Biotechnology: Ownership and control of genetic resources:
An Amazing Battle!

Three Questions from the Biotech debate:

Question 1: What IS biotech being used for? What drives the expansion of GMO acreages?

A. Pro: It is used to create better, more productive, and environmentally-friendly products.

B. Con: Research is just going to high-profit crops.

Question 2: What are the risks of GMOs?

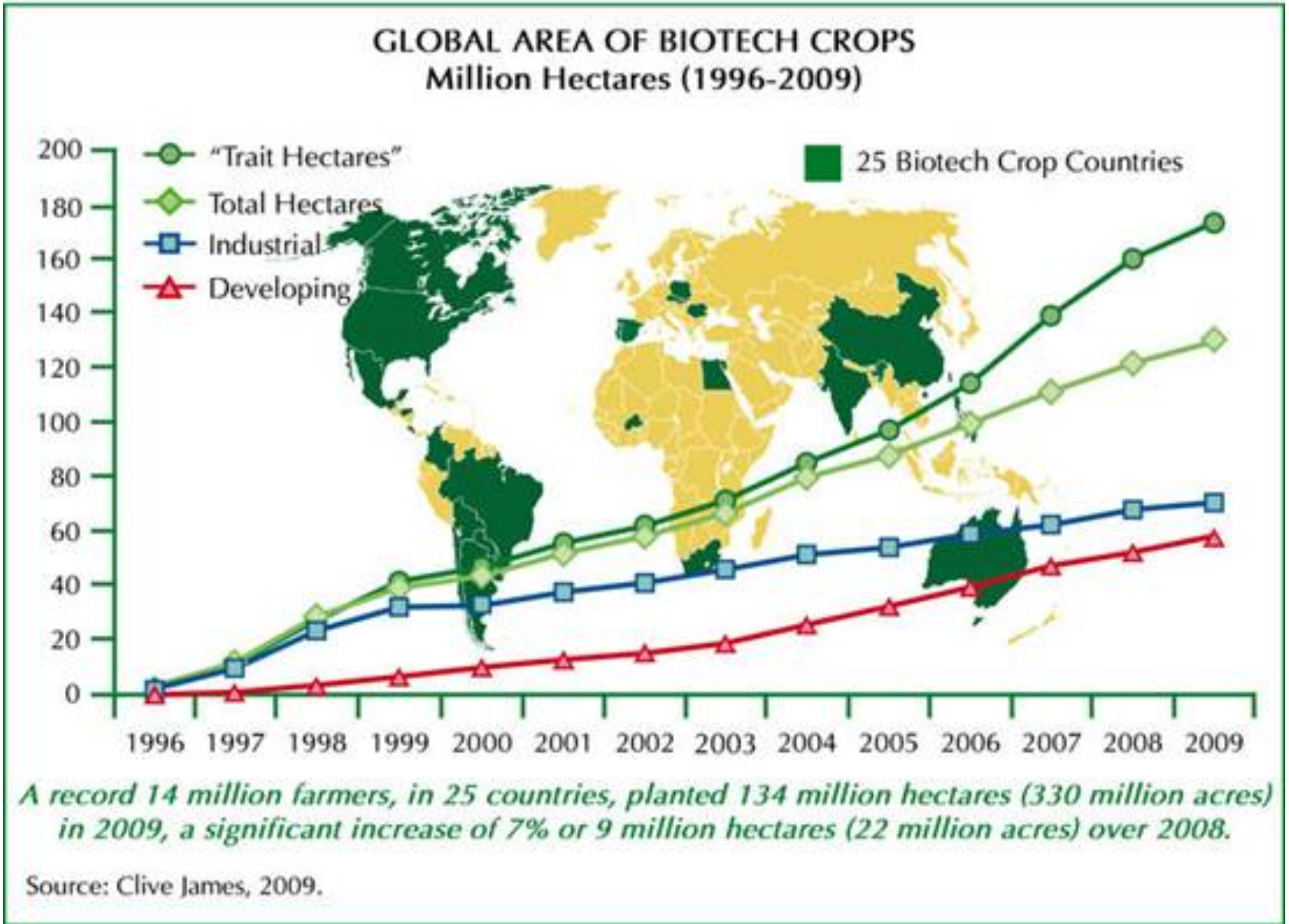
Do Risks outweigh benefits?

Question 3: Who owns genes? ¿Can genes be bought, sold and owned under existing U.S. law?

