, Pakistan built more biotech instutions to conduct further research. The crops under genetic transformation by different public sector institutions are: wheat, rice, sugarcane, cotton, soybean, chickpea, groundnut, brassica, potato, tomato and chili.

It is estimated that with the expected release of stacked traits of biotech cotton before 2015, Pakistan could gain significant benefits of approximately US$800 million per year to its farm economy, at 90% adoption of biotech cotton. Increased adoption of biotech cotton would substantially reduce insecticide sprays, less exposure of farmers and farm laborers to insecticides, higher quality of cotton and higher return to cotton farmers, and overall gains to the farm economy at national level.

SOURCES

James, Clive. 2015. 20th Anniversary (1996 to 2015) of the Global Commercialization of Biotech Crops and Biotech Crop Highlights in 2015. ISAAA Brief No. 51. ISAAA: Ithaca, New York.

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BIOTECH COUNTRY **FACTS & TRENDS**

South Africa

South Africa planted 2.3 million hectares of biotech crops in 2015.

In recent years, African spring rains came late, decreasing maize crop production in South Africa. The projected El Niño in 2015 was even more severe and lasted longer, decreasing the intended hectarage of all biotech crops in South Africa by 25%, or ~700,000 hectares. The devastating drought in 2015 decreased biotech crop hectarage from an intended record of 3.0 million hectares to 2.3 million hectares.

The total biotech crop area in South Africa in 2015 was 2.3 million hectares, down from 2.7 million hectares in 2014, a 15% decrease.

Biotech maize area in South Africa for 2015 is estimated at 1.8 million hectares at an adoption level of 90% of the 2 million total maize hectares. This hectarage is broken down into 550,000 hectares insect tolerant; 284,000 hectares herbicide tolerant; and 940,000 hectares of stacked Bt/HT.

Herbicide tolerant soybean is projected at 508,000 hectares, to be planted in 95% of 535,000 hectares in 2015 — down 8% from 552,000 hectares biotech in 2014, and down by ~160,000 hectares (24% decrease) from an intended 670,000 hectares in 2015.

In 2015, 12,000 hectares were planted with insect resistant biotech cotton, a 100% adoption rate.

COUNTRY PROFILE

Population: 54.5 million
GDP: US$384 billion
GDP per Capita: US$7,350
Agriculture as % GDP: 3%
Agricultural GDP: US$11.5 billion
% employed in agriculture: 5%
Arable Land (AL): 12.1 million hectares
Ratio of AL/Population*: 1.4

Major crops:
- Sugarcane
- Maize
- Wheat
- Grapes
- Potato

Commercialized Biotech Crops:
- HT/Bt/HT-Bt Cotton
- HT/Bt/HT-Bt Maize
- Ht Soybean

Total biotech crop area and (%) increase in 2015:
2.3 Million Hectares (-15%)
Increased farm income, 1998-2014: US$1.8 billion

*Ratio: % global arable land / % global population

BIOTECH CROP ADOPTION

South Africa planted insect resistant cotton, its first biotech crop, in

1998. Insect resistant maize was planted in 2000, herbicide tolerant soybean in 2001, and herbicide tolerant maize in 2003.

In 2015, 67 biotech events have been approved for food, feed and cultivation, including 4 Argentine canola events, 10 cotton events, 40 maize events, and 12 soybean events.

FUTURE PROSPECTS

The first biosafety guidelines in South Africa was developed by a small group of scientists in 1978. The GMO Act was approved in 1997, and entered into force in 1999 when GMO regulations were approved. Applications for permits are assessed by the national scientific Advisory Committee and their subcommittees, with recommendations forwarded to the national government's GMO Executive Council.

South African scientists interact and collaborate with international biotech counterparts, and conduct research on genomics and all other 'omics. The first sequencing of an organism in Africa was done by local scientists on the livestock heart water parasite, as was the first animal cloning of a goat.

Some new local innovations in biotech are: a patent on RNA hairpin duplexes for resistance to plant viruses, exploring valuable proteins in cassava leaves and modifying cassava to resist viruses, developing tobacco plants as biopharma factories for antibodies, a new anti-malaria drug, and marker genes for improved detection of new gene mutations that cause cystic fibrosis.

Awaiting regulatory approvals are: novel promoters, drought tolerance genes, maize streak virus resistance, and a range of experimental GM sugarcane events.

BENEFITS FROM BIOTECH CROPS IN SOUTH AFRICA

It is estimated that the economic gains from biotech crops for South Africa for the period 1998 to 2014 was US$1.8 billion and US$245 million for 2014 alone (Brookes and Barfoot, 2016).

SOURCES

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BIOTECH COUNTRY **FACTS & TRENDS**

Uruguay

HT soybean occupies 100% of Uruguay's national soybean hectarage.

In 2015, Uruguay had reduced planting of biotech soybean and maize at ~1.4 million hectares, a 12% decrease from 1.64 million hectares in 2014. Consistent with other countries, the decrease in total plantings of the two crops was probably due to low prices, along with other factors.

