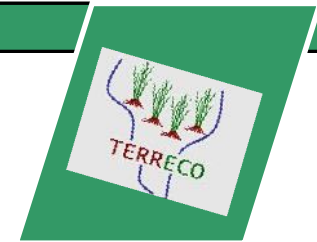


**TERRECO WORKSHOP IN BAYREUTH**

**11 - 14.04.2010**



# **Modeling the Tradeoffs between Agricultural Intensification and Environmental Protection in South Korea**

Trung Thanh Nguyen

**Bayceer**  
Bayreuth Center of Ecology  
and Environmental Research

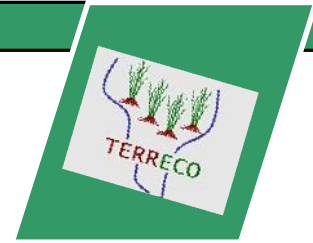


**강원대학교**  
Kangwon National University



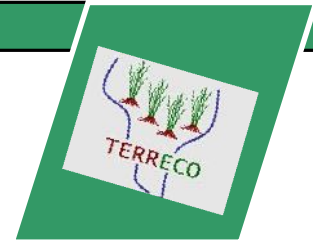
**YONSEI UNIVERSITY**

# Outline



- Introduction (tradeoffs and externalities)
- Conceptualization (total regional welfare)
- Methodological issues (programming)
- Challenges

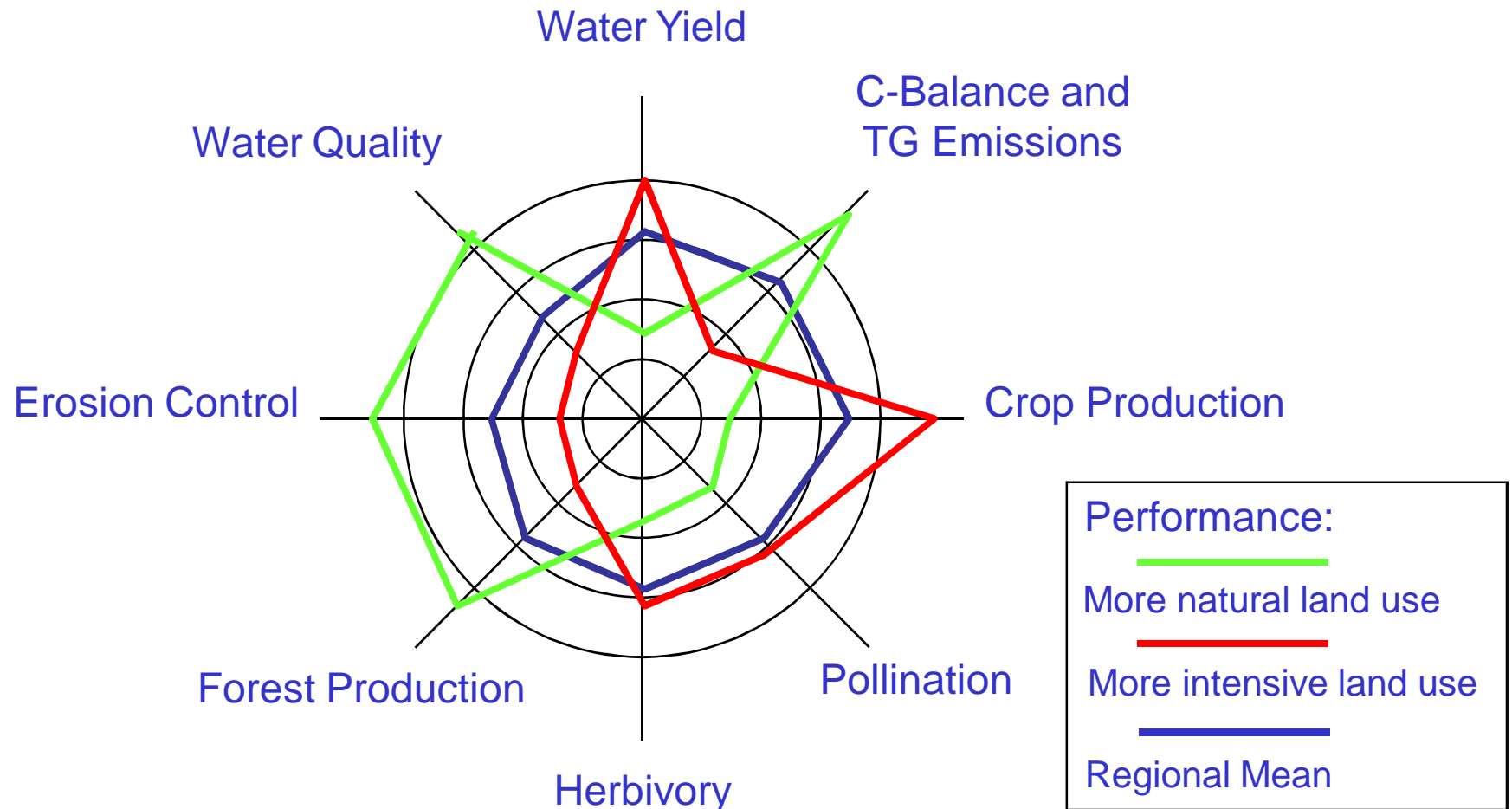
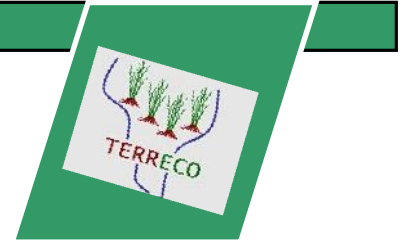
# Tradeoffs



“There is no such thing as a free lunch!”