Yes, maybe...current law may be changing

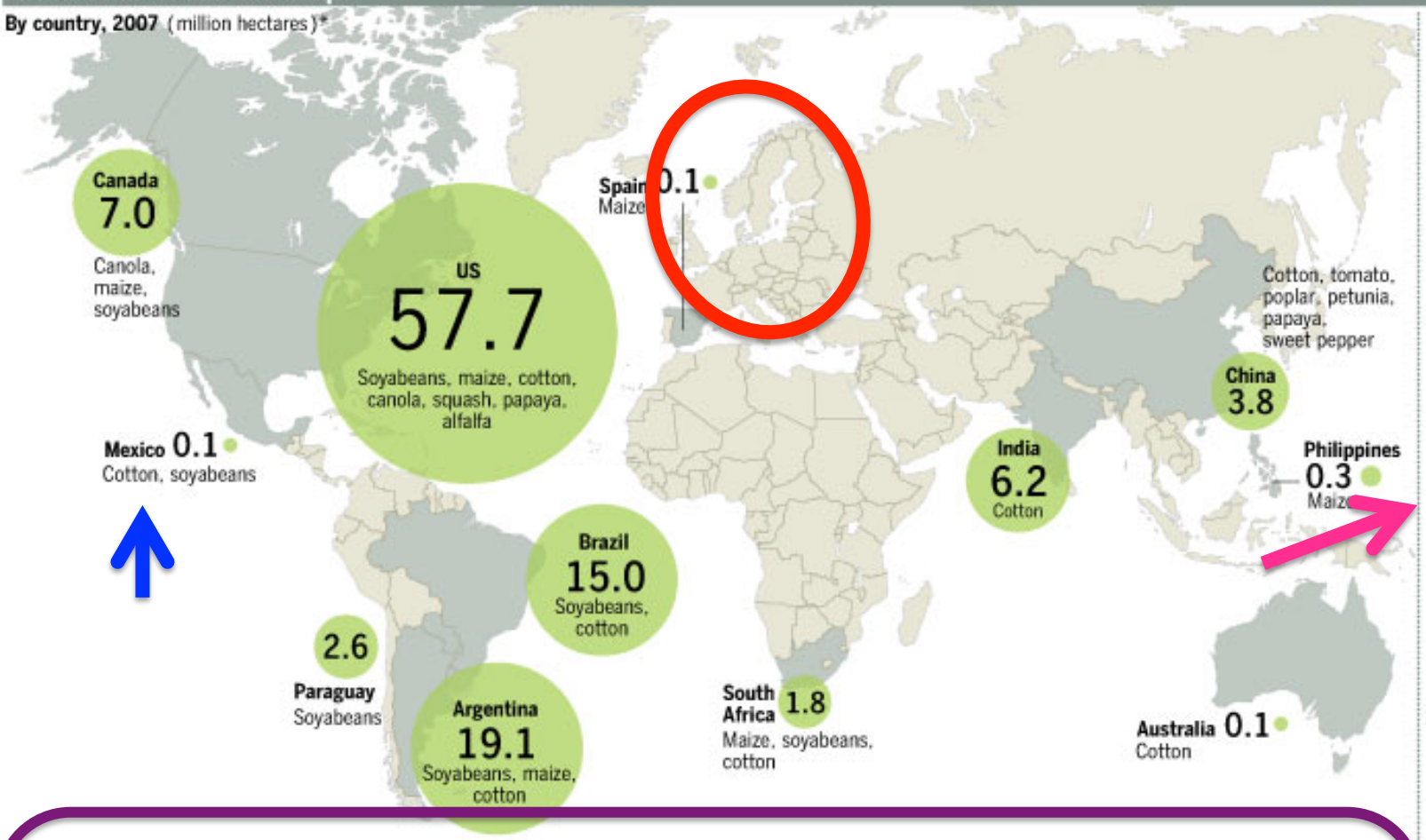
1. if genes are modified, definitely
2. If ownership rights to modified genes are guaranteed by Intellectual Property Rights (IPRs) legislation

Genetically Modified Organisms: Question 1:
Used for what crops? Feeding the World? Corporate Profit?

