Welfare and Co-existence

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Presented at the International conference GMCC
Amsterdam November 18 2015
Thanks to Justus Wesseler

overview

- The need for Co-existence is an indicator of a divide
- Where is the consensus?
- Sources of disagreement?
- About GMO and organic
- Regulations
- Co-existence
- Conclusion

Shared goals?

- Feed more people need to increase production by 30-50% by 2040
- Deal with climate change
- Do not increase footprint of agriculture
- Reduce
  - food waste
  - Pollution
  - Poverty
  - Hunger (eliminate!)
  - gap between poor and rich
- Increase opportunity for rural development
- Use more renewable resources

Sources of disagreement

- Agricultural technology
  - Use of chemicals
  - Utilization of molecular biology
- Role of corporation
  - Farm size
  - Intellectual Property Rights
  - Market power
- Free trade

My argument

- To solve the problem we need “all of the above” strategy
- Molecular biology as chemical tools are essential
- Yet people can identify zones for different forms of agriculture

Common grounds; Need to meet food needs and reduce human foot print

- Higher yield per acre
- Increase productivity throughout the supply chain
  - Less waste
- Less meat?
- Conservation of water and chemical
- Reduce pollution
- Better utilization of knowledge (human capital)
  - More ecology
  - More advance biology

Concern: Climate change

- Increase weather instability
- Migrating weather
  - Mexico and Oklahoma loss land Canada become more valuable
  - Africa and India losses productive capacity
    - Siberia and Iceland gain
  - Migrating pest
- Faster melting snow
  - Flood
  - Less water storage
- Rising sea water

Adaptation to climate change

- New crop systems
  - Changing crops
  - Modifying varieties-
  - Addressing weather and pest
  - Drought tolerance
- Water conservation
- Water storage
- Know where and when
  - to give up (Migration)
  - To take advantage of new opportunity (Investment
  - How to manage human relocation
- Innovation
- Adoption
- Migration
- Trade
- Insurance
- Fast response
- Increased productivity
- Do more

Common ground: Enhancing renewable resource use and rural income

- Transition from non-renewables to renewables provide more opportunities for farming
  - Biofuel
  - Fine chemicals
  - Building materials
- Will require land, water and other resources
- Will lead to a major increase in bioeconomy with more spatially supply chain
- Requires increased productivity and diversity of agricultural production

Consideration: demand for luxury goods

- Capacity to pay for food of majority of humanity is low- most want **safe healthy tasty affordable food**
- But there are segments interested in differentiated higher value products-in terms of food and amenities
  - Exotic off season fruits and veggies
  - Organic
  - Various forms of eco tourism
- There is a place for **co-existence**
  - **Commercial – organic and other forms of ag**
  - A bifurcated food system has been in existence for years

Need “all the above” approach to enhance productivity

- Since enhancing productivity and adaptability are paramount- need to use all our tools
- Agro ecology and Biotechnology need to co-exist
- Science provides tool to assess safety and productivity
- Therefore…GMO and similar tools must be allowed

What is GMO?

- Most foods are genetically modified (GM)
- GMOs apply the best techniques in molecular biology and allow us to understand what we are doing.
  - Difficulty for regulators when breeding technologies change

⇒ The term "GMO" is a political construct: (an idea that is 'constructed' through the political process_Ron Herring)

⇒ EU Directive (Article 2, 2001/18):

⇒ *"For the purposes of this Directive:*

- *(1) ¤organism¤means any biological entity capable of replication or of transferring genetic material;*
- *(2) genetically modified organism (GMO)¤means an organism, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination;"*

How Dangerous is it?

- There are organizations on record saying that:

"[There are] no new risks to human health or the environment from GMOs approved by regulators so far."

- List of organizations:
  - Research Directorate General of EU (2001)
  - French Academy of Sciences (2002)
  - French Academy of Medicine (2003)
  - UK Royal Society (2003)
  - British Medical Association (2004)
  - German Academies of Science and Humanities (2004)
  - OECD (2000)
  - Director-General of World Health Organization (2002)
  - International Council for Science (ICSU) (2003)
  - Food and Agriculture Organization of the UN (2004)

What does EO Wilson (who coined the term “biodiversity”) think?

"I'll probably get it in the neck from my conservationist colleagues, but we've got to go all out on genetically modified crops. There doesn't seem to be any other way of creating the next green revolution without GMOs.”

GMO has had Substantial Impacts with Limited Adoption

Effect	Corn	Cotton	Soybean
Supply increase	5-12%	5-20%	2-40%
Price reduction	4-16%	16-28%	2-49% (mostly extensive margin)

**There is also evidence of substantial health effects and environmental quality improvement effects.

Is GM more Difficult for Farmers to use? The Evidence says no.