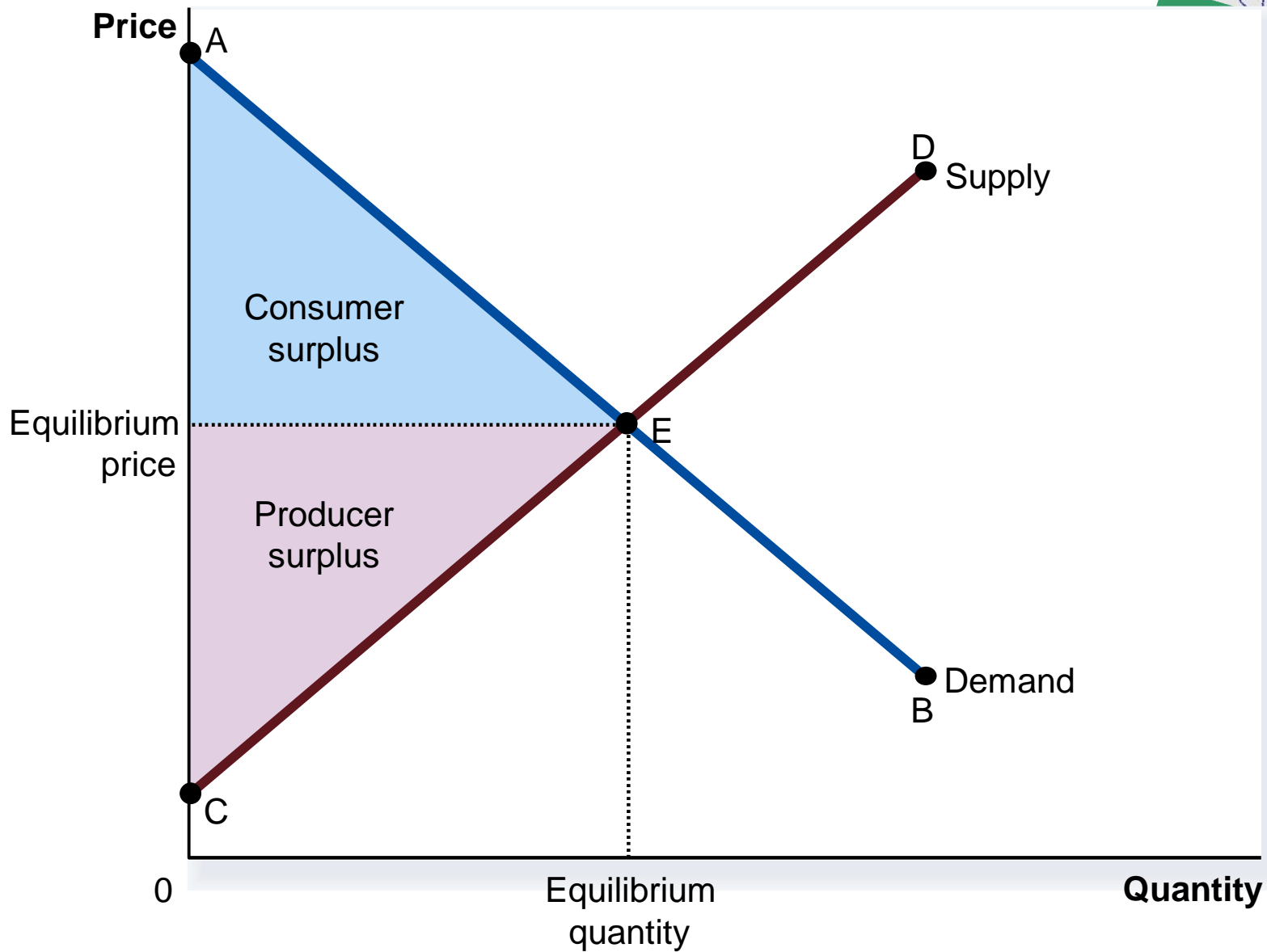


# Tradeoffs in ecosystem services

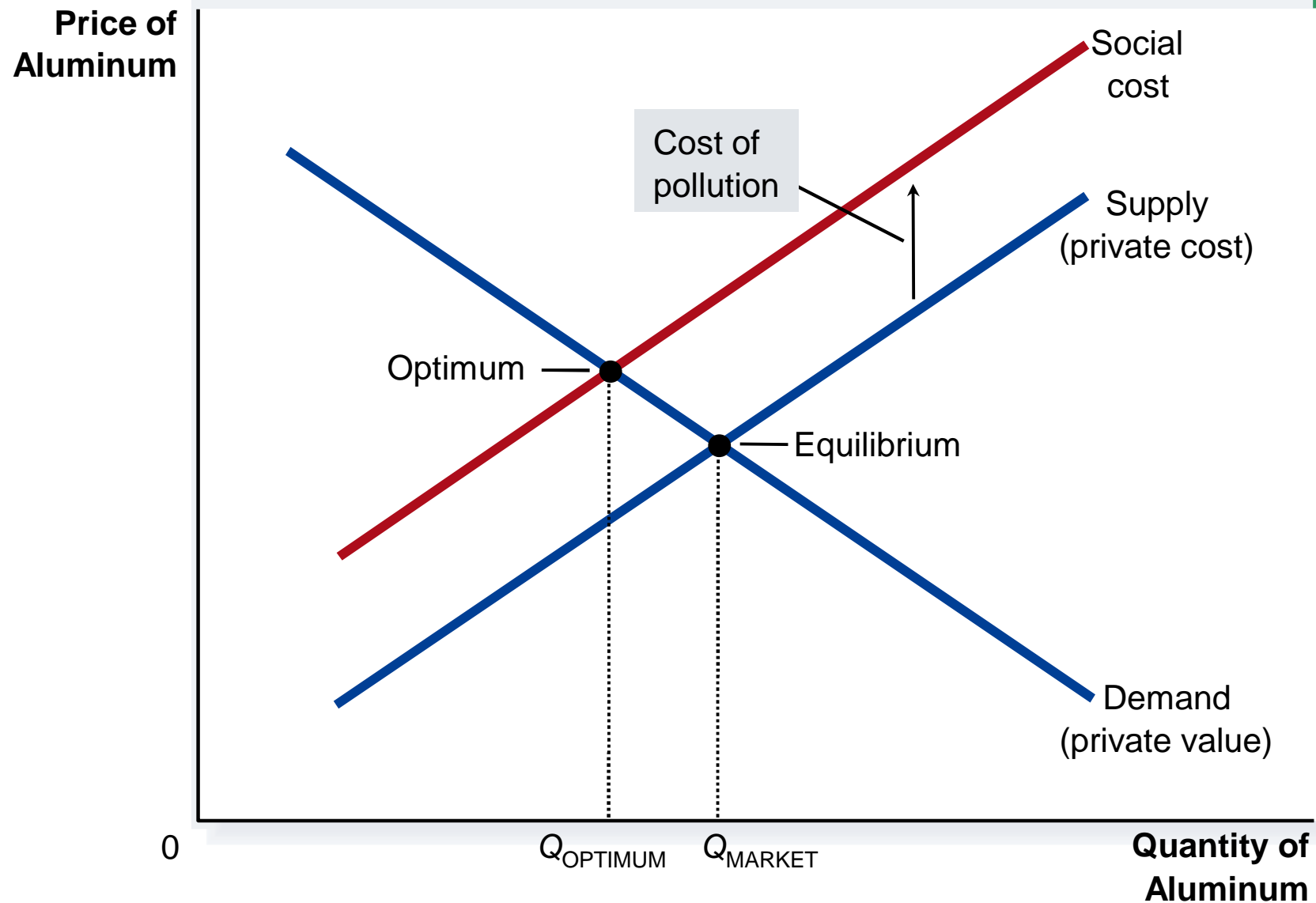


Tenhunen, 2009 (based on MEA, 2005)