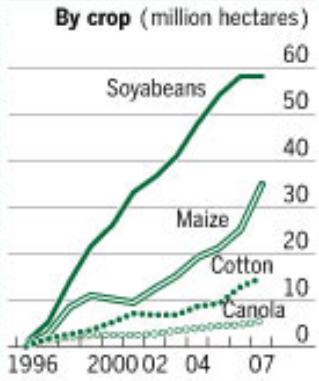


Global area of biotech crops

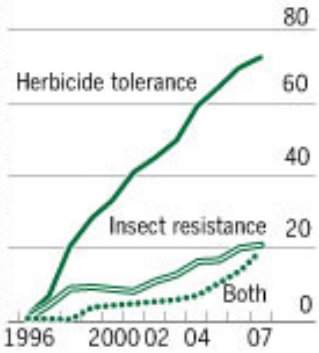
By country, 2007 (million hectares)*



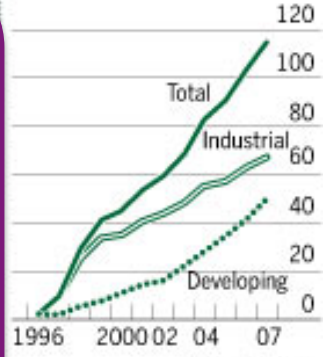
By crop (million hectares)



By trait (million hectares)

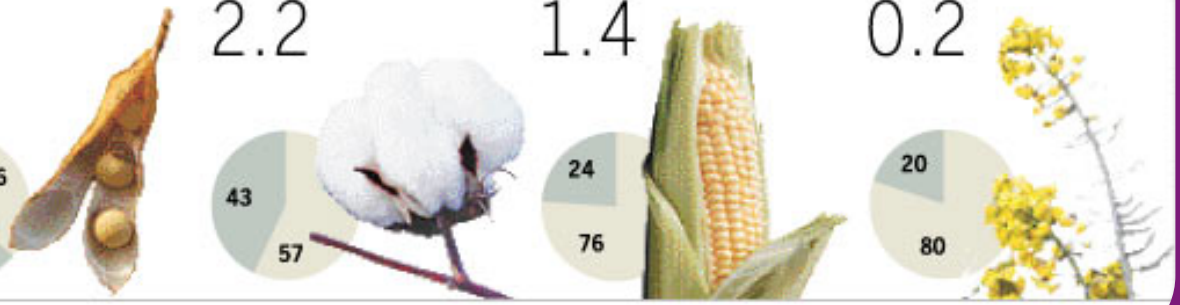


By type of economy (million hectares)



Source: Isaaa

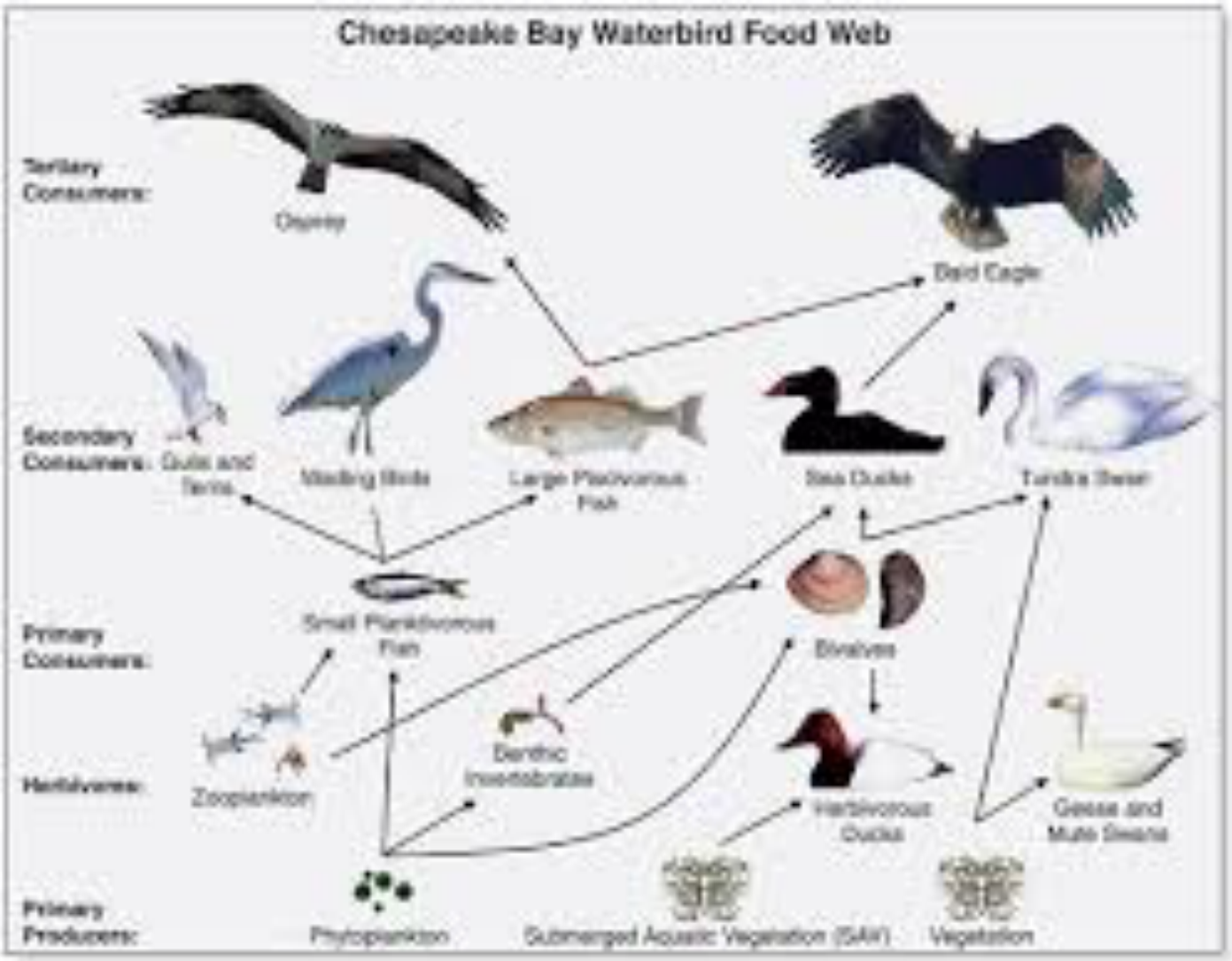
Main GM crops	Soyabeans	Cotton	Maize	Canola (oilseed rape)
Estimated boost to farmer income, 2006 ($bn)	3.1	2.2	1.4	0.2
Global adoption rates (%)				
Biotech	64	43	24	20
Conventional	36	57	76	80



