



STRUCTURAL AND POLICY DRIVERS OF FARM PRODUCTIVITY AND SUSTAINABILITY IN OECD AND G20 COUNTRIES

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The productivity-sustainability challenge

- Total Factor Productivity (TFP) has been the main source of agricultural production growth in recent decades
- Long-term productivity growth along the food chain is thus required to respond to growing and changing global demand.
- This common challenge needs to be achieved sustainably, while coping with climate change.
- Business as usual is not an option and further innovation is needed.



There are also opportunities for the sector

- Sustainable productivity growth in food and agriculture contributes to sectoral competitiveness, viable farms and attractive rural areas.
- Market developments offer opportunities for traditional exporters of agro-food products but also for developing high value, specific agri-food chains valuing environmental or health attributes.
- There is a large diversity of conditions and performance across and within countries.

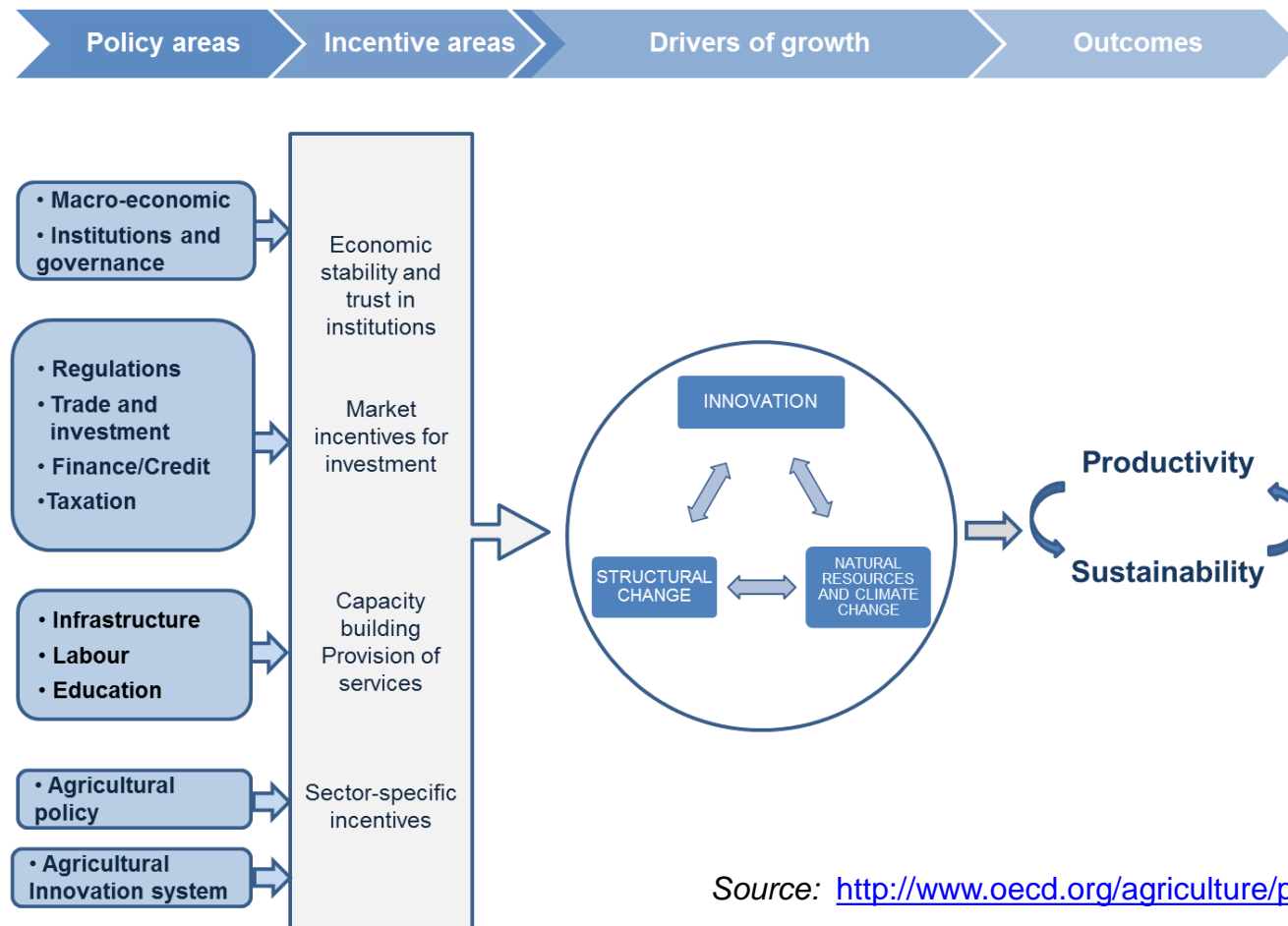


- Framework applied to country reviews using existing information
 - 10 reviews since 2015 so far plus 3 on-going
- Analysis of specific topics to strengthen the framework
 - Agricultural policy impact on productivity, environmental performance and climate change
 - Focus on other policy areas: Taxation, education and skills
 - Farm-level analysis: Drivers of farm performance
- Synthesis of main finding early 2019



OECD productivity and sustainability framework

General and sector-specific policies affect innovation, structural change, natural resource use and climate change, which drive productivity and sustainability.



Source: <http://www.oecd.org/agriculture/policies/innovation>



Why focusing on farm-level analysis?