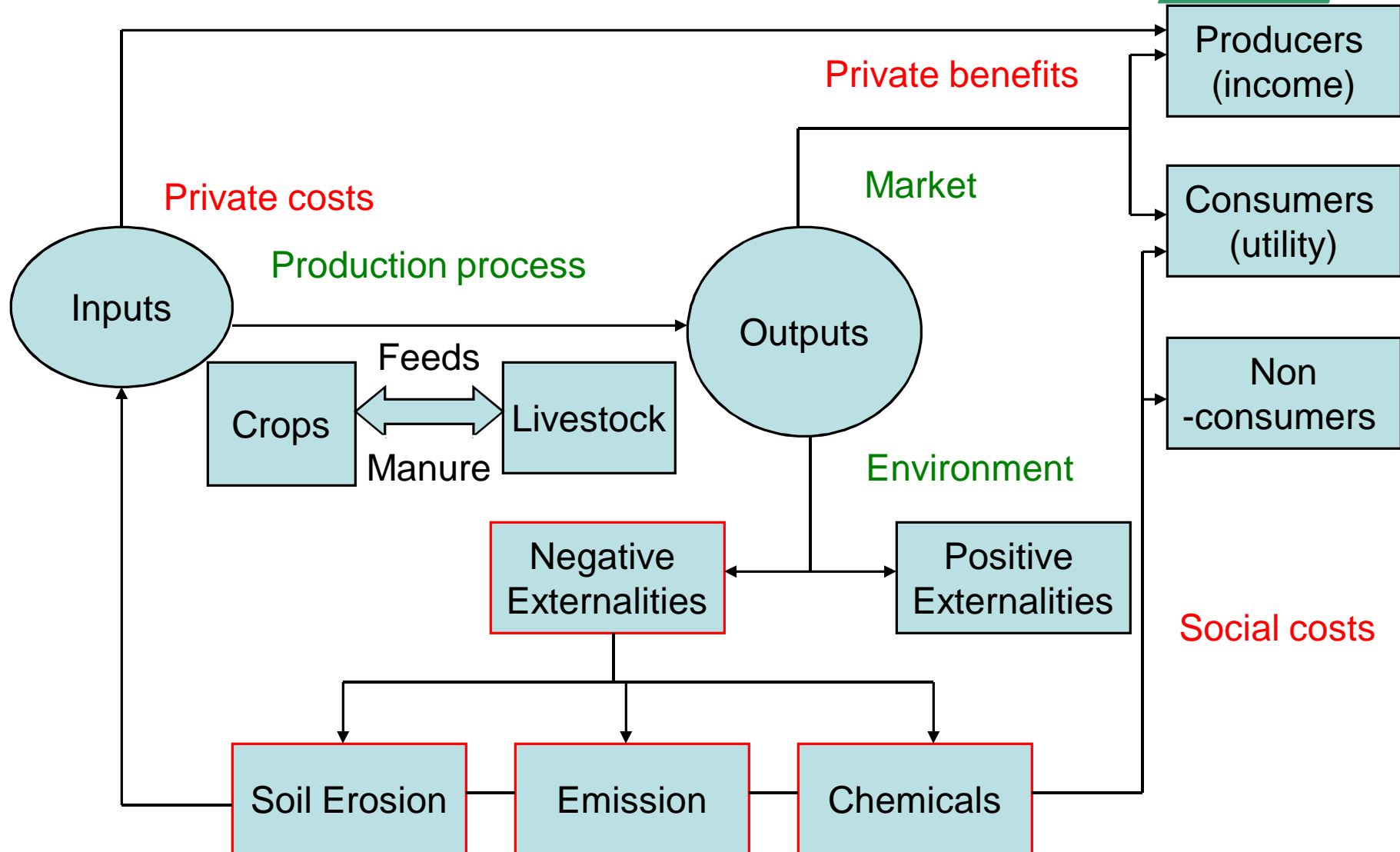
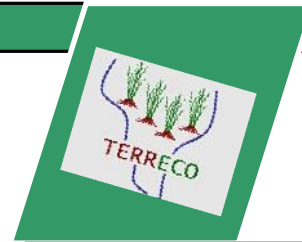
# Maximization of (regional) welfare



