

“Role of Agricultural Biotechnology in Responding to Challenges on Climate Change, Food Security and Agriculture”

Sidi Asmono

Indonesia Coordinator

Program for Biosafety Systems (PBS), IFPRI

UN CAPSA Workshop

Bogor, 25 November 2014

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY **IFPRI**

Overview

- I. Introduction
- II. F A O
- III. Global Ag Biotech status
- IV. Global challenges
- V. Ag Biotech one tools to address the challenges
- VI. Ag Biotech impact

I. Introduction

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

PBS – Who We Are & How We Work

- Independent
 - Share the evidence and science of biosafety
 - No product to sell
- **Local knowledge** through sustained local teams
- A diverse, comprehensive, integrated approach
 - Food, feed and environmental safety experts
 - Independent policy research
 - Economists, ex-regulators
 - Legal analysis
 - Innovative and integrated outreach approaches
- Reproducible models and best practices

Where We Work

- 
- Asia
 - Vietnam
 - Indonesia
 - Philippines
 - Global
 - Cartagena Protocol
 - Africa
 - Kenya
 - Uganda
 - Nigeria
 - Malawi
 - Tanzania
 - Ghana
 - Ethiopia
 - Regional harmonization
 - COMESA, ECOWAS

Services We Provide

- Capacity building for national biosafety officials
- Technical support for development of operational biosafety policies
- Guidelines for safety trials
- Farmer release guidelines
- Functional coordination among agencies
- Strategic outreach & communication
 - Science fact management
 - Capacity building for decision makers
- Strategy support



II. F A O

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI



FAO's Director General

29 September 2014

FAO calls for “paradigm shift” towards sustainable agriculture and family farming

“ ... Options such as Agro-ecology and climate smart agriculture should be explored, and so should **biotechnology and the use of genetically modified organisms**, FAO's director-general said, noting that food production needs to grow by 60 percent by 2050 to meet the expected demand from an anticipated population of 9 billion people. "We need to explore these alternatives using an inclusive approach based on science and evidences, not on ideologies," as well as to "respect local characteristics and context," he said.

Source : <http://www.fao.org/news/story/en/item/250148/icode/>

Program for Biosafety Systems – <http://pbs.ifpri.info/>



III. Global Ag Biotech status

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Worldwide Importance

27 COUNTRIES PLANTED BIOTECH CROPS IN 2013



FOR THE SECOND CONSECUTIVE YEAR DEVELOPING COUNTRIES PLANTED MORE BIOTECH CROP HECTARES THAN INDUSTRIAL COUNTRIES

19 DEVELOPING COUNTRIES

94.1 Million Hectares

Brazil	Burkina Faso
Argentina	Myanmar
India	Mexico
China	Colombia
Paraguay	Sudan
South Africa	Chile
Pakistan	Honduras
Uruguay	Cuba
Bolivia	Costa Rica
Philippines	

8 INDUSTRIAL COUNTRIES

81.1 Million Hectares

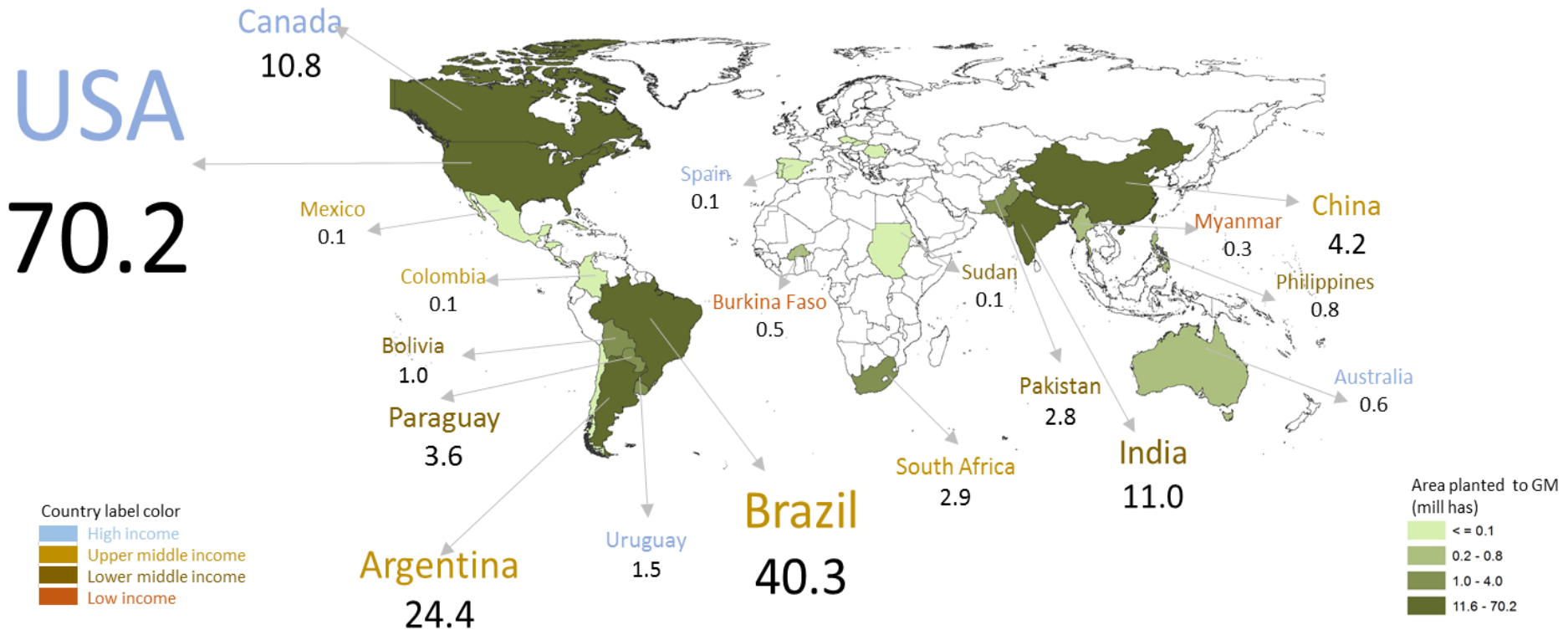
USA	Portugal
Canada	Czech Republic
Australia	Romania
Spain	Slovakia

SOURCE: ISAAA, 2014.

Worldwide Importance



Grown in 27 countries on 175.3m ha.