* Excludes countries with GM area less than 0.1m hectares

FT Graphic: Liz Faunce

Question 2: RISKS & Benefits



Environmental: Problem of the food web / Web of Life

Environmental Risks:

Risk 1. Biodiversity is reduced by biotech

new cultivars replace traditional varieties, reducing genetic diversity

Genetic Erosion and Species Extinction result

New Cultivars: new genetically engineered plants replace traditional crops

i. **Genetic erosion results when new crops displace traditional crops, and the more diverse genome of traditional crops is lost due to a failure to plant them: e.g., bean diversity**

Environmental Risk 2: Poisoning Ecological Relationships

A. Cultivars produce environmental poisons:
   i. BT poisoning of people...
   ii. corn pollen, Bacillus thuringiensis, and monarch butterfly deaths
   June 2010, US Supreme Court rules that BT Alfalfa needs a full USDA environmental review.
B. What is the effect of introducing toxins into existing ecological relationships? Corn grown traditionally across the Americas under traditional, non-agrochemical methods

Environmental Risk 3:

Gene transfer produces New 'Aliens': aliens in this context may be defined as ‘exotic’ or non-native species of plants. Historically the introduction of ‘weed’ species to new continents has created problems, e.g., difficulties in Native American agriculture

Biotech gene transfer: local weeds take up the same properties that have been transferred to cultivars via biotechnology. This may occur through a type of viral transfer, where naturally-occurring viruses move gene pieces to neighboring plants

Environmental Risk 4:

Potential for *increased* use of herbicides

Case: Monsanto's 'roundup-ready' corn, soy, alfalfa, etc.

…As the graphic demonstrated, herbicide tolerance is by far the greatest trait cultivated in GMOs