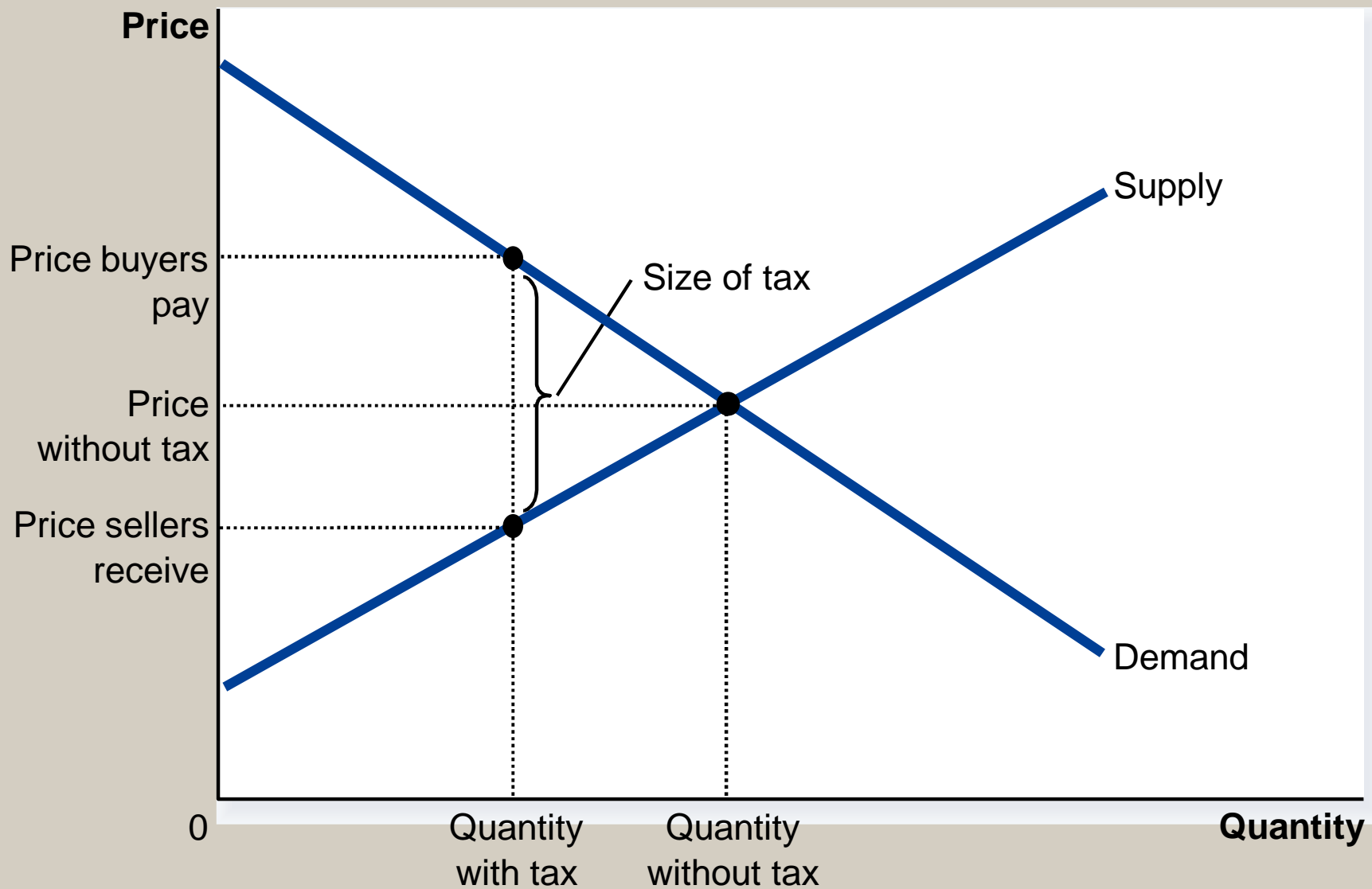
# Externalities



# Agriculture and Environment

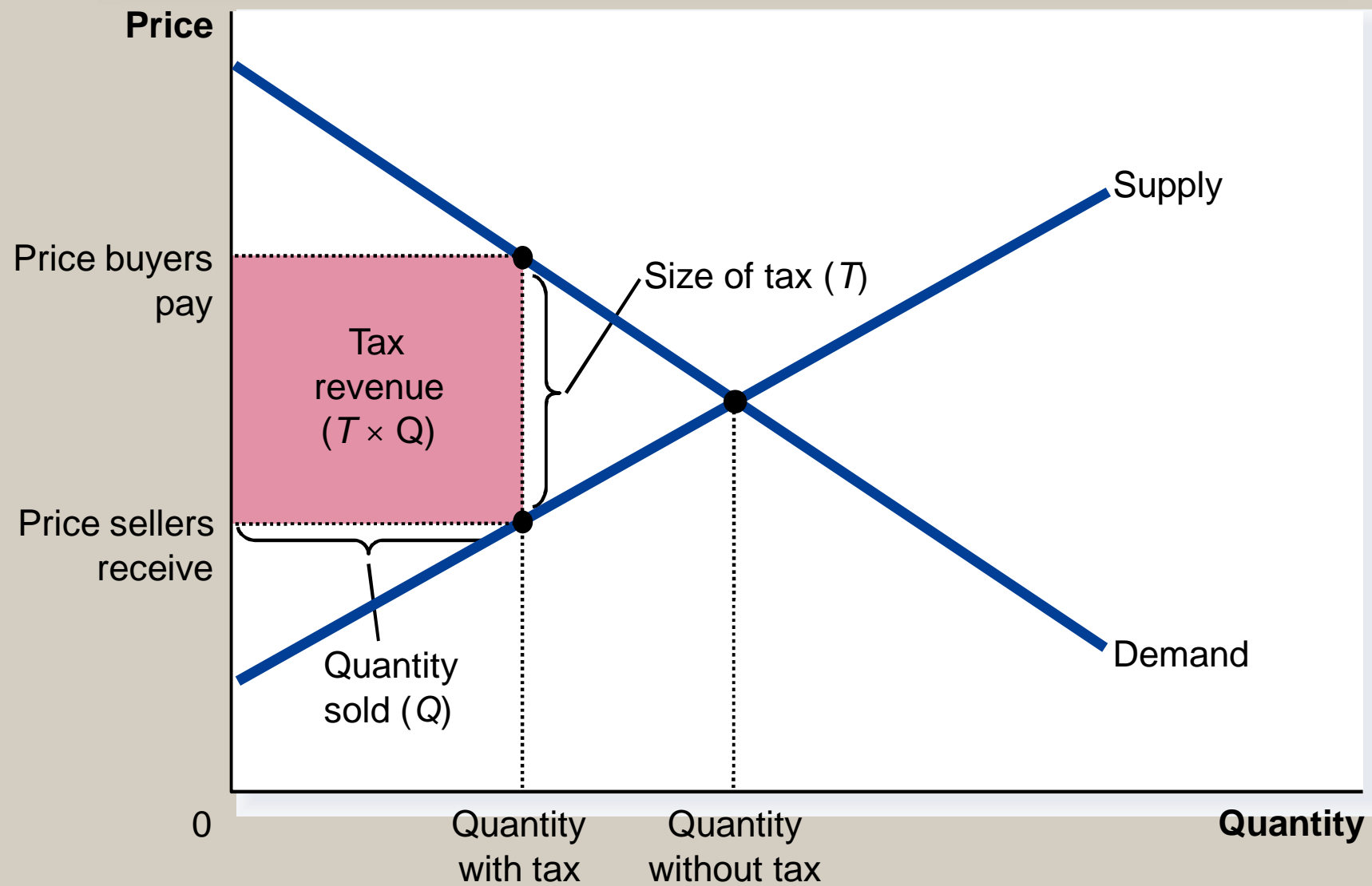


## The Effects of a Tax

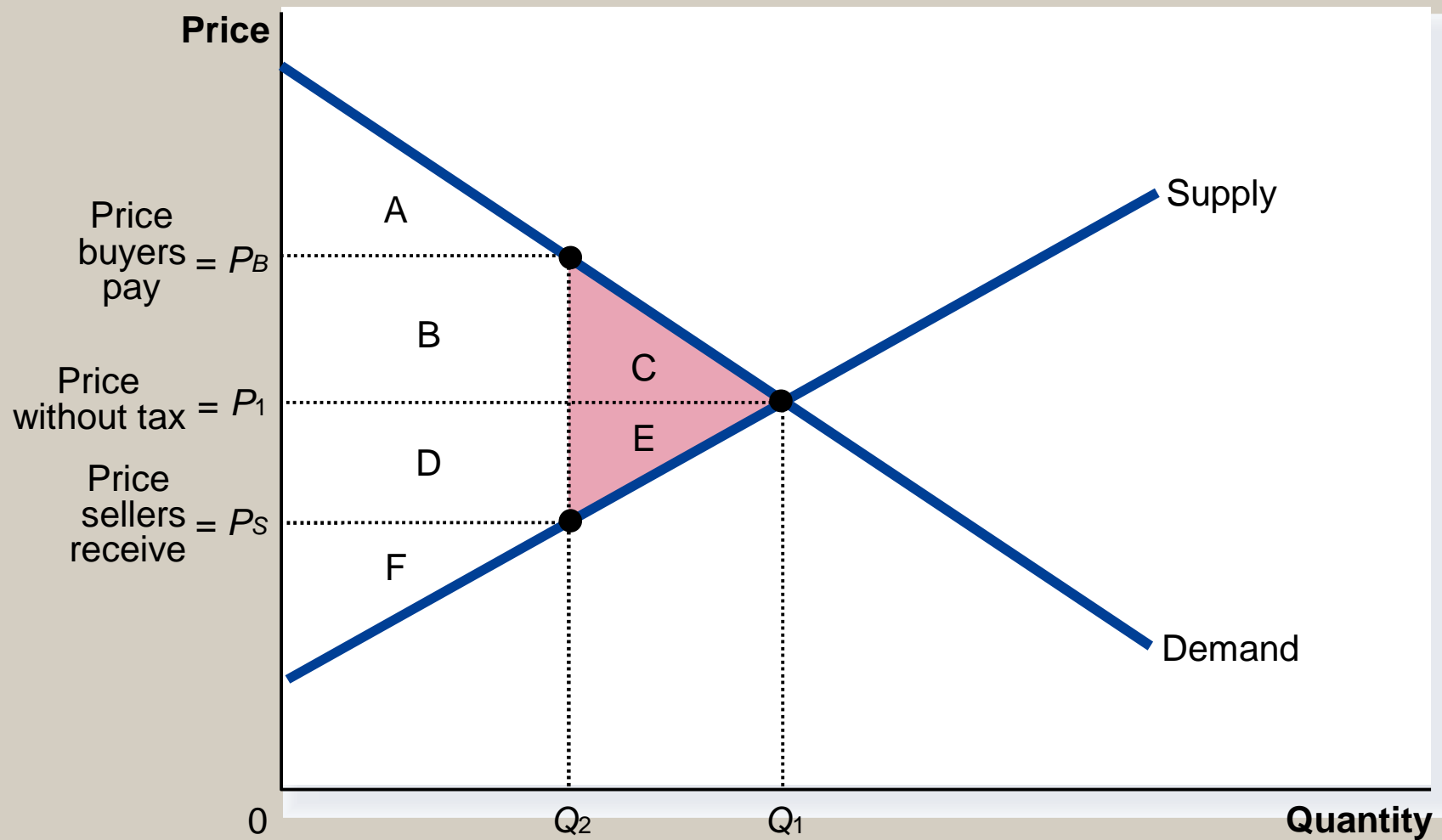




## Tax Revenue




## How a Tax Effects Welfare?



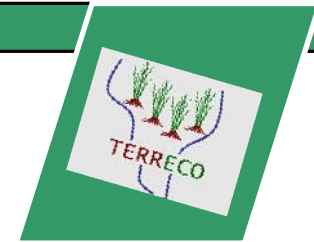
## How a Tax Affects Welfare?

	Without Tax	With Tax	Change
Consumer Surplus	$A + B + C$	$A$	$-(B + C)$
Producer Surplus	$D + E + F$	$F$	$-(D + E)$
Tax Revenue	None	$B + D$	$+(B + D)$
Total Surplus	$A + B + C + D + E + F$	$A + B + D + F$	$-(C + E)$



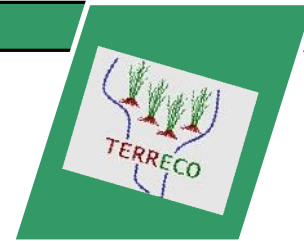
