

# **Role of Innovation in (Bio-) Technology in Restructuring Agriculture to Climate Change**

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# The problem of agriculture

25% of Global Greenhouse Gas Emissions

14% of all EU CO<sub>2</sub> emissions (thanks to subsidies&noGM)

48% of all the methane emissions

70% of the global water use

52% of all nitrous oxide emissions

## **Global Reality**

1 billion people suffering from hunger and malnutrition

9 Billion people by 2050: desiring more milk, eggs and meat

Climate Change affects the most vulnerable most

# Agricultural Biotechnology and Climate Change

## Mitigation:

### *No-Tilling Practice (Herbicide Tolerance)*

- > Increased soil fertility and carbon capture, less soil erosion, water use less machine use, no ploughing > CO<sub>2</sub> emissions (already reality)

### *Nitrogen-Use Efficiency (Alanine Aminotransferase)*

- > -50% fertilizer use for the same yield, less nitrous oxide, reducing pressure for land use change (proof of efficacy in field trials with rice and wheat) (Company: Arcadia Biosciences, UC Davis)

### *Improved Efficiency of Photosynthesis (-Photorespiration)*

- Increase of plant biomass without adding water or fertilizer (already reality) (Nature Biotechnology 2007, 25(5):593-599)

Combination with successful organic farming practices absolutely feasible (e.g. Tomorrow's Table 2008) but **opposed by Europeans**

- > *No mention of biotechnology or genetic engineering in the FAO report on agriculture and mitigation (October 2009)*
- > *Diouf: Organic is fine but not sufficient (to mitigate deforestation)*

# Adaptation

*Transgenic crops/trees resistant to abiotic stresses:  
Drought-Tolerance, Salt-Tolerance, Flood Tolerance*

> Proof-of-Efficacy in the field (Science 625: 662-3, Oct. 2009)

Local adaptation of crop varieties (affordable local breeding)  
A scale-neutral technology (if regulation would be fair)  
(e.g. flood tolerant but preserving the qualities of the indigenous variety)

## *Alternative Energy Production*

Third Generation Biofuels (genetically engineered algae use sun-light to produce refined oils (Synthetic Genomics, Science 325: 379 (2009) available by 2012): Carbon Dioxide as a Resource

## *Sustainable/affordable Meat/Fish Production:*

*Improved feed conversion, herbivorous fish in rice paddies, robust cattle*

# Industrial Biotechnology & Climate Change

*Biobased products as substitutes for petrochemical products*  
(Nature Biotechnology 26(8): 851-3)

- Renewable and Biodegradable Resource, less energy-intensive in production and disposal

Genetically modified enzymes in the production of feed, food, cosmetics, detergents, paper, textiles, etc)

- > Efficient use of resources, substitute for chemicals > less energy

Bioremediation (transgenic bacteria, plants)

Cleaning up lakes, rivers, soils, industrial sites, waste

- A New Biology for the 21st Century (Issued in Nov. 2009 by the US National Academy of Sciences)

# The European Debate: Real or Fake

The EU/Germany as first mover on global climate change?

Yes, it was the driving force behind the Kyoto Protocol

...but the Protocol essentially failed to deliver

...Kyoto after 2012 should learn from previous mistakes

...Large investments in alternative energy and adaptation necessary

(Nature, Time to ditch Kyoto. Nature, 449: 973-976)

Problem in Europe: Politicians seem to know which Alternative Technologies are appropriate and therefore eligible for subsidies

Biotechnology is merely linked to agrobiofuels

CDM is used for Pet-Projects for PR rather than R&D

Exemption from EU Emission Permits: Agriculture, Coal (partly), Transport (Car). Not included are methane and nitrous oxide

# Looking at political actors to explain the framing of the debate

**Leading scholars** are  
physicists,  
meteorologists,  
ecologists,  
geographers,  
neoclassical economists

**Missing:**  
Molecular Biotechnology  
Business & Innovation  
Economic History  
Engineering  
Technology Policy

**Leading Political Parties** are  
The social democrats  
The greens

Ideological Orientation  
(e.g. organic biofuel)

**Politicians and Educators** influenced  
by popular documentary movies.  
Framing by famous opponents of  
agbiotech (e.g. Bob Watson, WGBU)

Merging the particular  
science perspective  
with prevailing  
ideology of parties with  
a stake

## Objective of my research paper

Exploring the potential of biotechnology in adaptation, mitigation and renewable energy production

Using policy network analysis to find out why the biotech-debate and the climate change debate don't mix in Europe