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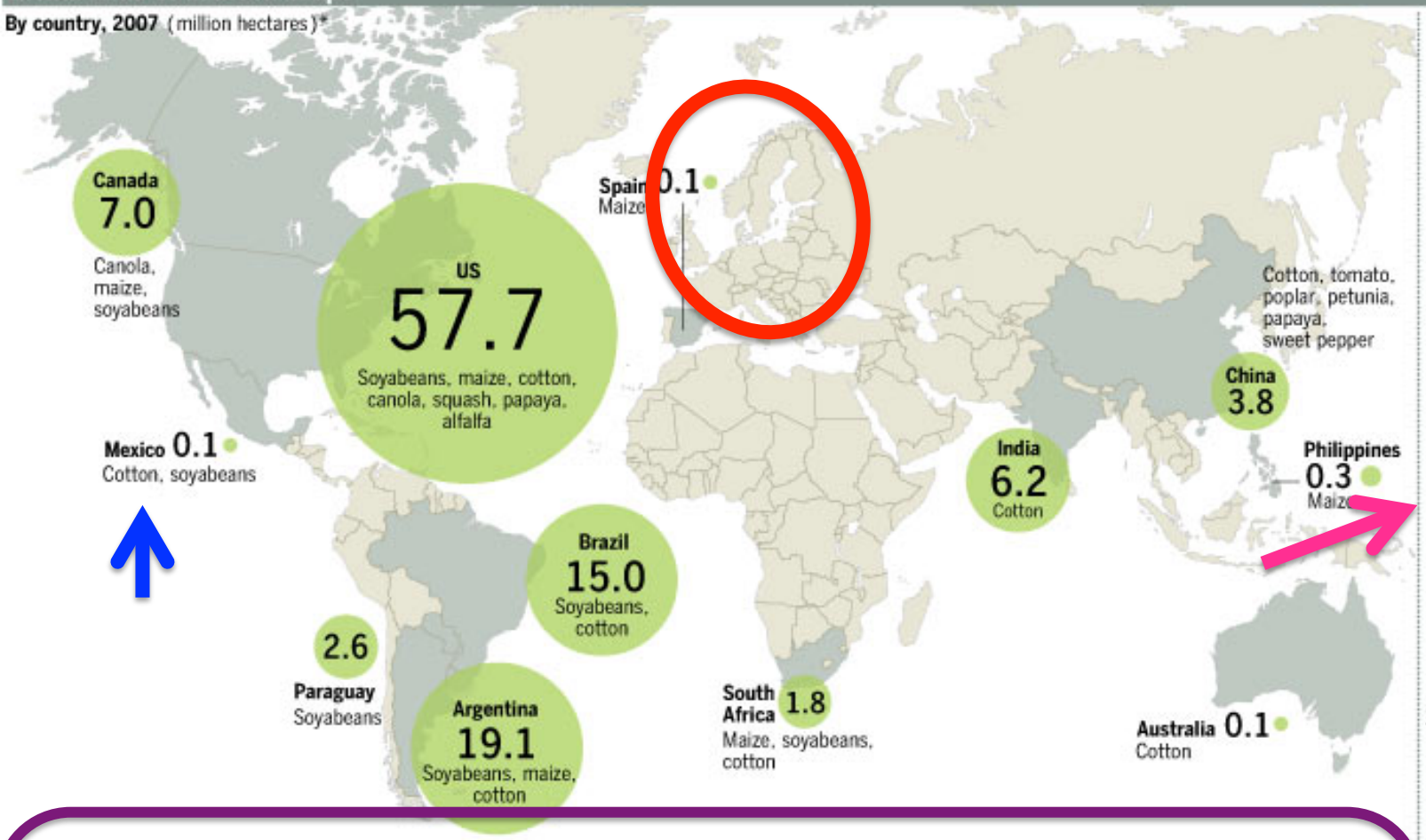

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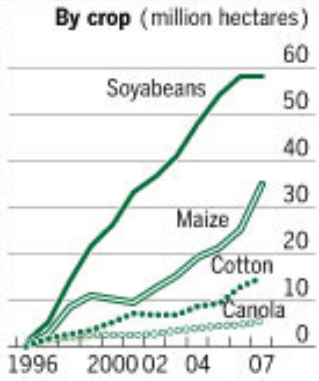

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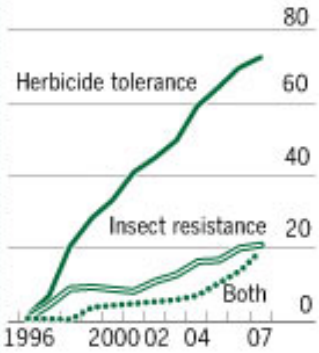

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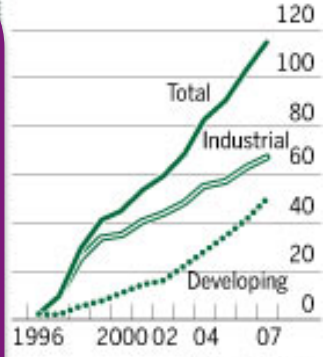