Country	GM crop	First year legal to plant	Percent of total crop in 2011
India	Cotton	2002	88 percent
Brazil	Soybean	2003	83 percent
Burkina Faso	Cotton	2008	58 percent
Philippines	Yellow maize	2003	64 percent
South Africa	White maize	2001	72 percent
China	Papaya	2006	99 percent

The poor benefited from GMO

- The benefits of GM have been shared between
  - Farmers
  - Biotech companies
  - Consumers
- Over time benefits to consumers increased
- With 100% adoption in part of India, smallholders must benefit
- Simple to use technology
- But they may lack credit or have lower priority
- Case studies show increases in income (25%+ in India) and reduced poverty
- Higher yield effect of cotton in India shifted industry to that country, reducing its size in the US
- Less exposure to toxic chemicals
- Lower food prices benefit the urban poor

Environmental and Health Implications

- CO_2 savings from avoided land use changes.
- No-tillage boosts carbon sequestration on existing land.
- Reduced input demand and fuel use.
- Reduced toxic chemical use and runoff.
- GM actually saved lives:
  - Less exposure
  - Lower food prices
- GM was adopted by subsistence farmers and improved their livelihoods.

GMO and adaptation to climate change

- Climate change will cause migration of weather
  - Migration of people due to weather is big political risk
- Need to adapt crops to weather conditions
  - We did it historically with traditional breeding
    - But it was slow
- Pest can move; trees cannot
- Will need a quick way to address new diseases
- Genetic tools can do the job

Differences in productivity source of hope

The big productivity gaps between nations provide opportunity to increase yield per/acre and reduce waste on with the same or lower land base

But technology transfer requires

- skill
- capital
- May be slowed by regulatory constraints

Africa can benefit from fruits of modern technology

- Needs resource transfer
- Supporting regulatory environment

Biotechnology and biodiversity

- If new traits are introduced to best local varieties, GMOs can actually maintain and enhance biodiversity.
  - Instead of identifying one "super variety" to address a problem – as in selected breeding – it will allow keeping diversity
  - It will allow also restoring old varieties that were eliminated because of flaws treated by genetic manipulations

Costs of Delaying Golden Rice

	Total Number of Eyesight's Saved (1000's)		Total Number of Eyesight-Years Saved (1000's)		Total Benefit Generated, 10% Interest Rate (millions of $)		Total Benefit Generated, 4% Interest Rate (millions of $)	
k	**One Year Delay**	**30 Year Delay**	**One Year Delay**	**30 Year Delay**	**One Year Delay**	**30 Year Delay**	**One Year Delay**	**30 Year Delay**
0.2	86	2,588	1,167	35,016	277	2,733	312	7,800
0.5	214	6,408	2,858	85,738	657	6,576	756	18,900
0.8	340	10,214	4,536	136,081	1036	10,368	1,196	29,900

- *k* represents the maximum rate of adoption (i.e. the probability of adoption).
- One can see that the total benefit lost from delay of Golden Rice each year is between $277 million and $1.2 billion.
- A delay of 30 years results in an aggregate discounted benefit lost of between $2.7 and $29.9 billion.

Golden Rice is not the only lost opportunity

- New genetically modified (GM) traits can address the maize streak virus, which is endemic to Africa and causes ~30% or more in crop losses.
- There is a corn variety that combines drought-tolerant and insect-resistant varieties for use on smallholder farms in sub-Saharan Africa.
- A transgenic regular and plantain-banana variety that addresses a major disease as well as nematode problems that lead to 20-30% reduction in yield.
  - Tens of millions of people depend on these bananas, and these varieties are still not approved.
- The poor pay for the anxieties of the middle class.

Bans and Excess Regulation prevent GM from Reaching its Potential

- The impact of GM would have been much larger if:
  - Europe allowed the growth of GM varieties
  - Regulation was less restrictive
    - *"Unjustified and impractical legal requirements are stopping genetically engineered crops from saving millions from starvation and malnutrition,"* says **Ingo Potrykus.**

If available GM has been adopted in food crops

- Prices of wheat rice and corn would have substantially declined (20-40%)
- Land would have been available for other activities
  - Including environmental amenities
- Use of pesticides would have declined further
- Further reduction in GHG
- New traits would have been developed and introduced
- We would further on our way towards a renewable agriculture