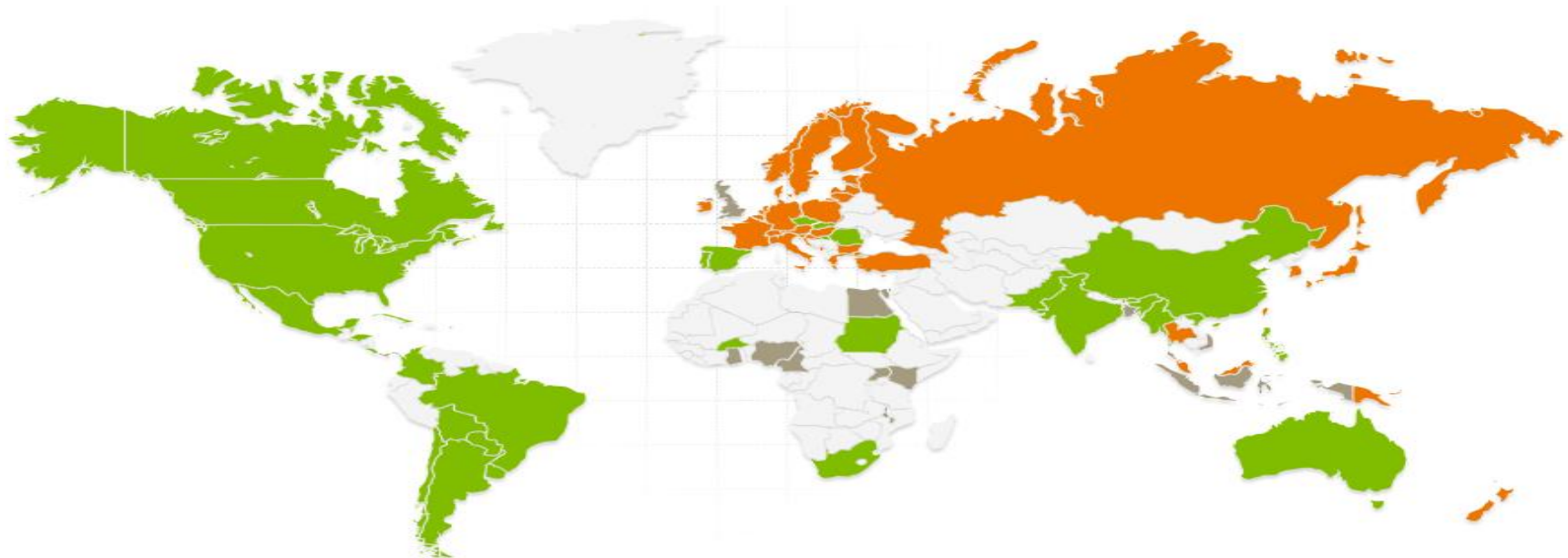


Of the 17.3 million farmers, about 14.7 million were smallholder farmers from China, India and the Philippines.

Global Use & Development

AS OF 2013, GMOS ARE **GROWN**, **IMPORTED**, AND/OR USED IN **FIELD TRIAL RESEARCH** IN **70 COUNTRIES**.

● Growing Biotech and Granting Import Approvals ● Granting Import Approvals ● Approving Research Field Trials



GM Crops Being Grown

Reduced Pesticide Use

- Insect resistant maize
- Insect resistant cotton
- Virus resistant squash
- Insect resistant soybean
- Virus resistant papaya

No-till Compatible

- Herbicide tolerant canola
- Herbicide tolerant cotton
- Herbicide tolerant maize
- Herbicide tolerant soybean
- Herbicide tolerant sugar beet



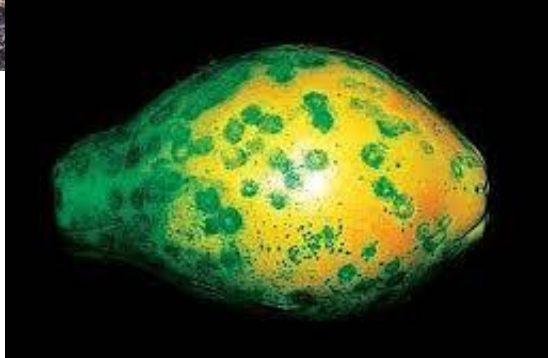
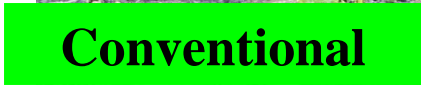
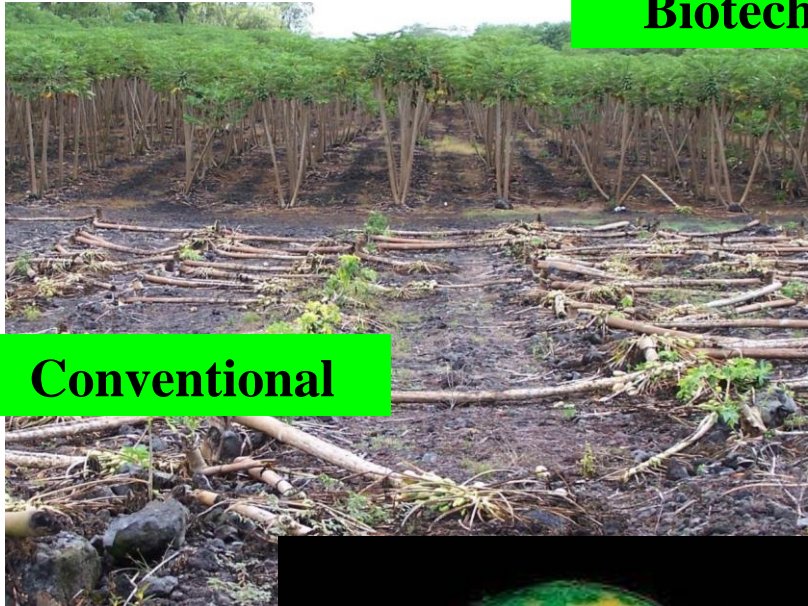
<http://www.isaaa.org/gmapprovaldatabase/>

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Results



Additional Potential

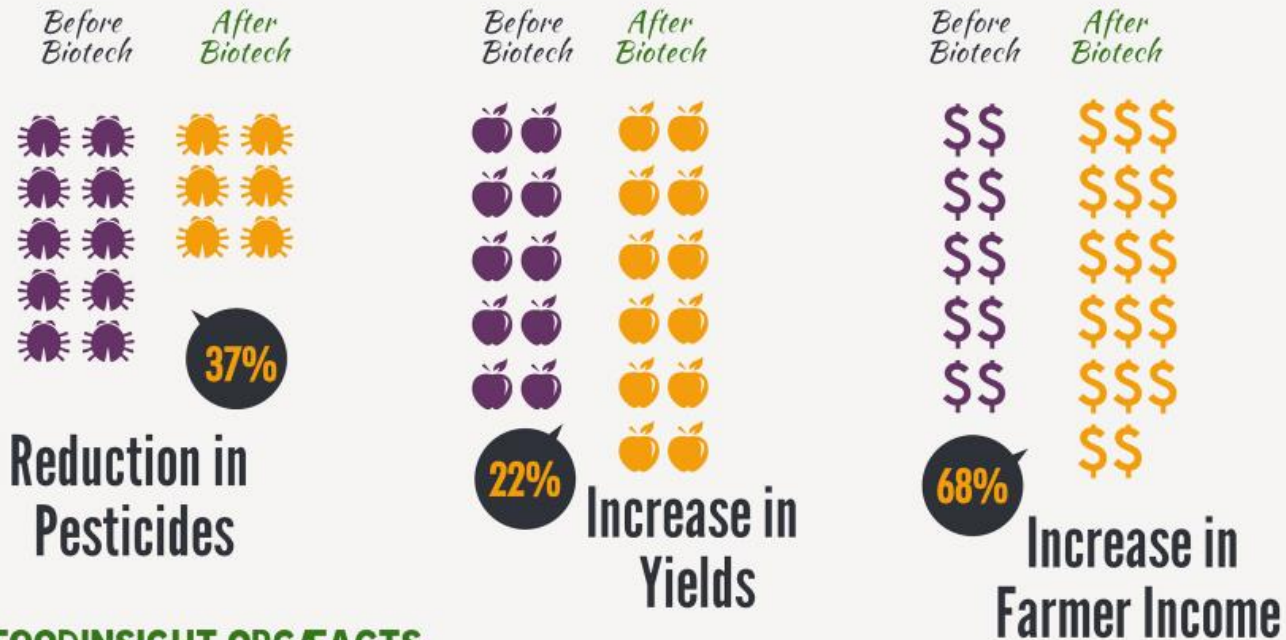
- Banana
 - Enhanced nutrition
 - Disease resistant
- Cowpea
 - Insect resistant
- Cassava
 - Virus resistant
 - Enhanced nutrition
- Maize
 - Drought tolerant
- Rice
 - Salt & drought tolerant
 - Enhanced nutrition
- Sugarcane
 - Drought tolerant
- Eggplant
 - Insect tolerant



Meta Analysis Study

IMPACTS OF BIOTECH

The latest PLOS ONE metastudy looked at the impacts of biotechnology. We dove in.



