EU Approaches to modern and sustainable agriculture: The global dimension

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1. Key EU programs aimed at sustainability of agriculture (1)

- Farm to Fork Strategy: Domestic sustainability along the value chain.
- Green Deal: Domestic sustainability: Domestic Greenhouse Gas (GHG) emissions.
- Biodiversity Strategy: Domestic biodiversity.
- EU Protein Plan: Domestic Production.

1. Key EU programs aimed at sustainability of agriculture (2)

- Common characteristic: International interactions not considered.
- Including them may yield a more complete assessment of the suitability of program design.
- International interactions may even be more important than domestic effects.

1. Key EU programs aimed at sustainability of agriculture (3)

- Sustainability has 3 dimensions: Environmental, economic and social.
- Focus in my presentation is on the enviromental dimension.
- Environment: Climate and global natural capital (agricultural land, natural habitats, biodiversity).

2. Changing international framework conditions (1)

Increasing scarcities in world agriculture

- Oversaturation with GHGs of the global climate commons with: Climate change.
- Increasing scarcity of global natural capital (incl. land suitable for farming, natural habitats and their biodiversity).

2. Changing international framework conditions (2)

Growing concerns about world food security

- The more than one century long trend of declining commodity prices has ended.
- Since 2000: upward trend in prices.
- World food needs: +120% (2000-2050).
- UN warning: Increasing hunger; >5000 children die every day from undernutrition: Equivalent to fatal crashes every day of 28 B747-8.

2. Changing international framework conditions (3)

- Poor countries will be most significantly and negatively affected by climate change.
- Poor countries used to be net net exporters in food and agriculture.
- Today they are net importers: Caught in the *Malthusian Trap.*
- FAO: Food import gap + 400% (2000-2030).
- 2030-2050: Continuing rapid growth of the import gap.

2. Changing international framework conditions (4)

- The world (incl. GER, EU and China) must increase production significantly.
- In the EU, the times of plenty are over. EU has become a major net importer in food and agriculture (on the commodity level).
- On balance, EU land use outside her borders for her own needs in food and agriculture: 17-34 million ha.

3. The global climate commons and the ILUC effect (1)

- ILUC: **I**ndirect **L**and **U**se **C**hange
- Example: Growing EU bioenergy production.
- Declining domestic EU food production.
- Rising prices: Growing incentives for global expasion of the agricultural acreage**.**

3. The global climate commons and the ILUC effect (2)

- Accelerated expansion of the global agricultural acreage.
- Additional loss of natural habitats and their biodiversity.
- Additional GHG emissions.
- Any reduction in domestic EU production acts to accelerate global acreage expansion.
- Any increase in domestic EU production acts to reduce the global acreage expansion.

3. The global climate commons and the ILUC effect (3)

- IPCC 2019 Report on land and land use change.
- Annual GHG emissions of world agriculture (CO2e):
  - On the land being farmed presently (1.5 billion ha): 6.2 ± 1.4 billion t.
  - Annual global acreage expansion of 4.35 million ha: 4.9 ± 2.5 billion t.
  - GHG emission per ha of land expansion is a **large multiple** of what is emitted per ha on the land farmed today.

3. The global climate commons and the ILUC effect (4)

- Direct GHG emissions (CO2e/ha und Jahr)
  - GER: 3.9 t
  - World: 4.1 t
- GHG emissions per ha of acreage expansion: 183 t CO2e.
- Rather conservative estimate used in the following calculations.
- IPCC Data: CO2e >1000 t/ha and/or far more than 4.35 Mio. ha acreage expansion. Could not be verified.

3. The global climate commons and the ILUC effect (5)

- Agriculture in GER and the EU: Integral parts of the global agricultural system.
- Developments in the domestic agricultural economies can only be correctly understood and analyzed in a global context.
- **!!!** The atmosphere in which the global climate evolves is a **global common resource:** Domestic policy decisions must account for that.
- They have to account for the ILUCs of other users of the **global commons** to domestic GER or EU policy decisions**!!!**

3. The global climate commons and the ILUC effect (6)

- Tradeoffs or synergies: Common occurance between domestic and global effects
- Policy instruments aimed at improving EU agricultural sustainability may:
  - have positive effects on global sustainability or
  - have negative effects on global sustainability.
  - For a correct assessment of the net effect, each instrument has to be analyzed.

4. Example 1: Agriculture in the European Green Deal (1)

- Agriculture must reduce direct domestic GHG emissions over time according to a schedule to be determined.
- Organic farming shall be expanded.
- Chemical crop protection use: 50 per cent reduction.
- Fertilizer use: Reduction ≥ 20 per cent.

4. Example 1: Agriculture in the European Green Deal (2)

- Analysis for GER: 100 per cent organic farming.
- Yields in organic farming in GER: 50 % of yields with modern farming.
- Expansion to 100 % organic farming in GER: Cutting in half total production in GER.

