Territorial impacts of agro-ecological farming practices and food systems transformation in the European Union in 2050

Input to the symposium on Agroecological transitions of farming systems: Strategies and their implications for sustainability and governance in different European contexts

Elin Röös, Andreas Mayer, Adrian Muller, Shon Ferguson

AES 94th Annual Conference | 29-30 March 2021
Five storylines for future EU food systems

- **Global food systems**
  - 1. Business as Usual
  - 2. Agro-ecology on Export

- **Local food systems**
  - 3a. Localisation for Protectionism
  - 3b. Localisation for Sustainability
  - 4. Local agro-ecological food systems

Low level of agro-ecological farming practices

High level of agro-ecological farming practices
Storyline 1: Business-as-usual

- Globalisation of the EU food system continues
- Farmers incentivised to produce low value commodities leading to further specialisation of farming systems and regions
- Current production and consumption trends in the EU continue
Storyline 2: Agro-ecology for exports

- Globalisation of the EU food system continues
- Strong support for agro-ecology driven mainly by export opportunities
- Substantial expansion of agro-ecology for export oriented products
- Cropland expansion allowed
Storyline 3a: Localisation for protectionism

- Nationally or locally produced foods, regardless of production methods, are prioritised over foods produced in agro-ecological farming systems

- Drivers: rise in nationalism and protectionism

- Focus is on increased production of bulk commodities

- Diet develops according to current BAU-projections
Storyline 3b: Localisation for sustainability

- As Storyline 3a but developments are **driven by sustainability objectives**
- No cropland expansion allowed
- Still a moderate implementation of agro-ecological practices
- Diets change toward more plant based and food waste is reduced

Photos: iStockPhoto
Storyline 4: Local agro-ecological food systems

- Drivers: A rapid **increase in climate and environmental concerns** among large population groups

- In 2050, on average across member states between 20-50% of land is farmed with strong agro-ecological practices serving mostly local markets.

- Healthier and more sustainable diets – aligned to the local availability

- Animal species consuming human edible feeds (pigs and poultry) decrease, ruminant production is mainly grass-based
Modeling results

Two types of models:
- Biophysical
- Complementary economic equilibrium model

Main aim: to identify robust strong patterns, in particular related to trade-offs and synergies

Patterns behind the results:
- The food system becomes smaller – in particular: less animal source food (and thus less feed production)
- Commodity group shares change (e.g. more vegetables)
- Regional production patterns change
Cropland and grassland use

Territorial impacts of agroecological farming practices in the EU in 2050
Biophysical outcomes

Greenhouse gas emissions

- 2012
- BAU
- Aeexp
- LfP
- LfS
- LAE syst

Greenhouse gas emissions with vegetation regrowth
Irrigation water use (relative to the baseline)

Irrigation water - water stress adjusted (relative to the baseline; country level)
Production of animal-based food (rel. to BAU 2050)
Territorial impacts of agroecological farming practices in the EU in 2050

Labour

Labour input (Crops; relative to the baseline; country level)

Labour input (Livestock; relative to the baseline; country level)

Labour input (Total; relative to the baseline; country level)
Territorial impacts of agroecological farming practices in the EU in 2050

**Producer value**

- Producer value (Crops; relative to the baseline; country level)
- Producer value (Livestock; relative to the baseline; country level)
- Producer value (Total; relative to the baseline; country level)
Territorial impacts of agroecological farming practices in the EU in 2050

Labour productivity

Labour productivity (Crops; relative to the baseline; country level)

Labour productivity (Livestock; relative to the baseline; country level)

Labour productivity (Total; relative to the baseline; country level)

- FOFA_BAU_2050_Test
- LF_P_2050
- AE_exports_2050
- LFS_2050
- AE_food_2050
Economic modelling: goals and caveats

• Goal:
  • Which price changes would be needed to see the biophysical outcomes as economic equilibria?
  • i.e.: which combination of economic taxes or subsidies are needed to reach the alternative 2050 scenarios?
  • 3 policies:
    • EU Production tax/subsidy
    • EU Consumption tax/subsidy
    • EU import tariff

• Caveats
  • We model policies required to reach the desired production, and consumption
  • We do NOT model policies to induce agro-ecological production methods
  • The model does not include the welfare benefits from agro-ecological production (ecological services etc)
Economic modelling: main results

- Agro-ecology leads to higher prices, lower economic welfare for many commodities
- The required changes in prices are very large

- Results highly dependent on how responsive future production is to policies
  - Highly responsive ("elastic supply"): smaller price and welfare impacts to reach agro-ecology
  - Non-responsive ("inelastic supply"): large price and welfare impacts to reach agro-ecology
Economic modelling: Takeaways

- Agroecology requires fundamental shifts in production and consumption
  - Infeasible to reach agroecology using market-based economic policies alone
  - Consumer preferences need to change
  - Production mandates may be more feasible than taxes

- Need to “flatten the (supply) curve” / avoid lock-in in the long run
  - Future production systems need to be flexible, responsive to market conditions
Key messages

• Agro-ecological transformation in the EU can be a promising option, but need to be complemented with dietary changes to avoid leakage of environmental pressures

• Drastic changes are needed – that likely are not achievable with known market-based policies alone

• Particularly, healthy low-meat diets and reduced food waste allow for several important measures
  • Increasing self-sufficiency
  • Nature-based climate solutions (i.e. re-/afforestation)
  • A general extensification of crop yields
  • Agricultural reserves for the future, if needed (higher resilience)

• Potential trade-offs require particular attention:
  • e.g. increased water use with increased vegetable production

• The biggest effects relate to changes that address the total production, and not on improving efficiencies – “make the food system smaller”
Elin Röös, elin.roos@slu.se
Adrian Muller, Adrian.Mueller@fibl.org
Andreas Mayer, Andreas.Mayer@boku.ac.at
Shon Ferguson, shon.ferguson@slu.se
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 773901.