FOODINSIGHT.ORG/FACTS

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

III. Global Challenges

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Challenge to feeding 7 billion growing global population

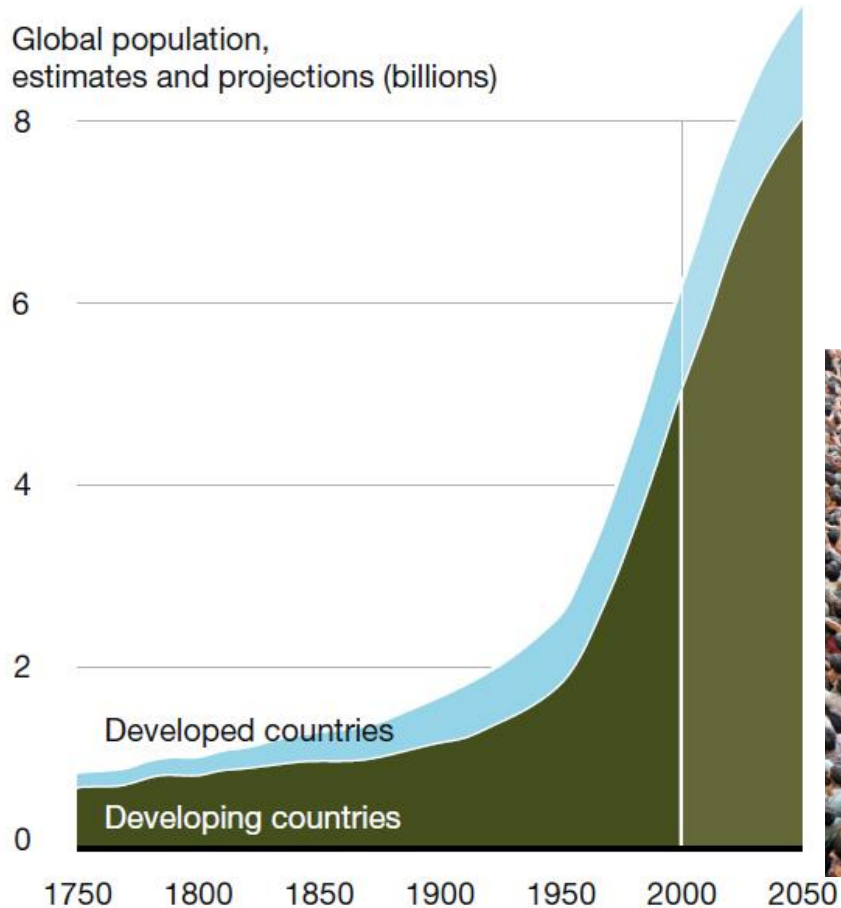


Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Demographic Changes

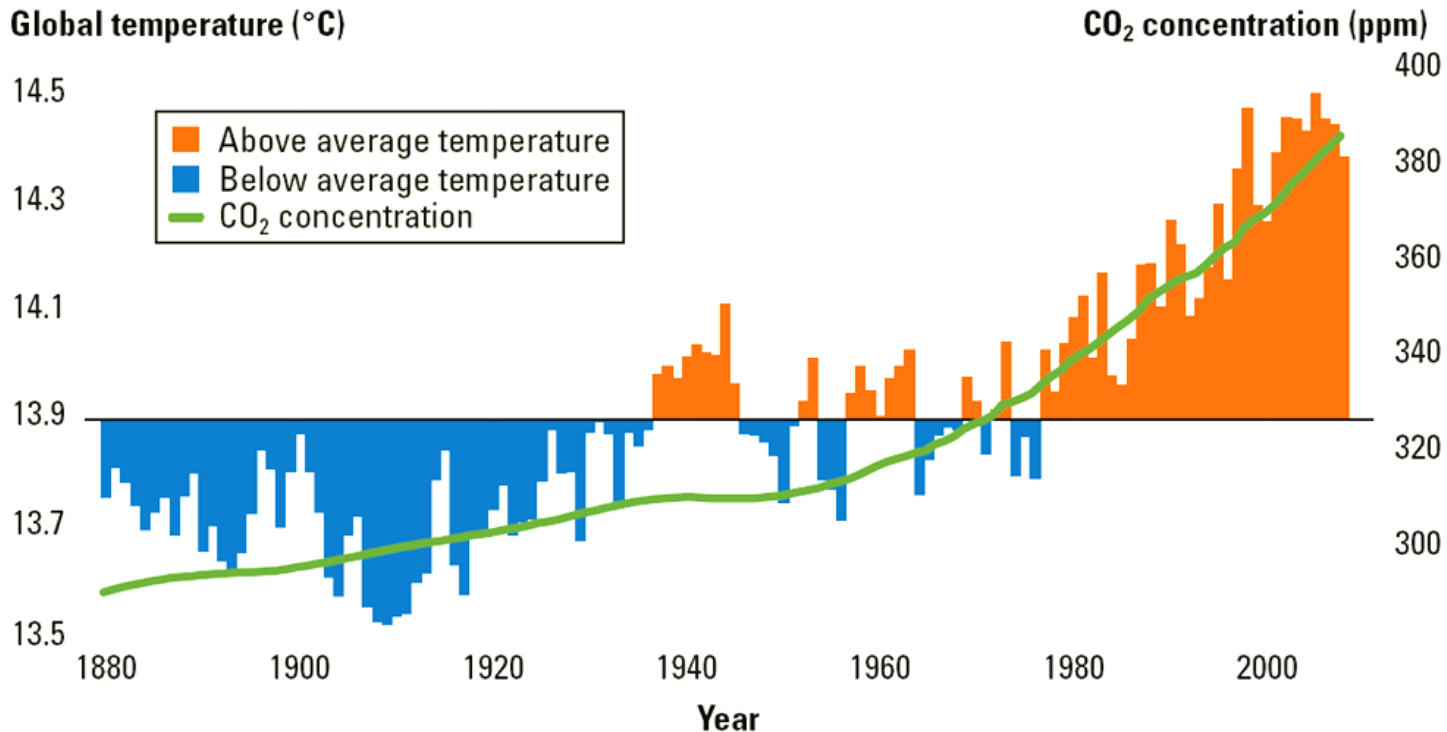


~7 billion in 2011
~ 9 billion by 2050
~25% Increase in Asia



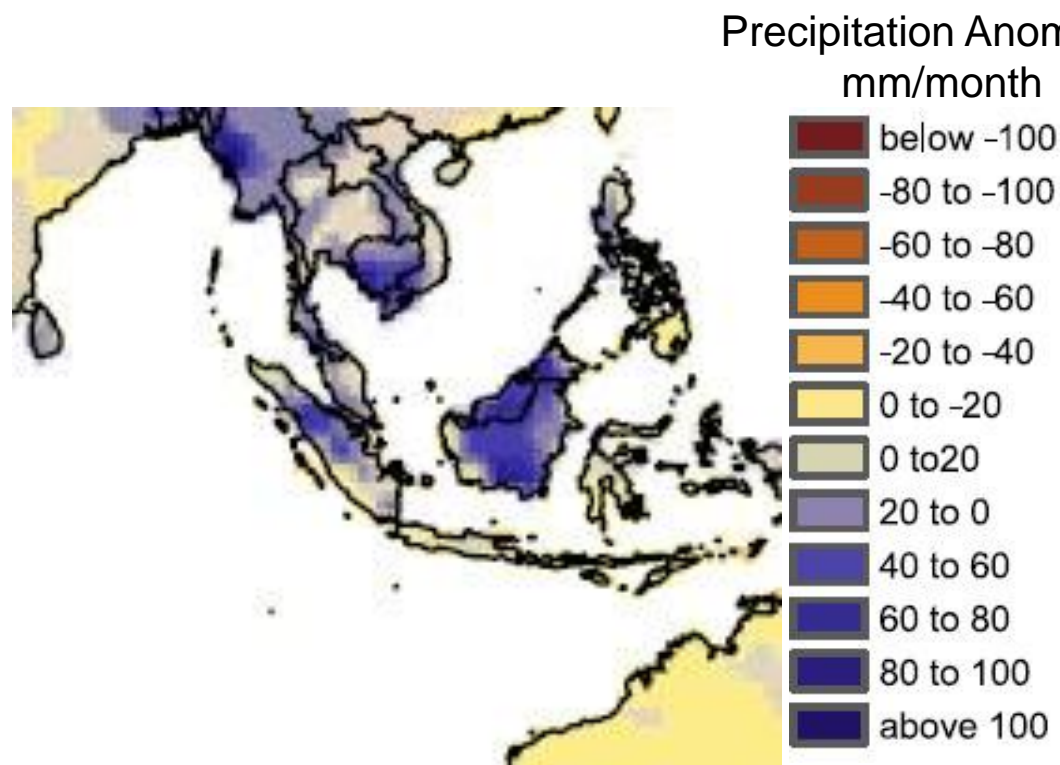
Rising levels of °C and CO₂

Figure FA.3 Global annual average temperature and CO₂ concentration continue to climb, 1880–2007



Source: Adapted from Karl, Melillo and Peterson, 2009