Economic losses from delay of decisions

	Table 5: Discounted Net Benefits (in billions of $) of Adoption of GM Corn, Wheat, and Rice							
Elasticity	*a=0.35*				*a=0.8*			
Interest Rate	**4%**		**10%**		**4%**		**10%**	
Time Horizon	**30 Years**	**Infinite**	**30 Years**	**Infinite**	**30 Years**	**Infinite**	**30 Years**	**Infinite**
Corn (7.5%)	136	214	61	67	139	220	63	69
Corn (15%)	254	402	115	126	268	423	121	$133
Wheat (10%)	178	282	81	88	184	290	83	$91
Wheat (20%)	328	518	148	162	347	548	157	$172
Rice (10%)	349	551	158	173	360	568	163	$178
Rice (20%)	641	1,013	290	318	679	1,073	307	$337
Total (low)	$663	$1,047	$300	$328	$682	$1,078	$309	$338
Total (high)	$1,223	$1,933	$554	$606	$1,294	$2,045	$586	$641

The aggregate benefits of adoption of GM corn, wheat, and rice over the next 30 years range from $300 billion to $1.29 trillion.

The aggregate benefits of adoption of GM corn, wheat, and rice over an infinite time horizon range from $328 billion to $2.04 trillion.

Achieving efficient co-existence regulations

- But there are behavioral and political constraints
- Science ,Welfare economics, behavioral and political economics need to co-exist

Why efficient regulations

- We Aim to achieve food security and environmental improvement objectives and control risks at **least cost**
- Heavy regulations are appealing on the surface yet costly
  - May breed corruption
  - Lead to concentration
  - Only large organizations can afford complying
  - May result in riskier outcome in the longer run
- Heavy regulation in one region may harm it in the long run-
  - much of the agricultural biotechnology research capacity from Europe to the United States
  -

Science: Biotechnology is evolving

- Molecular biology will enhance ability to improve crop breeding
  - Gene-editing (Crispr)
    - Easy to use and may be applied effectively in China
- Information technology and robotics are improving-
- They enhance precision agriculture-make it more affordable – complementary to GMO
- Will they be opposed by environmental groups?

The reality of organic agriculture

- Arbitrary definitions- a social construct
  - Can gain from marrying molecular technologies…
- Not healthier than commercial ag in general
- Can thrive in some environments
  - California irrigated desert, High human capital
- Not in others–
  - humid high pest realities, lack of skills
- May lead to larger farms (to diversify risk)
- Is part of sophisticated agribusiness
- Is a source of extra farm revenue and income
- GO for it - where and when people are ready to pay for it.

Constraint: Attitudes toward change

- There is a desire to move towards a renewable economy
  - But resistance against much of the actions it entails
  - Some is based on basic economics but
- Traditional environmental instinct is to preserve, protect, conserve
  - Some perceive Sustainability as steady state nirvana
  - Precautionary approaches
  - **But evolution exists and change occurs**
- Need to adapt and take calculated risks

Guidance: Basic principles

- The perfect is the enemy of the good
  - Avoid bans and extreme measures and encourage choice
- Emphasize Science based evidence and judgments
  - Science may be flawed – but it is the best approach humans have
- Enhance access to information
- Enhance Free trade
- Assess economic and social impacts of various policies with a globa perspective
  - What is good for European and American agriculture is not necessarily good for the world

Specific issues: Labeling

- Mandatory or voluntary labeling of GM-food labeling?
- Mandatory
  - Warning are justified where the is real risk-do not frighten
  - Tradeoff – Freedom of information vs. Cost of providing it
  - People interested in NO GM food (middle class?)gain
  - People who care less(low income households particularly) pay
- Non GM-food labelling:
  - for those who care,
  - similar to organic, halal, kosher

Issues in identity Preservation

- Private sector standards
  - Non GM food market important in EU
  - Truth in advertising: Who checks health, environmental, and sustainability claims on non GM labelling
  - may create future credibility problems
  - system not costless
- Why not advertise GM-food?
  - Environment, health, sustainability

Thorny problems

- What to do with low Level Presence policies
  - zero thresholds?
  - How to establish minimum concentration standards?
  - How to Balance costs risks and uncertainty?
  - When to modify minimum standards?
- How to mange intellectual property?
  - What to patent?
  - Length of patent?

Conclusions

- Diverse objectives lead to diverse solution
- There is a place to strong commercial agriculture striving to enhance sustainable productivity
- And a strong organic niche

Conclusions

- Regulation should not be used to establish dominance
  - But to protect consumer and the environment
  - To prevent adventitious presence and mix up
    - With reasonable tolerance

- EU needs to consider implications of restricting GMO for its competitiveness and Humanity future

- You can not worry about climate change and restrict your efficient tools