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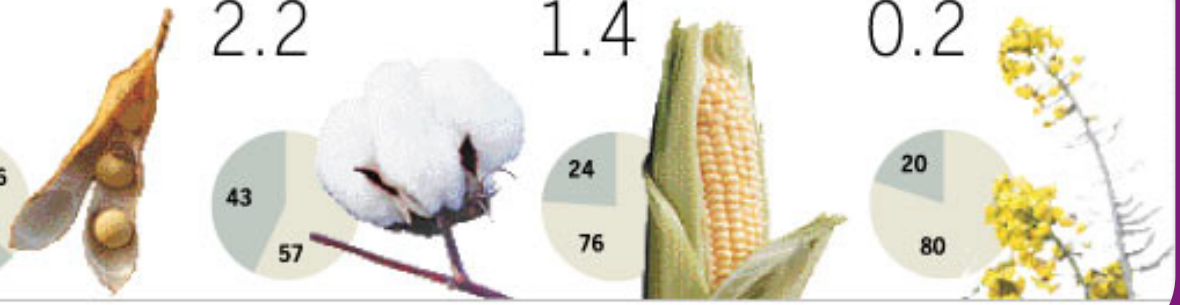

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Human Risks 1. 'Poor-get-poorer': Rich farmers profit at the expense of poor farmers, especially in Global South (extension of Green Revolution problem, rich adopters displace the poor)

Golden Rice: Who will be able to afford the new Crop? Not legal to replant genetically modified seed, so only highly capitalized farms can make use of it

Will Biotech generally be useful? If not, how can biotech be constrained to specific items?

Biotech and Land Grabs: Potato case in text

Human Risks 2:

Human health risk (last as this is an environmental class…)

Allergen transfer with gene transfer:

"There is now a large body of evidence that shows that GM crop/food production is highly prone to inadvertent and unpredictable pleiotropic effects": that is, when one gene change affects multiple metabolic pathways within the organism

--How will Golden Rice affect other genes and gene expression?

Finally, Who Owns the Genes, Anyway??

'Ownership' is a hotly contested aspect of biodiversity treaties

- **Of Crop and Plant genes?**
- **Of Human genes? Your genes?**

¿by Global Northern citizens/Institutions of Developing World derived genes?

¿or by peoples & governments of the Global South acting to prevent germplasm removal?

¿or by You? (i.e., public ownership)

http://www.youtube.com/watch?v=2LipA3oB5xk (quite polemical!, but well-done)

http://www.youtube.com/watch?v=Wtw704KDipg&feature=related

US Case

Recent Struggle over BRCA gene testing by Myriad: should a company be able to charge $3000 to see whether you have a gene that predisposes you to breast cancer?
(btw...men also get breast cancer)

Court Rules Patents on Genes Are Illegal: Products of Nature, Not Invention

by Heidi Stevenson
31 March 2010

Reversing a frightening trend granting patents on living creatures and their genes, US Federal Judge Sweet has issued a ruling that may overturn patents on life forms. Myriad Genetics' claim that isolating DNA from the body transforms and makes it patentable was turned down with the statement that it's only been a "lawyer's trick" that's allowed it to happen before.

"Jaw-dropping" verdict against Myriad in BRCA patent case

Category: gene patents
Posted on: March 30, 2010 5:58 AM, by Daniel MacArthur

One of the major potential stumbling blocks for the field of genome-based diagnostics - particularly as we begin to move into the whole-genome sequencing era - is the unresolved issue of gene patents.

Currently somewhere in the order of 20% of the protein-coding genes in the human genome are covered by some kind of patent protection. However, the legal status of gene patents remains contentious.

U.S. Says Genes Should Not Be Eligible for Patents

By ANDREW POLLACK
Published: October 29, 2010

Reversing a longstanding policy, the federal government said on Friday that human and other genes should not be eligible for patents because they are part of nature. The new position could have a huge impact on medicine and on the biotechnology industry.