Change in Rainfall Patterns

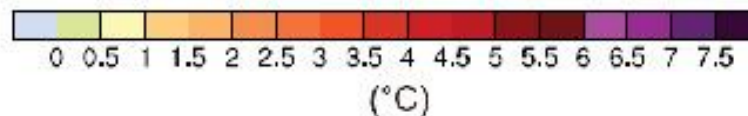
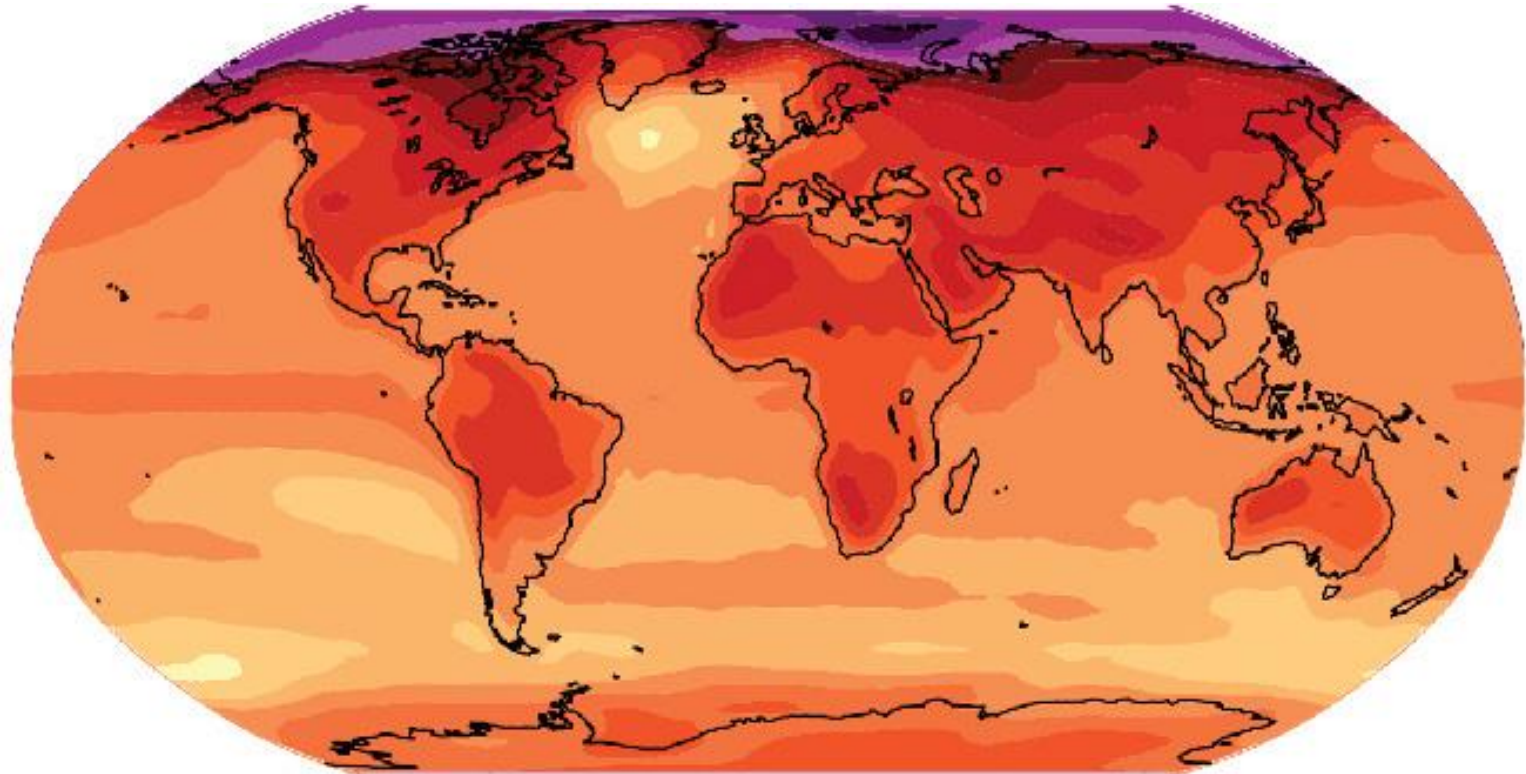


One model of changes in patterns of rainfall for the end of the century

Source: Gumpenberger et al., Env. Res Letters
2010

Global Warming

Predicted increase in surface temperature in 2090



Source: IFPRI

Global warming would result in

- Melting of the polar ice-caps which will in turn cause
- A rise in sea level which may threaten the existence of 4,000 Islands in Indonesia
- And on others may result in the Salinization of coastal regions

Consequences

Increase in the frequency of floods...



Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Consequences and also of droughts



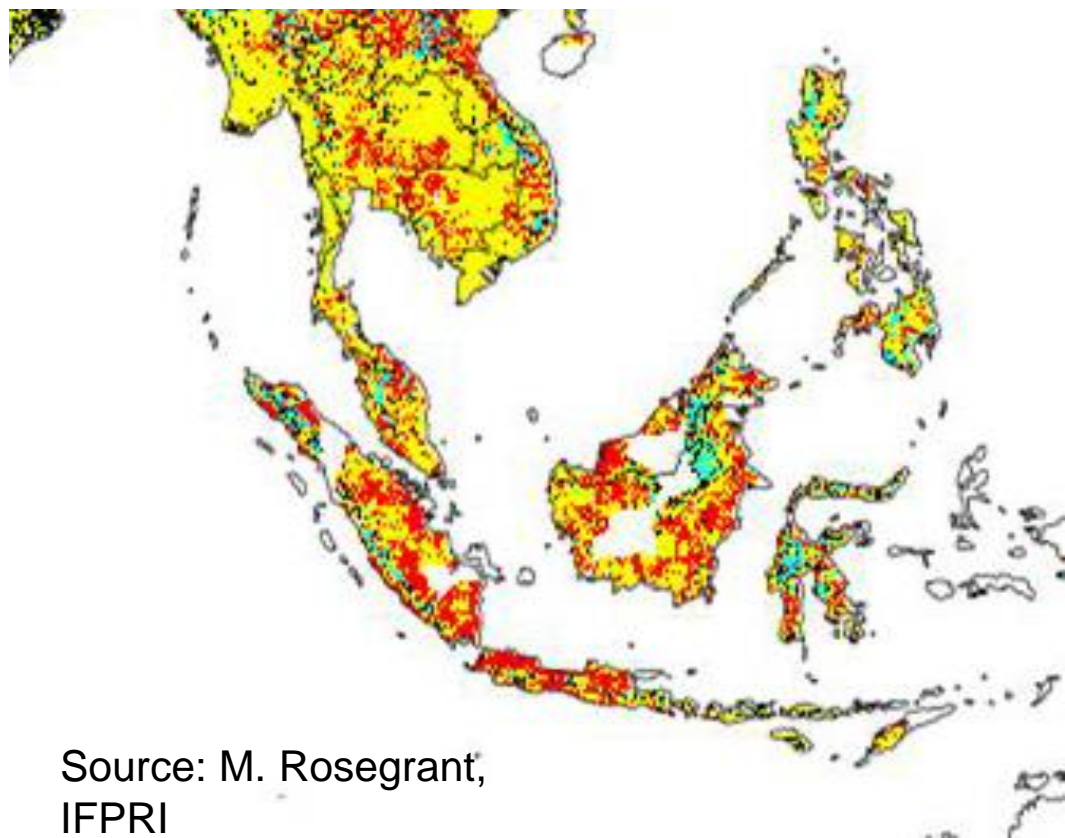
Program for Biosafety Systems – <http://pbs.ifpri.info/>







FACILITATED BY IFPRI

Consequences

Percentage change in Irrigated Rice production in 2050



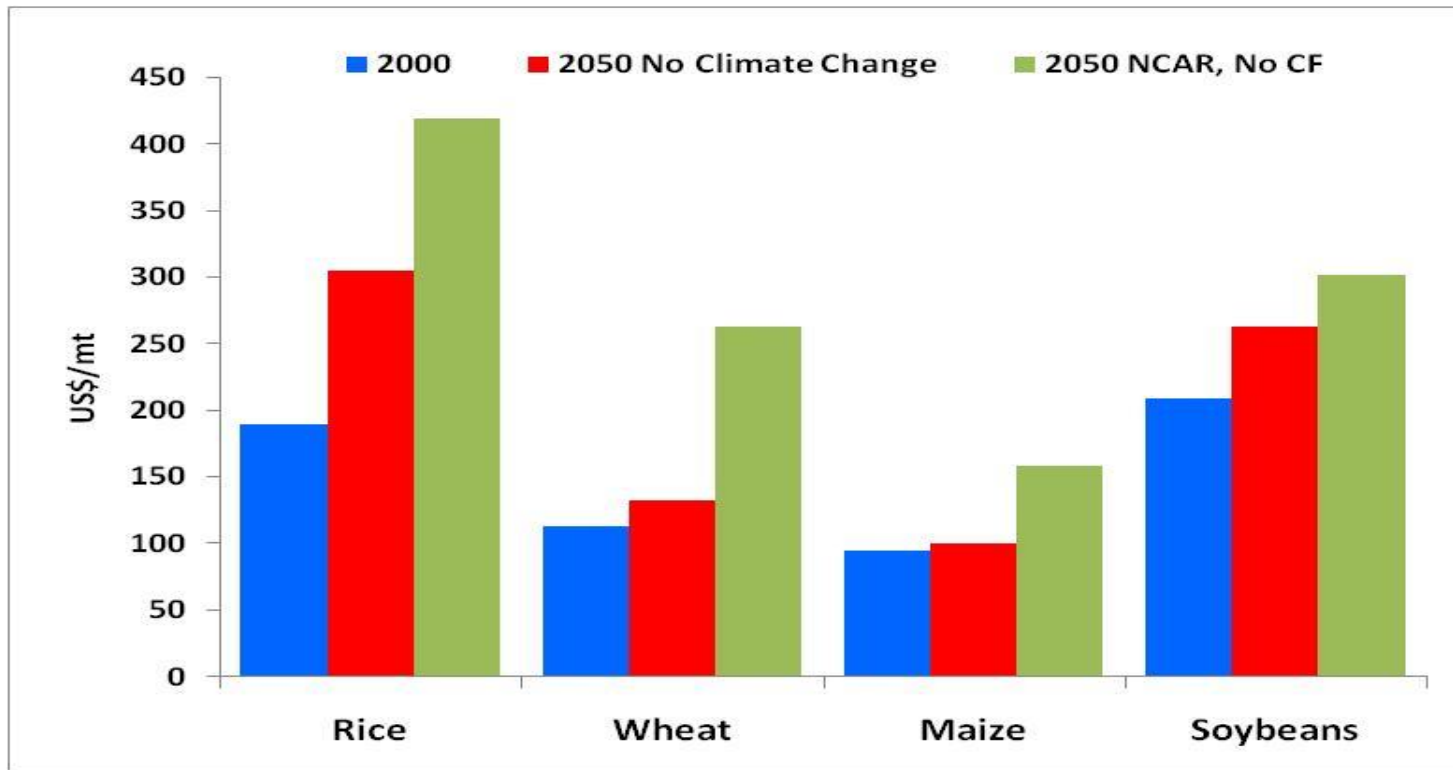
**Average Reduction
in Yield in Asia –
27%**

-  2000 old area lost
-  loss > 25% of baseline
-  loss 5–25%
-  change within 5%
-  gain 5–25%
-  gain > 25%
-  2050 new area gained

Source: M. Rosegrant,
IFPRI

Consequences

Impact on International Food Prices



Price increase due to climate change: ~13% (soybean) to >100% (rice, wheat)