4. Example 1: Agriculture in the European Green Deal (3)

- Additional global acreage expansion: +6.5 million ha (conservative estimate).
- Additional CO2e emissions: 1.1 billion t.
- Cost to society: € 200/t CO2e.
- Climate cost to society at large: € 220 billion.
- **Climate cost to society per ha of land converted to organic farming in GER: € 18300.**
- **Pigou tax on organic acreage necessary** to cover the negative **global** externalities of organic farming in GER.

4. Example 1: Agriculture in the European Green Deal (4)

- What is the net effect? Additional ILUC related emissions of GHGs minus direct emission reductions in GER.
- Change in total CO2e emission of moving to 100 % of organic farming in GER:
  - Reduction in **direct domestic** emissions:
    12 million ha * 2 t CO2e per ha = 24 million t CO2e
  - Additional CO2e Emissionen of acreage expansion: 1.1 billion t CO2e (indirect emissions triggered by **ILUC**).
- Net **increase** in **ttl. emissions** of CO2e
  = (1100-24) million t = 1076 million t.

4. Example 1: Agriculture in the European Green Deal (5)

- Additional cost to society:
  - Global loss of 6.5 million ha of natural habitats.
  - Loss of global biodiversity: Equivalent to biodiversity in 2.2 million ha of rain forest.

4. Example 1: Agriculture in the European Green Deal (6)

- The intended significant reduction in the use of chemical crop protection and fertilizer could **potentially** be **consistent** with the objectices of the Green Deal or the F2F Plan if crops generated with molecular methods of plant breeding were permitted in the EU (e. g. CRISPR/Cas9).
- Examples: Improved N efficiency of crops, resilience against biotic and abiotic stress.
- This is not the case, however.
- Therefore: These EU programs **act to damage both climate and global natural capital.**

4. Example 2: Innovation and yield growth (1)

- Research and innovation: Integral part of EU sustainability programs.
- Every percentage point rise in EU yields:
  - Reduction of global acreage expansion: 1.2 million ha (ILUC).
  - CO2e Emissions avoided: 220 million t.
  - Climate cost to society avoided: € 44 billion.

4. Example 2: Innovation and yield growth (2)

- Under the EU sustainability programs, agriculture ought to be given credit in its GHG emission balance for the reduction global acreage expansion resulting from yield growth.
- So far: This is not considred at all.

4. Example 2: Innovation and yield growth (3)

- Yield growth and innovation in German agriculture, 2003-2013 (Source: Noleppa, 2016)

Crop	Yield growth per ha and year (%)	Innovation (% TFP growth per ha and year)
Wheat	0.86	1.44
Maize	1.26	1.86
Oilseed Rape	0.98	1.58
Sugar Beets	2.46	3.06

4. Example 2: Innovation and yield growth (4)

- Yield growth in GER agriculture has been realized while intensity of land use has declined.
- Some reasons:
  - Agriculture 4.0 (precision agriculture, AI) in both crop and livestock production.
  - Possible further yield growth possible while reducing land use intensity: Molecular crop breeding (e. g. increase in N-efficiency, more efficient use of sunlight; more resilience against biotic and abiotic stress).

5. Conclusions (1)

- The EU sustainability programs for agriculture completely **disregard their global dimensions** and the very **high value** to society of **innovation** and **productivy growth**: Climate protection and preservation of global natural capital.
- These programs cause effects that are contrary to what the EU claims to achieve with them.
- The programs also do not account for the changing international framework conditions faced by world agriculture (particularly increasing scarcities of agricultural land, natural habitats, biodiversity).

5. Conclusions (2)

- The EU intends lead by example for other countries by expanding organic farming, and reducing fertilizer and crop protection use.
- If other countries would, in fact, follow the EU example, the damage to climate and global natural capital would even be larger.
- For the world at large, incl. the EU!!!

5. Conclusions (3)

- Sustainability measures with effects that look intuitively appealing when focus is only on the local or national level may actually turn out to do more harm than good when the international interactions (ILUC) are included in the analysis.
- The gobal dimensions of domestic food and agricultural policies matter but tend to be disregarded.

5. Conclusions (4)

- Only with modern, productive and innovative agriculture will it be possible in 2050 to
  - provide enough food for 10 billion humans at prices that the poor can afford while at the same time
  - successfully fighting climate change and
  - preserving the domestic and the global natural capital.

Biodiversity in GER under alternativen land use schemes relative to 100 % modern agriculture

(In both schemes GER poduction -50 %; detrimental effects on climate and natural capital are identical)

Land use scheme	100% organic	50% modern ag. 50% natural succession
Global loss of natural habitats (million ha)	- 6,5	- 6,5
CO2e (billion t)	+ 1,1	+ 1,1
Domestic biodiversity (million indexpoints)	+ 228	+ 516

Thank you for your attention!

Book manuscript titels:

GER: „*Ökodämmerung der Landwirtschaft?*

Hunger, Klimaschutz und Nachhaltigkeit“

ENGL: „Twilight of Organic Farming?

Hunger, Climate Protection and Sustainability“