Biotech soybean occupies 100% of the national soybean hectarage of ~1.33 million hectares.

Biotech maize occupied 88,000 hectares in 2015, compared with 90,000 hectares in 2014. Of the 88,000 hectares of biotech maize, 97% was the stacked Bt/HT product.

ADOPTION OF BIOTECH CROPS

Uruguay introduced biotech soybean in 1996, followed by Bt maize in 2003. The country approved five events on the same day in early 2011. In September 2012, Uruguay approved 3 stacked insect resistant (IR) and herbicide tolerant (HT) biotech corn, 2 HT soybean and 1 stacked IR/HT soybean for commercialization.

In 2014, herbicide tolerant soybean CV127, insect tolerant corn MIR 162 and stacked Bt/HT MON 89034 × TC1507 × NK603 were approved for planting, for a total of 17 event approvals from 1996 to 2014.

BENEFITS OF BIOTECH CROPS IN URUGUAY

Uruguay is estimated to have enhanced farm income from biotech soybean and maize of US$179 million in the period 2000 to 2014 and the benefits for 2014 alone is estimated at US$30 million.

SOURCES

James, Clive. 2015. 20th Anniversary (1996 to 2015) of the Global Commercialization of Biotech Crops and Biotech Crop Highlights in 2015. ISAAA Brief No. 51. ISAAA: Ithaca, New York.

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COUNTRY PROFILE

Population: 3.4 million
GDP: US$49.9 billion
GDP per Capita: US$15,780
Agriculture as % GDP: 10%
Agricultural GDP: ~US$5 billion
% employed in agriculture: 10%
Arable Land (AL): 1.8 million hectares
Ratio of AL/Population*: 2.2

Major crops:
- Rice
- Maize
- Soybean
- Wheat
- Barley
- Sugarcane

Commercialized Biotech Crops:
- HT Soybean
- Bt Maize

Total biotech crop area and (%) increase in 2015:
1.4 Million Hectares (-12%)

Increased farm income, 2000-2014: US$179 million

*Ratio: % global arable land / % global population

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BIOTECH COUNTRY **FACTS & TRENDS**

Bolivia

Bolivia grew ~1.1 million hectares biotech soybean in 2015.

There are approximately 2 million hectares of cropland in Bolivia, and soybean is a major crop in the eastern region occupying 1.28 million hectares.

Biotech RR®soybean was grown on ~1.1 million hectares in 2015 in Bolivia, a slight increase from the 2014 hectares of ~1 million hectares.

The adoption rate of RR®soybean in 2015 was ~80% of the total 1.3 million hectares.

Soybean from Bolivia is exported to Chile, Colombia, Ecuador, Peru, and Venezuela. The total soybean export in 2014 was 1.5 MMT at US$1.1 billion and an estimated 1.7 MMT in CY2015.

ADOPTION OF BIOTECH CROPS

According to the 2015 FAO estimates, Bolivia ranks eighth in global soybean production with 1.2 million hectares, after the USA (31 million hectares), Brazil (28), Argentina (19), India (12), China (6.6), Paraguay (3), and Canada (1.8).

In 2008, Bolivia became the tenth country to officially grow RR®soybean of 600,000 hectares.

BENEFITS OF BIOTECH SOYBEAN IN BOLIVIA

The growth rate of biotech soybean plantings in Bolivia from 2008 to to 2015 has significantly doubled.

It estimated that economic gains from biotech crops for Bolivia for the period 2008 to 2014 was US$636 million and US$107 million for 2014 alone.

SOURCES

James, Clive. 2015. 20th Anniversary (1996 to 2015) of the Global Commercialization of Biotech Crops and Biotech Crop Highlights in 2015. ISAAA Brief No. 51. ISAAA: Ithaca, New York.

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COUNTRY PROFILE

Population: 11 million
GDP: US$59.2 billion
GDP per Capita: US$5,364
Agriculture as % GDP: 10%
Agricultural GDP: ~US$2.4 billion
% employed in agriculture: 32%
Arable Land (AL): 4.3 million hectares
Ratio of AL/Population*: 2.0

Major crops:
- Soybean
- Maize
- Coffee
- Cocoa
- Sugarcane
- Cotton
- Potato

Commercialized Biotech Crop: HT Soybean
Total biotech crop area and (%) increase in 2015:
1.1 Million Hectares (+10%)
Increased farm income, 2008-2014: US$636 million

*Ratio: % global arable land / % global population

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BIOTECH COUNTRY **FACTS & TRENDS**

Philippines

350,000 small, resource-poor farmers in the Philippines planted 702,000 hectares of biotech maize in 2015.

In 2015, the area planted to biotech maize in the Philippines decreased to 702,000 hectares from 831,000 hectares in 2014 due to drought conditions in the maize-growing areas of the country.

The adoption rate of biotech maize in 2015 is similar to 2014 at 63%.