The area  $C + E$  shows the fall in total surplus and is the deadweight loss of the tax.

# Basic ideas



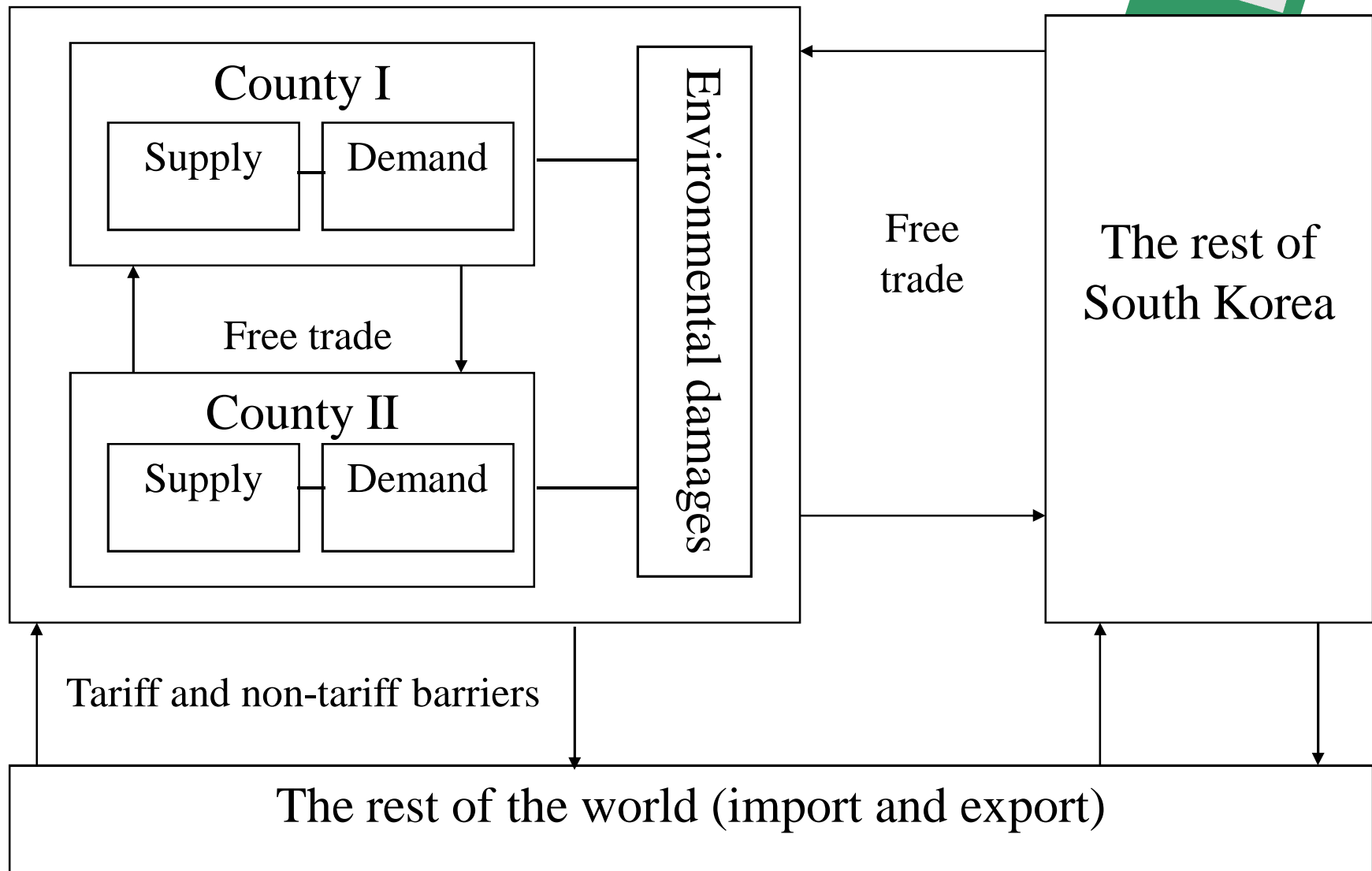
- Free market of agricultural products does not take into account the environmental problems created by intensive agricultural production (market failure),
- If the society takes this into account, producers and consumers of agricultural products will be impacted: their welfare will change, and thus total social welfare will change,
- This study is aimed to estimate these changes under different scenarios.