Source: M. Rosegrant,
IFPRI

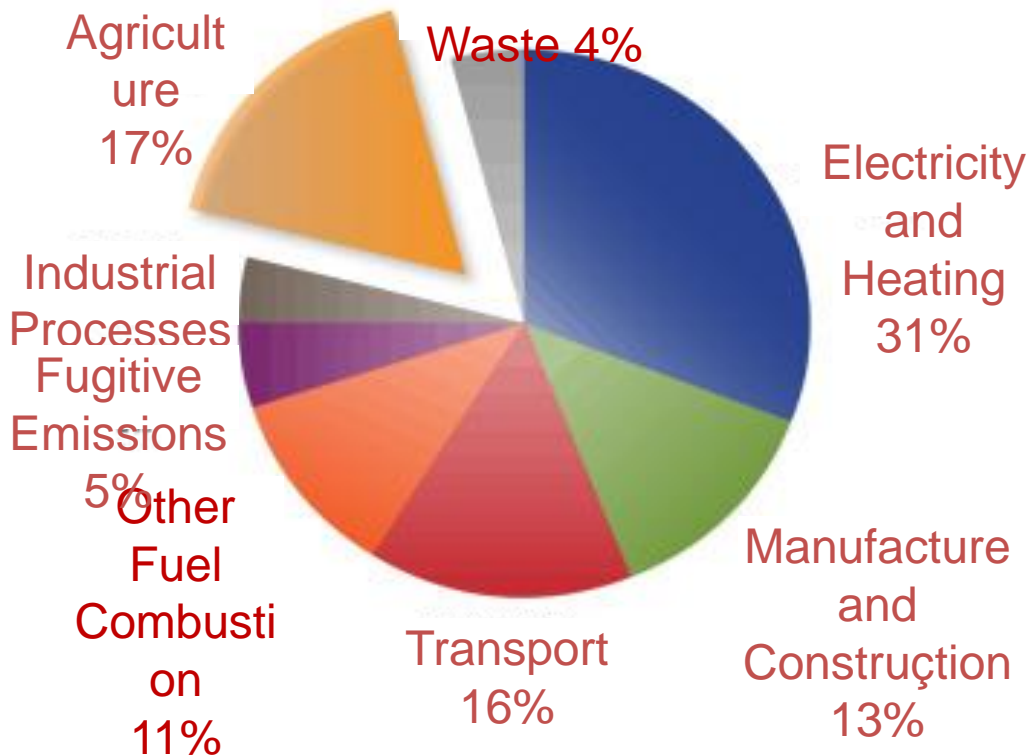
Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

The Role of Agriculture

Greenhouse gas Emissions by sector



Agriculture is the second most important sources of greenhouse gases

Source: WRI 2008

UN Millenium Development Goals



V. Ag Biotech tools to address challenges

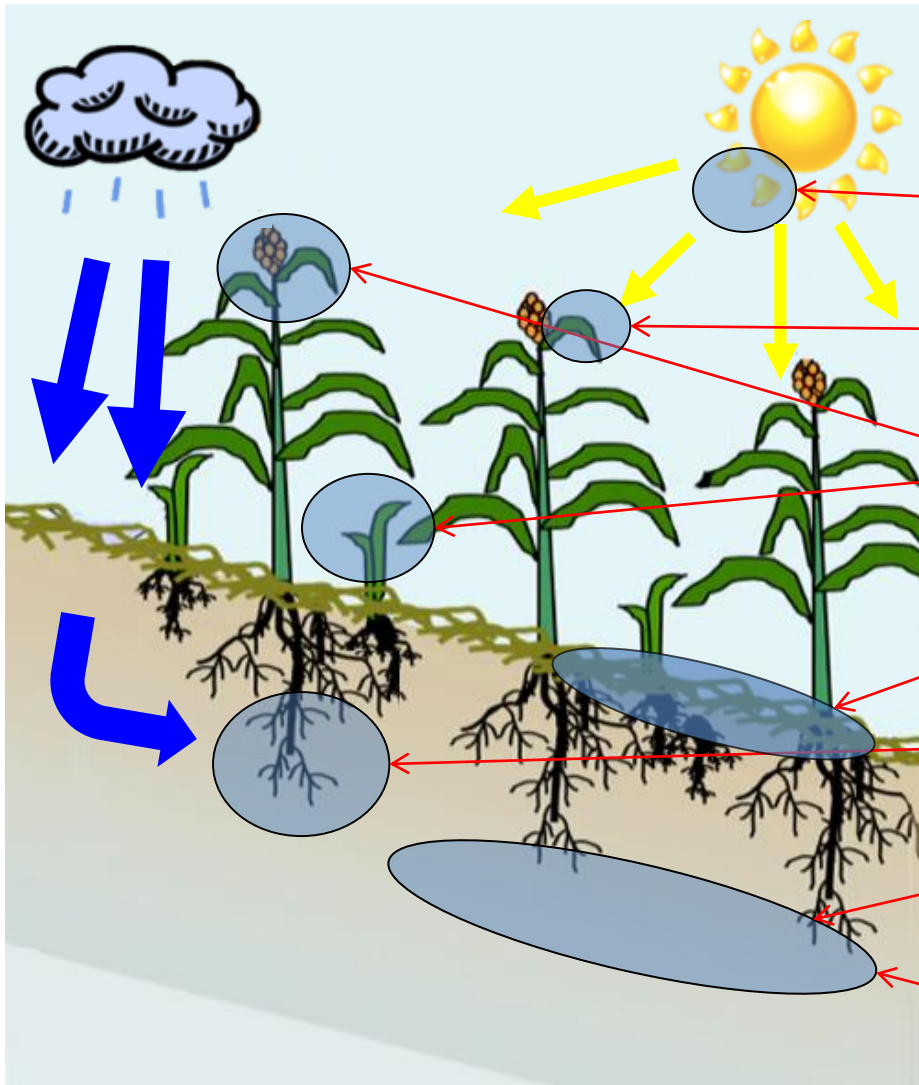
Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Biotechnology wholly compatible with sustainable intensification

Biotechnology contributions to sustainable intensification



Tolerance to higher **temperatures** (including modifying transpiration)

Improved **photosynthetic** efficiency

(improved nutritional quality)

through **biofortification** of cereals/legumes (including as fodder)

Reduce tillage through biotech-enabled **weed** management

More efficient uptake of **water**, including tolerance to moderate

drought

More efficient usage of soil

nitrogen

Tolerance of crops to **saline soils** & brackish water (including removing salt from soils)