The area occupied in 2015 by the stacked traits Bt/HT maize is 646,600 hectares or 92% of the total area planted for biotech maize; and with only 8% for herbicide tolerant maize at 55,000 hectares.

The number of small resource-poor farmers, growing on average 2 hectares of biotech maize in the Philippines in 2015 was estimated at 350,000.

In December 2015, the Supreme Court of the Philippines ruled that Bt eggplant, already successfully grown in Bangladesh for two years, was not approved for the Philippines.

Farm level economic gains from biotech maize in the Philippines in the period 2003 to 2014 is estimated at US$560 million and for 2014 alone at US$89 million (Brookes and Barfoot, 2016).

COUNTRY PROFILE

Population: 100.7 million
GDP: US$250 billion
GDP per Capita: US$2,590
Agriculture as % GDP: 12%
Agricultural GDP: US$30 billion
% employed in agriculture: 32%
Arable Land (AL): 5.4 million hectares
Ratio of AL/Population*: 0.2

Major crops:

- Sugarcane
- Coconut
- Rice
- Maize
- Banana
- Cassava
- Pineapple
- Mango

Commercialized Biotech Crop: Bt/HT/Bt-HT Maize
Total biotech crop area and (%) increase in 2015:
0.702 Million Hectares (-12%)
Increased farm income, 2003-2014: US$560 million

*Ratio: % global arable land / % global population

BIOTECH CROP ADOPTION

The total hectarage planted to the single trait Bt maize decreased by 76% in 2012, with no single trait Bt maize being planted since 2013.

Single trait herbicide tolerant (HT) maize was planted on 70,000

hectares in 2014, which is only 8.4%, of the total biotech maize planted in the country, and this was further reduced to 8% or 55,000 hectares in 2015.

On a percentage basis, biotech yellow maize has consistently increased by about 5% of the total yellow maize hectarage every single year from the first year of commercialization in 2003, reaching the highest level of 63% in 2014 (up from 62% in 2013).

A total of 13 biotech maize events have been approved for commercial planting in the Philippines since 2002: 3 single Bt, 4 single HT, 2-two Bt genes stacked, and 4 Bt/HT stacked trait.

In addition, a total of 75 biotech crops and products are currently approved for direct use as food, feed and for processing in the Philippines that include alfalfa, canola, cotton, maize, potato, rice, soybean, and sugar beet.

FUTURE PROSPECTS

New biotech crop products are being developed by national and international institutions in the Philippines.

Golden Rice (GR), is a biofortified rice being developed by the Philippine Rice Research Institute (PhilRice) and the International Rice Research Institute (IRRI). IRRI has reported that as of March 2014, the research, analysis, and testing of beta-carotene-enriched GR continues, in collaboration with national research agencies in the Philippines, Indonesia, and Bangladesh.

In March 2015, the anticipated global impact of the Golden Rice project in alleviating malnutrition was acknowledged when it was granted by the United States Patent and Trademark Office (USPTO) the prestigious 2015 Patents for Humanity Award on nutrition (IRRI, 20 April 2015). The award recognized the vision of Golden Rice (GR) co-inventors Ingo Potrykus and Peter Beyer, and the GR Humanitarian Board Secretary

Adrian Dubock for their royalty free access patent application for the Project, enabling small holder farmers to benefit from Golden Rice. This royalty free access has enabled IRRI and partner public institutions to continue research and development of Golden Rice on a not-for-profit basis.

The fruit and shoot borer resistant Bt eggplant project led by the Institute of Plant Breeding of the University of the Philippines at Los Baños (IPB-UPLB), was also a royalty-free technology donated by the Maharashtra Hybrid Seed Company (Mahyco) through a sublicense agreement. The proponents already completed field trials of promising hybrid varieties in the approved multi-location trial sites in Luzon and Mindanao in 2012.

Biotech papaya with delayed ripening and papaya ring spot virus (PRSV) resistance, by IPB-UPLB, has already been tested in confined field trials in 2012.

Bt cotton is being developed by the Philippine Fiber Development Administration (PFIDA, formerly the Cotton Development Authority). The technology, provided by Nath Biogene Ltd. and the Global Transgene Ltd. from India was tested for the first time in a confined field trial in 2010, started multi location field trials in 2012, and in 2013, data to complete regulatory dossiers are being collected in 2015 for commercialization purposes.

BENEFITS FROM BIOTECH CROPS IN THE PHILIPPINES

The benefits of biotech maize to Filipino farmers' livelihood, income, the environment and health have been well studied and documented. Farms planted with Bt maize in the Northern Philippine provinces have significantly higher populations of beneficial insects such as flower bugs, beetles, and spiders than those planted with conventional hybrid maize (Javier et al. 2004).

The farm level economic benefit of planting biotech maize in the Philippines in the period 2003 to 2014 is estimated to have reached US$560 million. For 2014 alone, the net national impact of biotech maize on farm income was estimated at US$89 million (Brookes and Barfoot, 2016).

SOURCES

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