# Objectives



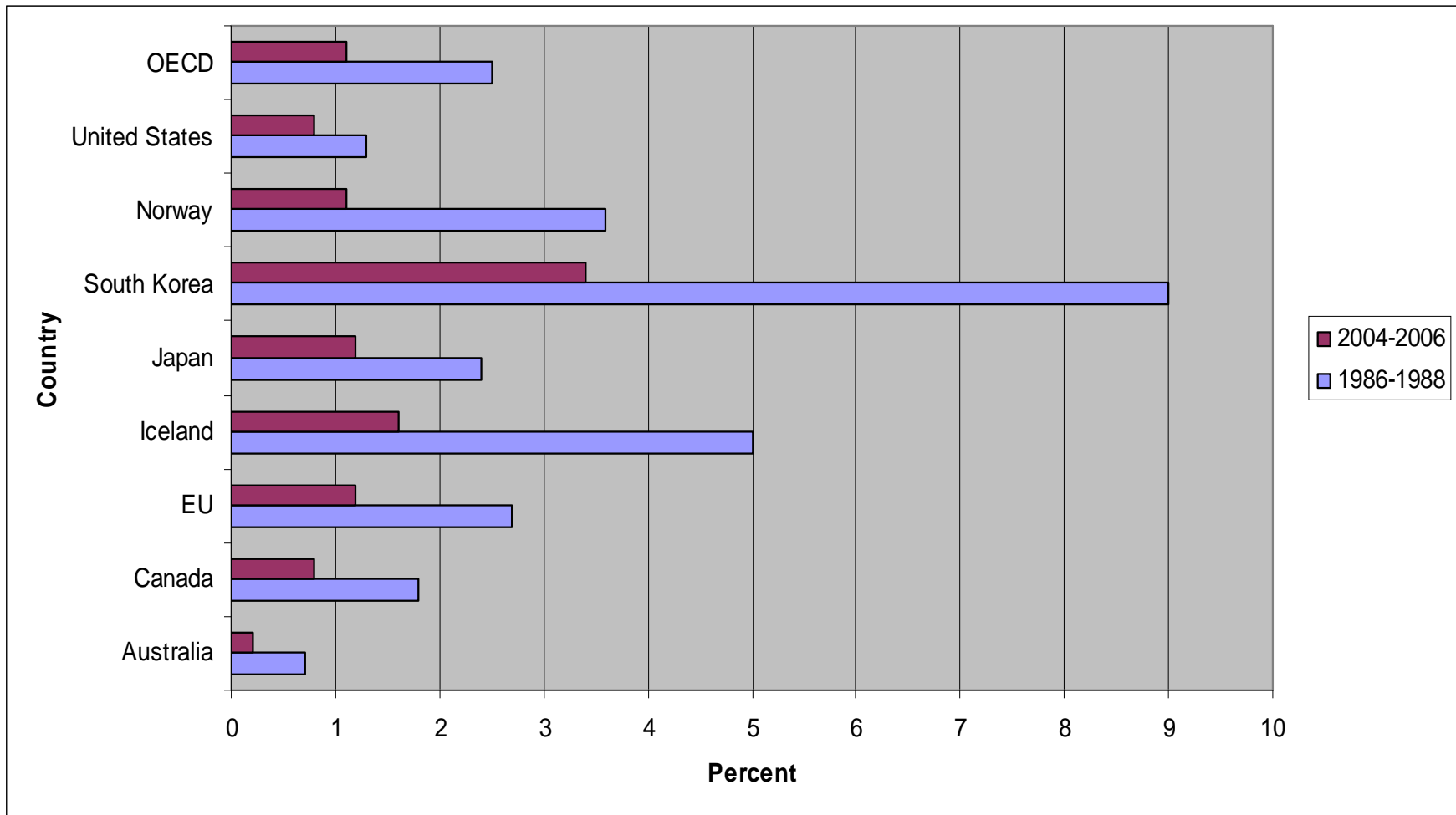
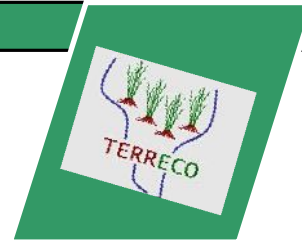
- This study is aimed at providing an economic analytical tool for policy-decision makers with regard to agricultural production and environmental damages as a basis for further agri-environmental policy formulation.
- Specifically, the study can:
  - estimate the supply of and demand for agricultural products under resource constraints (land, labor, capital),
  - stimulate changes in terms of agricultural production and human welfare (producers and consumers) under relevant scenarios,
  - quantify tradeoffs between agricultural production and its environmental damages.

# Conceptualization



# Subsidies to agriculture

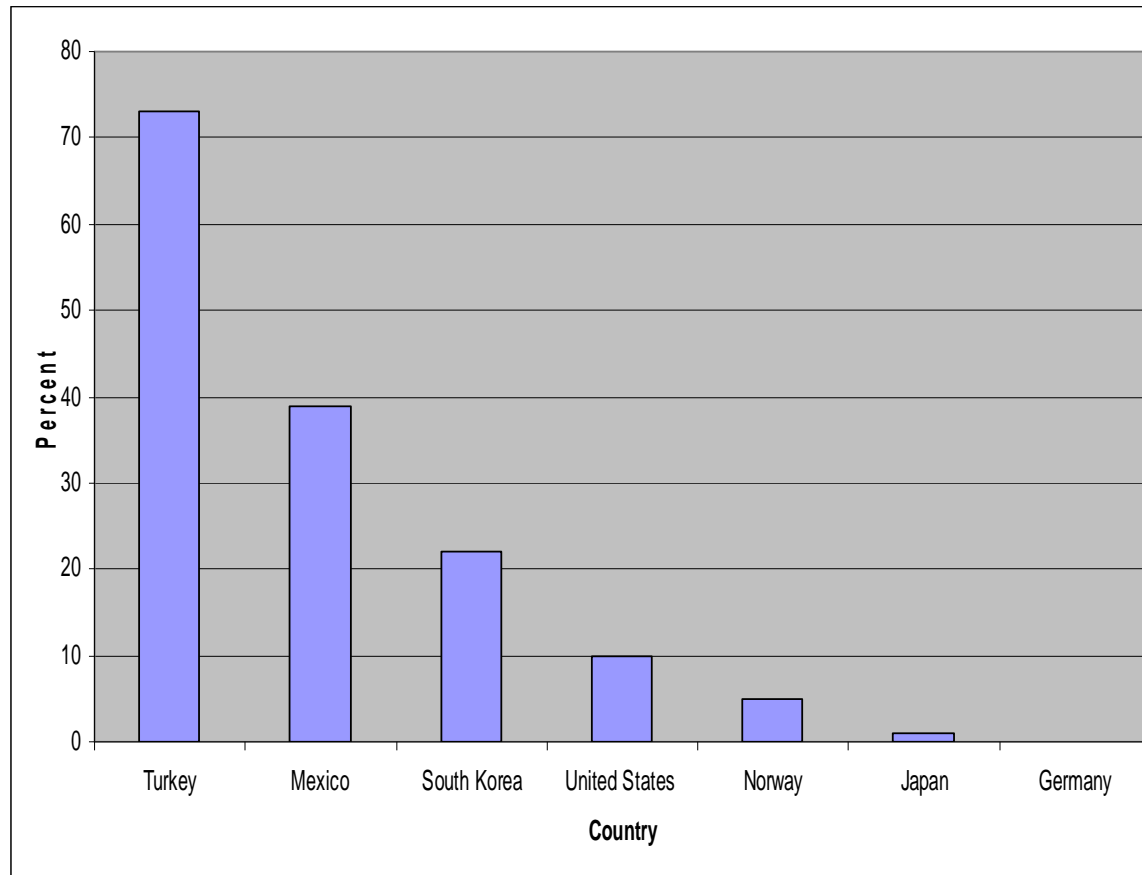
Total Support Estimate by Country (% of GDP)