Drought Tolerance Sugarcane

Variety : NXI-4T

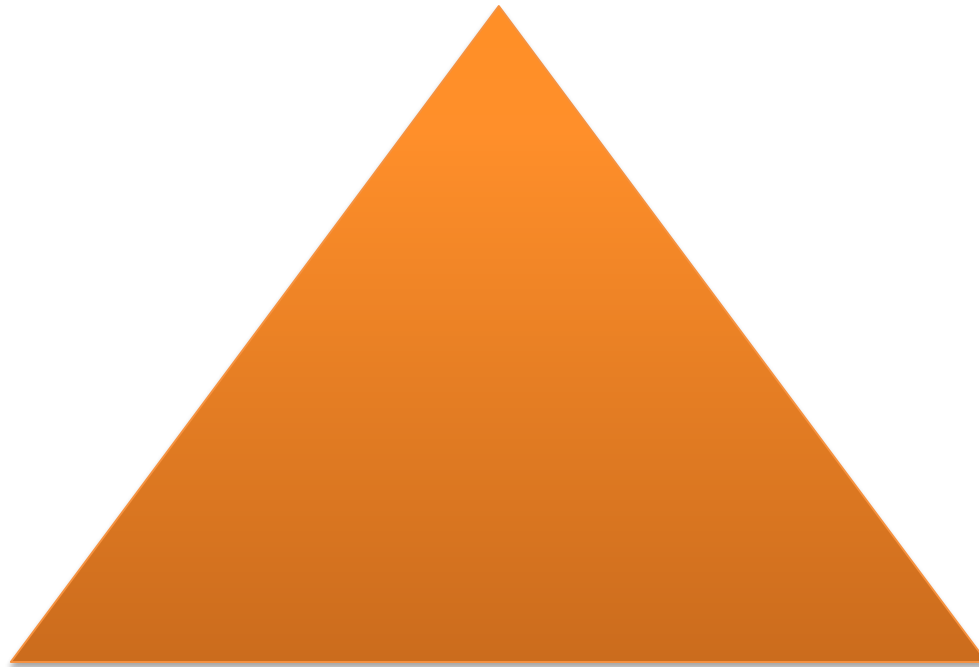


Source ; PTPN XI

- The 1st GM Sugarcane in the world, as well as the 1st Indonesian GM Product
- Developed by PTPN XI (state owned company) and University of Jember
- Improved sugar content by 28 %
- Optimize marginal land use
- Potentially boost sugar production

Public Private Partnership

Government



Academia

Industry

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Golden Rice

Nutrition Enhance Vitamin A

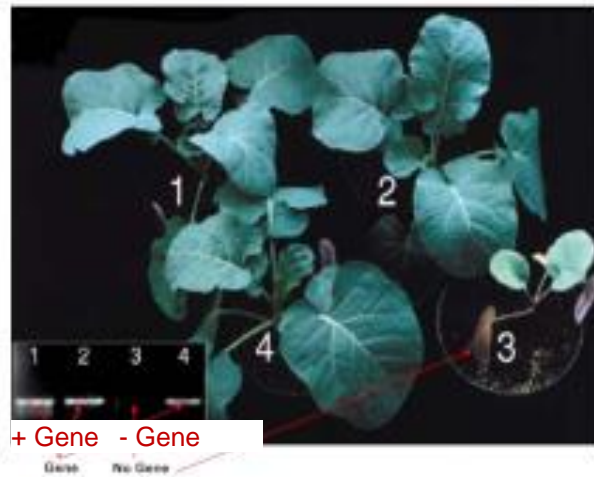


Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Nitrogen Use Efficiency (NUE)



The alanine amino transferase gene, derived from Barley. Simolar genes can be found in other plant species

Source: Arcadia Biosciences Inc.



NUE Canola



Conventional Canola

Nitrogen Use Efficiency



NUE Rice

Conventional Rice

Source: Arcadia
Biosciences Inc.

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Nitrogen Use Efficiency

Transgenic (GM) NUE Varieties under development

- Wheat
- Barley
- Maize
- Rice
- Canola
- Rape

Drought Tolerance

Control

Transgenic



Rice



A B C -

A B C -

Source: Arcadia Biosciences Inc.

Tolerance to Flooding



Damage
due to
flooding

Source: P. Ronald U.C. Davis

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Tolerance to Flooding

Tolerant
Line



Susceptible
Lines

Salt Tolerance

Tolerance to 200 mM NaCl In



Source: E. Blumwald
U.C. Davis

Heat Tolerance

Global warming and Rice Yields

An increase of 1 °C in night-time minimum temperatures is associated with a loss in yield of 10%
(IRRI Study)

Source: Peng *et al.* 2004 PNAS
101:9971-9975.

Heat Tolerance

Transgenic

Control



Canola

Source: M. Devine, Performance Plants Inc.

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

The Future

- Transgenic varieties with increased tolerance to high levels of Ozone (O_3)
- Transgenic varieties which take advantage (increased photosynthesis levels) of high CO_2 levels
- And?

VI. Ag Biotech impact

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Rosalie Ellasus

San Jacinto, Pangasinan, Philippines



Benefits

“I tried Bt corn after attending the Farmers’ Field School.

During that time, infestation of ordinary corn in our place was so high. But... with the Bt corn, I really saw that crops were so healthy. There was not even a trace of pests considering that they did not apply insecticide.

Furthermore, you no longer need to visit your corn field everyday and this gives you peace of mind. The production cost will be lessened as well, compared to conventional corn farming and the yield will be more. This is why I adopted Bt corn.”