source: NYT

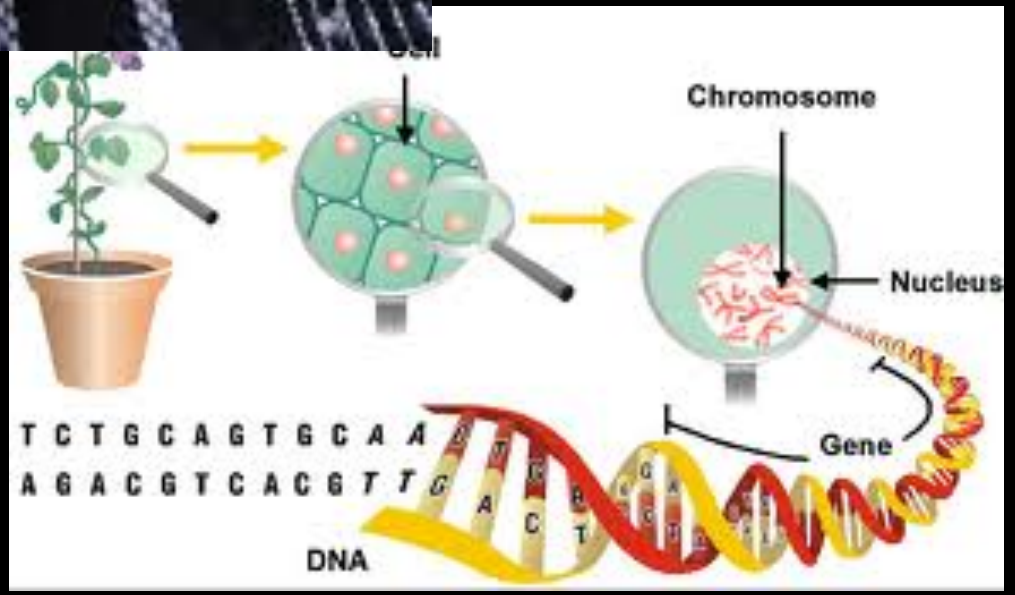
The US Government has decided to oppose gene patenting because genes as such represent an unchanged 'product of nature'

Recently Courts have agreed; we'll see what the Supreme court has to say...

So, What's the upshot?

1. **This is one of the most interesting contemporary points of struggle over nature**
   - **the $ and rights implications are enormous!**
   - **POLITICS!!**
2. **There is a lot of disagreement over ownership issues RE genes**
3. **Genetic restructuring is very risky, particularly 'transgenic' manipulation (e.g., fish to tomato) and the possibility of further transfers**
4. Age old concern: Need for regulation wherever, whenever
   - Technologies are inherently dangerous
   - possibility of untold profits will overwhelm the ethical sensibilities of a few
   - Possibilities for bioterrorism send chills down the spine!

Genetic Engineering: The Case of Golden Rice



Storyline: Children are suffering from a lack of Beta-Carotene, a precursor to Vitamin A

Rice has been genetically modified by inserting genes to increase the production and concentration of beta-carotene

This rice can be planted by poor people or distributed as aid, thereby resolving this deficiency

https://www.youtube.com/watch?v=8MCtVqmCoI8

Counter story:

1. What children really need is a balanced diet, why not a vitamin A supplement?
2. Golden Rice displaces traditional varieties of rice
3. Golden rice must be frozen to provide vitamin A
4. A great deal of fat must be consumed along with the rice: fat is expensive

https://www.youtube.com/watch?v=X2AAuWp7e7A

https://www.youtube.com/watch?v=nXubYtu54vs

Is there a corresponding Human Health Benefit?

1. Golden Rice must be eaten with a lot of fat to induce absorption of vitamin A: If consumers have money for fat, then they probably don't need vitamin A supplements.
2. This deficiency is caused by a lack of access to a nutritionally balanced diet: Vitamin A deficiency almost never occurs alone…

Bacon (Francis) Redux: Genetic Modification of Nature

The biotech 'new Atlantis'?

FIN

Questions:

1. Give two potential negative environmental consequences of the biotechnology revolution
2. Provide two considerations in the debate over ownership of genetic resources

Debate on Genetic Engineering:

I. Industry perspective:

[Biotechnology will] "greatly reduce reliance on Toxic pesticides…"
"By borrowing beneficial traits from elsewhere in nature, we can now make crops and plants naturally resistant to insects, to viruses. We can reduce the need to spray for pests. Nothing could be more natural, more logical."
Earl Harbison, President Monsanto Chemical

II. Public Interest perspective:

1. 'Internal' company economies – agrochemical companies (e.g. Monsanto) seek herbicide resistance to sell chemicals, resistant plants allow GREATER herbicide applications

2. Industry Concentration: Vertical integration joins seed, biotech and pesticide companies. As a result, control over genetic diversity may be vested in very few hands. Should this be a public resource?