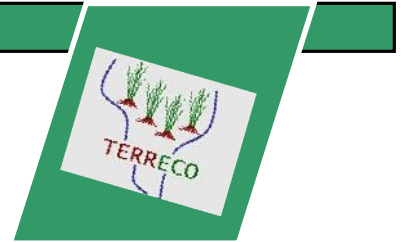
Source: OECD, 2007

# Soil Erosion

Agricultural land area classified as having moderate to severe water erosion risk (% , 2002)



Source: OECD, 2004





# Pesticide Use in Agriculture

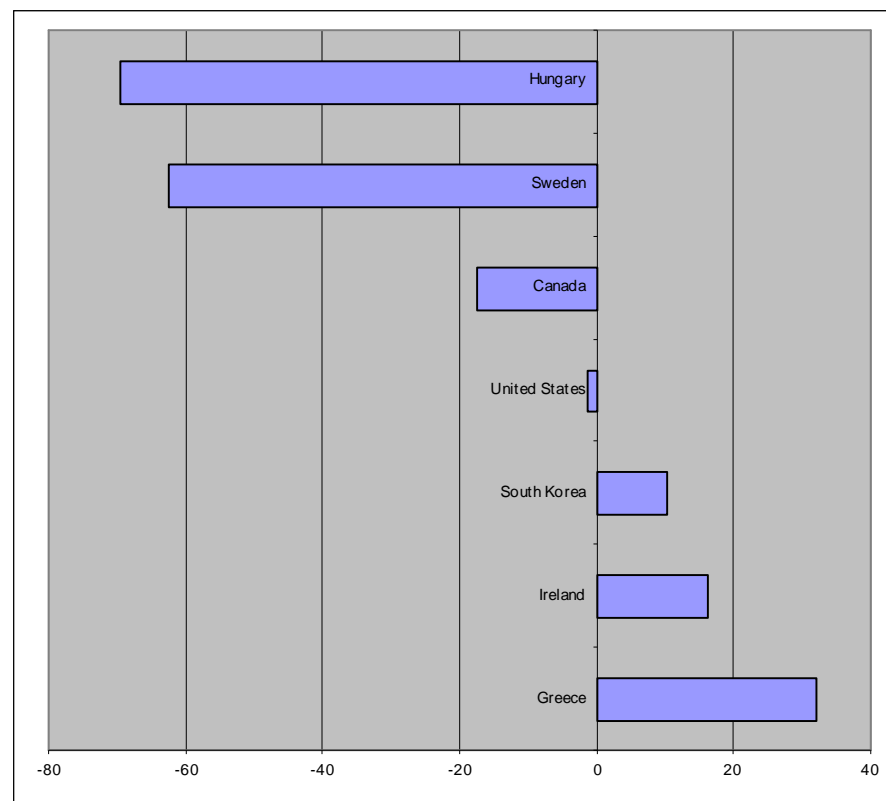
## Active Ingredients



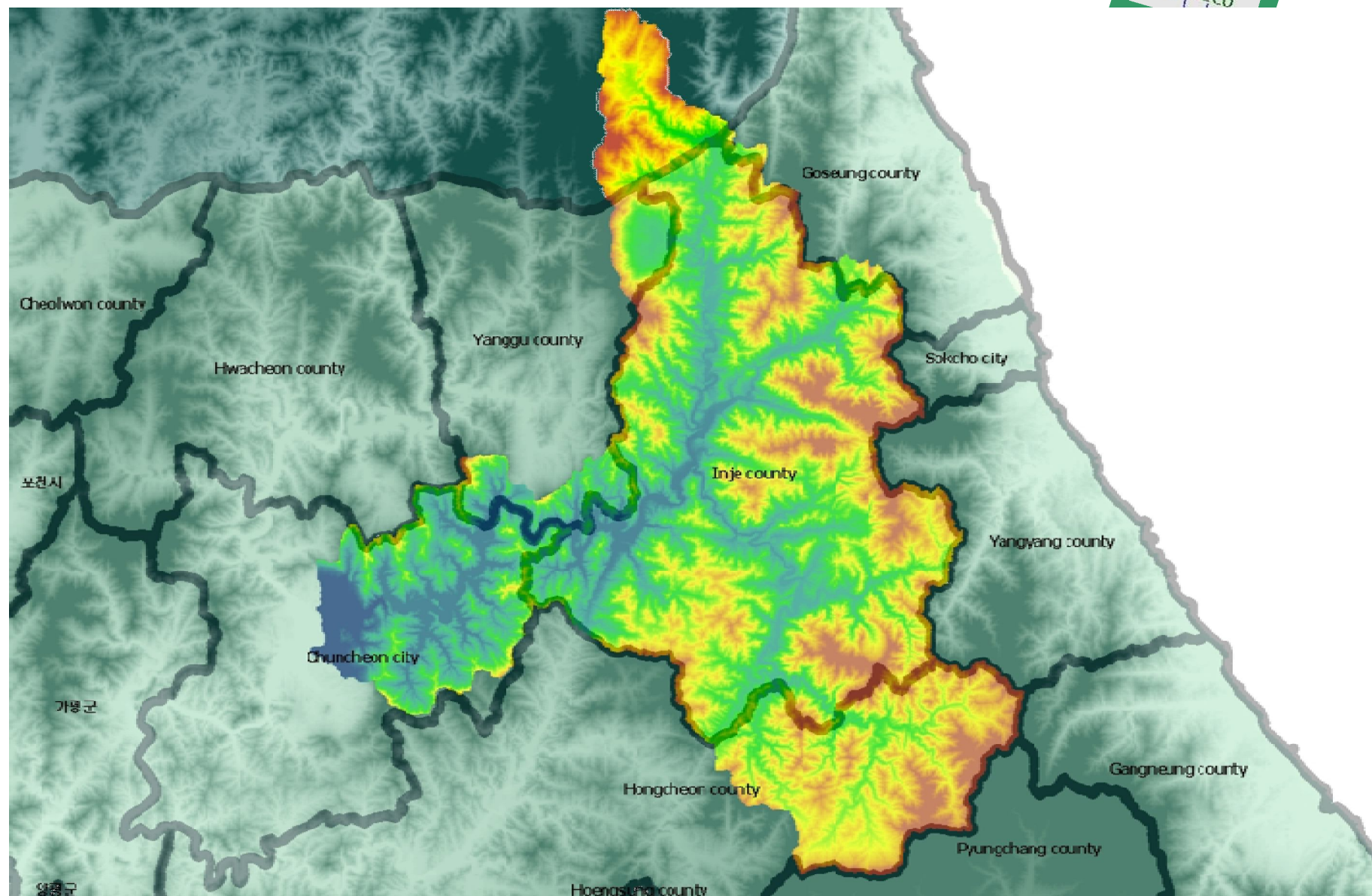
Country	Quantity (ton)	
	1985-1987	1995-1997
Hungary	28359	8628
Sweden	3885	1454
Canada	35370	29206
United States	377577	373115
South Korea	22726	25063
Ireland	1812	2107
Greece	6928	9143