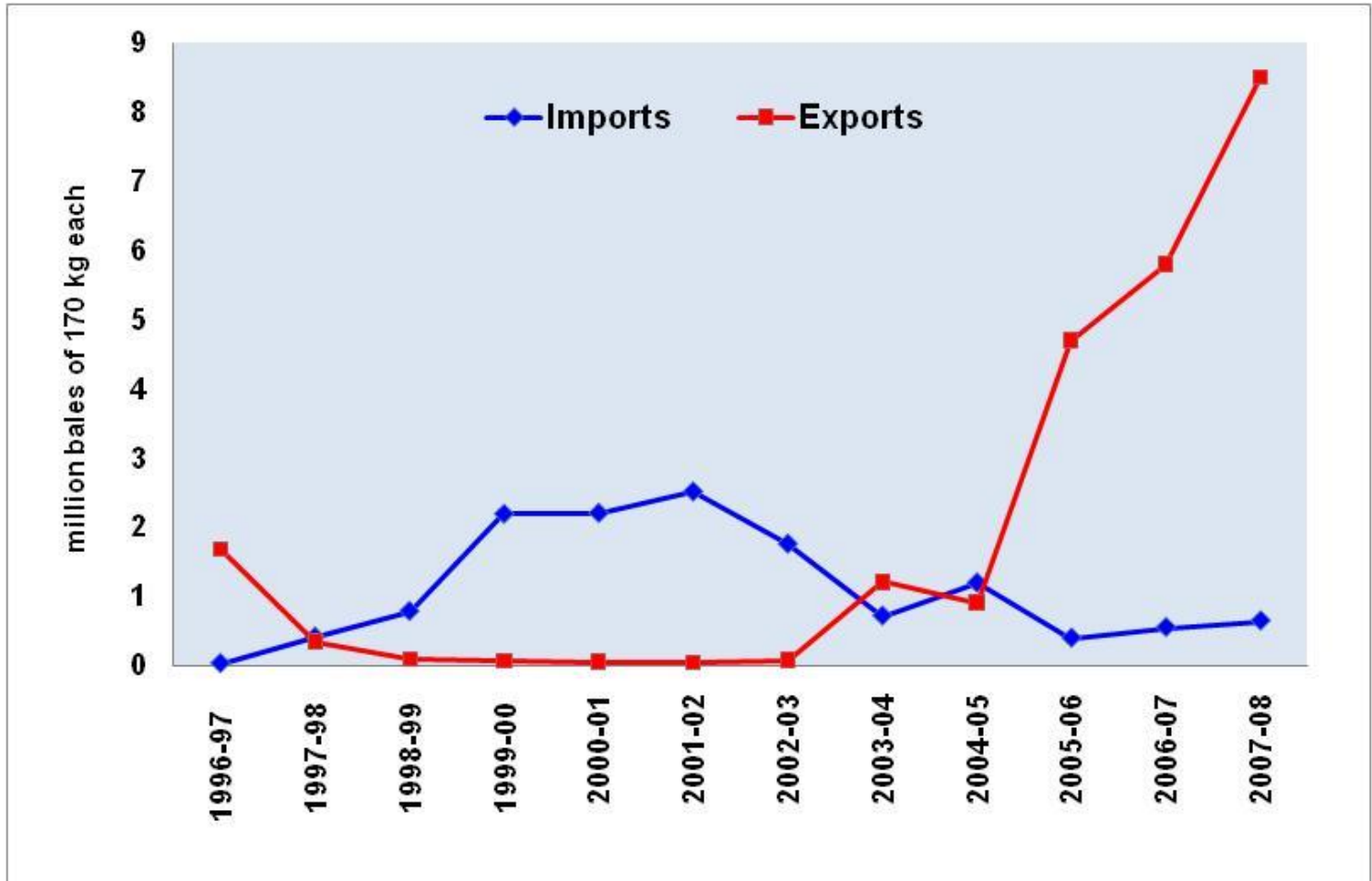
Benefits

Indalencio Supan
Balitucan, Magalang
Pampanga, Philippines

“We started to plant Bt corn in 2003. Because of planting Bt corn, we were able to buy a house and lot, farm machineries and even farm land.”



Impact: India emerged as 2nd largest exporter of cotton



Source: Cotton Advisory Board 2009

Program for Biosafety Systems – <http://pbs.ifpri.info/>

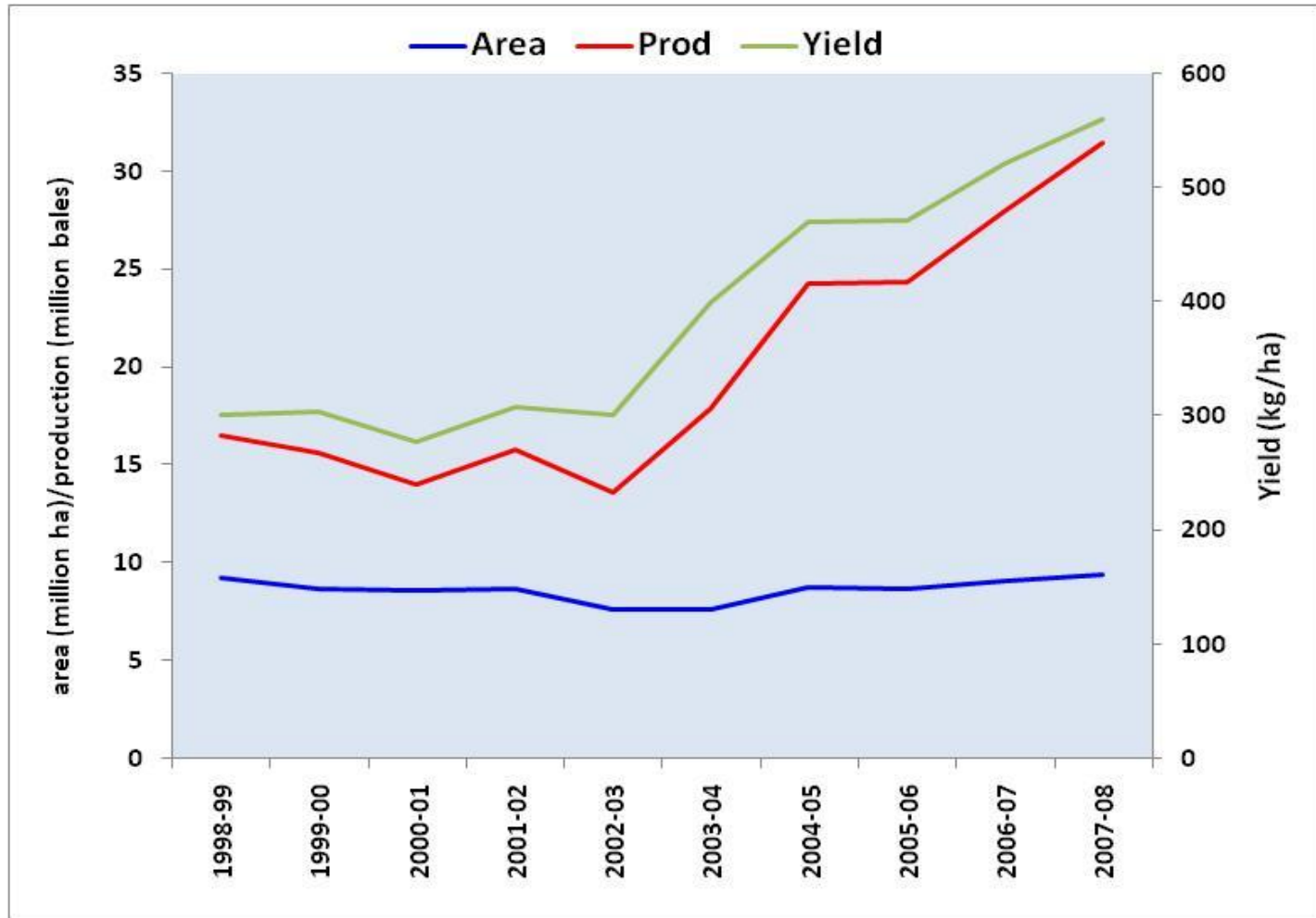


FACILITATED BY IFPRI

India: Bt Cotton

contributed to doubling of yields in 5 years

Source: Cotton Advisory Board



Biotech vs. non Biotech?

Source: Chrispeels & Sadava: Plants, Genes & Crop Biotechnology

Compared to what?



Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Biotechnology for Agriculture

- Significant progress is being made on drought tolerance, salt tolerance, and nitrogen use efficiency
- Largest benefits could be in rainfed and marginal environments, increasing crop yields and income and reducing pressure on irrigated environments
- Must still resolve public acceptance and biosafety issues and transfer of technology
- Public-private partnerships for development and commercialization of biotech/GMO varieties

THANK YOU

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Backup Slides

Program for Biosafety Systems – <http://pbs.ifpri.info/>



FACILITATED BY IFPRI

Brazil

- 2ND largest biotech adoption country in the world
- Biotech became economic engine for the country to strengthen their position as exporter country

Biodiversity is actually enhanced by the adoption of GM crops. Those crops commercialized to date have reduced the impacts of agriculture on biodiversity, through enhanced adoption of conservation tillage practices, reduction of pesticide use and use of more environmentally benign herbicides and through increasing yields to alleviate pressure to convert additional land into agricultural use

(Dr. Martina Newell, Director of International Biotechnology, University of California Davis)

Vietnam

- Regulation : if 5 developed countries (OECD category) has approved the food safety of biotech products, Vietnam regulatory systems will automatically approved.
- No separate approval for food and feed safety
- Approved Biosafety Certificates
 - Herbicide Tolerance Maize (GA 21 & NK 603)

Philippines

- More than 10 years biotech adoption
 - Contributed significant corn production increase
- Country owned biotech products :
 - Cotton
 - Maize
 - Bt Eggplant
- Stacked traits : Bt and Herbicide Tolerant

Indonesia

- ICABIOGRAD :
Potato : leaf blight resistance

- LIPI :
Rice : stem borer resistance (Bt)