Source: OECD, 2001

## Percentage change (%)

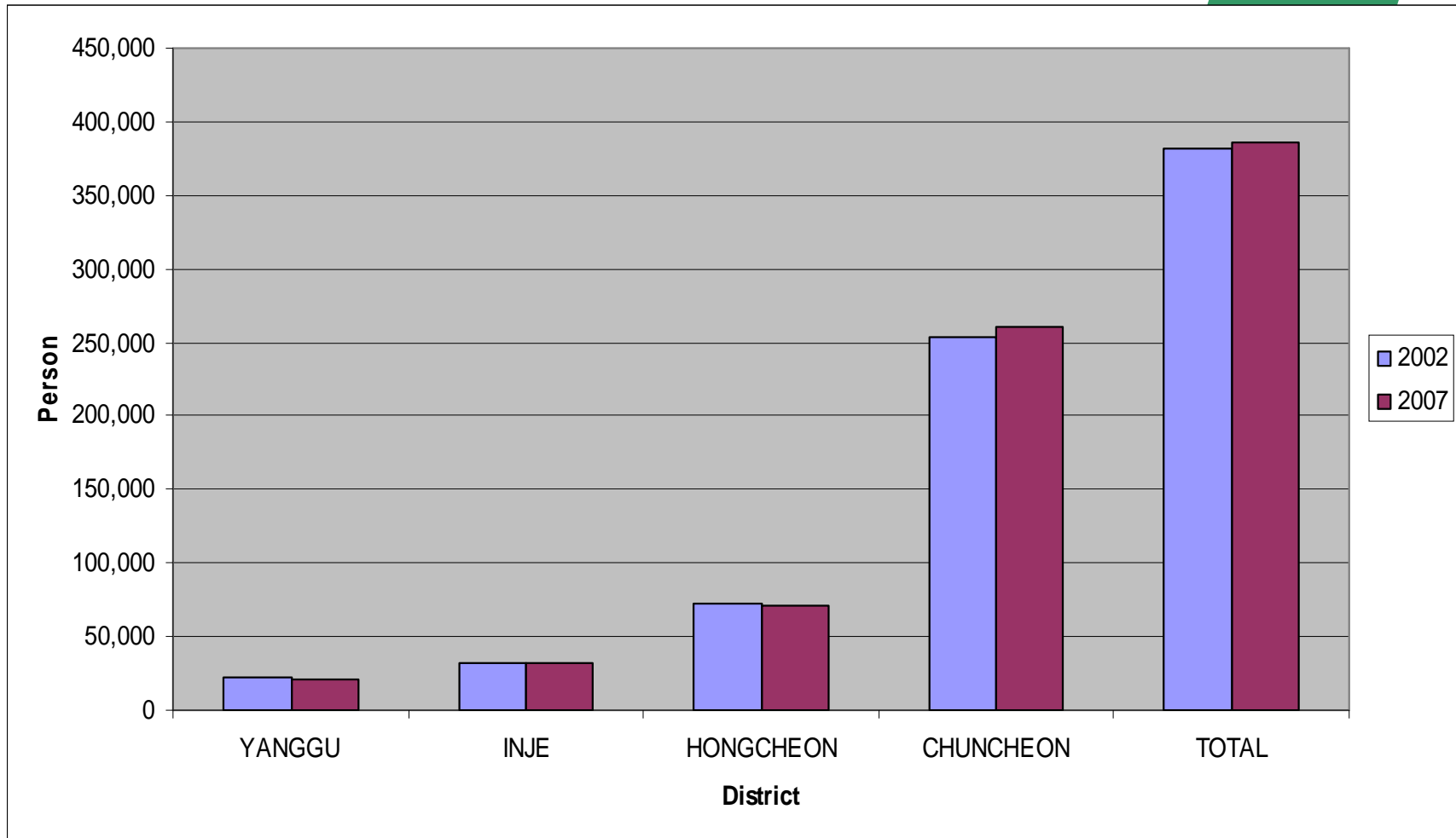


# Study area





# Population in study area



**Percentage of farm population: around 15%,**

**Source: County statistics, different years**

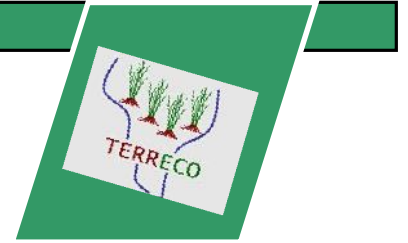
# Crop land per farm and rice paddy



Year	YANGGU		INJE		HONGCHEON		CHUNCHEON	
	Area (a)	Rice (%)	Area (a)	Rice (%)	Area (a)	Rice (%)	Area (a)	Rice (%)
2002	215.7	59.9	178.0	31.5	152.2	43.1	125	39.7
2003	224.4	60.6	166.0	31.3	152.2	43.1	116	39.6
2004	257.3	53	163.0	30.7	149.4	41.4	115	39.1
2005	234.4	50.9	158.0	30.6	163.7	40.5	118	38.6
2006	225.2	50.1	150.7	29.5	175.4	39.2	99	36.1
2007	219.6	50	137.2	29.5	172.1	38.1	96	35.6

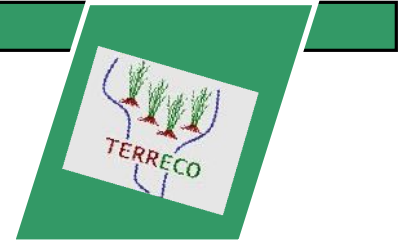
Source: County statistics, different years

# Innovations



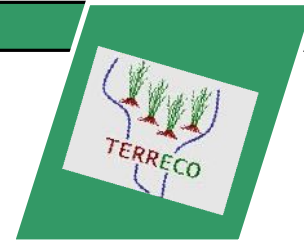
- Eroded soil quantity, chemical runoffs, and crop emission are co-products of agricultural production;
- Supply estimated by physiological process model;
- Specific considerations:
  - ✓ Climate change,
  - ✓ Changes in factor market,
  - ✓ Changes in policy instruments,

# Possible Scenarios



- Climate warming and more extreme climatic events (product supply),
- Intensification of industrialization (product supply and demand, labor supply),
- Economic crisis (demand, labor supply)
- Reunification (demand, supply)
- Policy change (PES, subsidies, etc..)

# Challenges



## ➤ Soil erosion:

- Total soil quantity eroded annually in the watershed,
- Soil quantity eroded annually per hectare for each crop,
- Economic losses due to soil erosion,

## ➤ Chemicals' residues:

- Total chemicals applied annually in the watershed,
- Chemicals applied per hectare for each crop and the quantity remains in the soil (not uptake by crop)

## ➤ Emission by agricultural crops,

## ➤ Domestic and international trade of agricultural products at district level

## ➤ Demand of agricultural products for industrial use,

## ➤ Korean expertise with regard to agricultural economic modeling



*Thank you for your attention*

한국수자원공사  
소양강다목적댐