- To complement aggregate analysis
- Structural developments affect policy effectiveness
- Policy developments towards more targeting
- Thus the need for farm-level information and analysis to evaluate and improve policies
- Specific challenges for OECD:
 - access to national data,
 - cross-country comparison (EU vs non-EU)



Network approach

- OECD set up a farm-level analysis (FLA) network, which meets twice a year since 2008, to promote farm-level analysis by:
 - exchanging experience in using farm-level data to develop indicators and analyse policy issues
 - Undertaking common projects allowing for cross-country comparison:
 - ToR defines common definition of population, farm categories (e.g. size, type), and variables (e.g. income) and indicators (mid-point).
 - Access to individual data for clustering or econometric analysis
- Website: www.oecd.org/agriculture/farm-level-analysis-network/



Working methods

- The networks meets twice a year
- To discuss implementation of common projects that contribute to OECD programme of work
- In most cases, countries provide data and OECD makes the analysis and draws policy conclusions
- To discuss data developments (e.g. EU FLINT project to collect additional data to evaluate new aspects, e.g. agri-environmental performance)
- and analysis done in countries
- Contact persons nominated by government, and experts invited on an ad hoc basis, including consultants



Findings on drivers and performance

- From country reviews
- From FLA work



Innovation as a driver of productivity and sustainability?

- The link between innovation and productivity is well established theoretically and empirically
- Total factor (TFP) growth largely reflects higher labour productivity, linked to larger farm size and adoption of labour-saving technologies, including information and communication technologies (ICT).
- Innovation in buildings and machineries allowed energy saving, better risk management, lower waste
- More sustainable practices (lower input) were developed and adopted,
- better management, production and marketing strategies
- and genetic improvement.
- Innovation also led to more sustainability, with appropriate incentives, and increased traceability



Structural change?

- Larger farms are generally found to be more productive than smaller ones as they can better manage labour and machineries, and use scale-dependent technology. Empirical evidence was found of the role of economies of scale in TFP growth in EU crop and dairy farms.
- Larger farms also have better access to knowledge, because of higher human and financial capacity to make changes.
- Large agri-food firms generally have more capacity to carry out innovation activities, acquire technology, deal with regulations and access markets.
- But innovation also benefits smaller farms (e.g. digital, sharing)
- Sustainability performance by farm size is less clear and more evidence is needed.



Natural resources and climate change?

- Natural resource use and climate change clearly influence the range of possible products and the choice of adapted production practices, and thus performance.
- In many instances, intense natural resource constraints have affected productivity performance.
- This triggered the development and adoption of more adapted technologies and practices, and changes in institutions and policy incentives.
- But the speed and extent of responses has varied, and more needs to be done.



Dynamics of dairy productivity: method (Kimura and Sauer, 2015)

- Dynamics of productivity growth in the dairy farm sector of England-Wales, Estonia, the Netherlands (by farm size)
- TFP measured at sector and farm level using a non-parametric method (Fisher index); sample weights applied to output and inputs;
- Unbalanced panel of FADN farms 2000-12
- Decomposition of TFP growth between farm-level TFP, resource reallocation between farms, entry-exit
- Impact of farm characteristics (by productivity class) on farm-level TFP estimated using censored regression model (Tobit) in a random effect specification (dummy for quota reform in 2008).



Dynamics of dairy productivity: results (Kimura and Sauer, 2015)

| Annual TFP growth | Dairy sector | Farm level un-weighted | Farm-level weighted | Large farms | Middle | Small |
|-------------------|--------------|------------------------|---------------------|-------------|--------|-------|
| Estonia | -0.2 | -0.48 | 0.85 | -0.11 | -0.41 | -1.25 |
| NLD | 1.3 | 1.18 | 1.17 | 0.79 | 1.23 | 1.70 |
| England-Wales | 0 | 0.32 | -0.26 | -0.36 | 0.05 | 0.75 |
| Germany | 0.5 | | | 0.4 | 0.4 | 0.9 |

- TFP growth results from higher land and labour productivity, but lower productivity of capital (especially in Estonia, where input use also increases)
- Reduction of TFP gap across farms (except in Estonia)
- Part-time farms have lower TFP
- Large farms have higher TFP (and stocking density)
- Positive effect of quota reform in the Netherlands and Estonia



Additional TFP measurement

- TFP growth by farm size in Korean, annual growth over 2003-15

| Sector level | Average of all farms | Large farms | Medium farms | Small farms |
|--------------|----------------------|-------------|--------------|-------------|
| 1.4% | 2.4% | 4.2% | 2.0% | 1.3% |

- TFP growth by farm type in Sweden, annual growth over 2002-14

| Sector level | Pigs | Cattle | Milk | COP crops |
|--------------|------|--------|------|-----------|
| 1% | 2.1% | 1.3% | 1.7% | -0.9% |



Link between farm productivity and innovation in the Netherlands: Method (Sauer, 2017)

- Dairy and crop farms in the Netherlands 2004-14
- Farm survey including innovation
- Structural multi-stage model linking innovation and productivity
 - Decision to innovation [0-1]
 - Decision on intensity of innovation [expenditure]
 - Output of innovation [0-1]
 - Impact of innovation: productivity change



Link between farm productivity and innovation in the Netherlands: Results (Sauer, 2017)

- Regulations and standards create a demand-pull for innovation
- Cooperation with knowledge institutions improves success
- Other positive factors include: farm own product and process-related development activities, farm size, age of operator, confidence in business and sector developments



Sources and drivers of productivity growth at farm level: Method (Bokusheva and Cechura, 2017)

- Crop farms from EU FADN 1995-2003 and 2004-13
- 6 EU MS: France, England Germany(E-W), Czech R., Hungary, Poland
- TFP measured and decomposed based on parameters of a stochastic input distance function (IDF).
- Translog functional form, with 3 outputs (cereals, other crops, other outputs) and 4 inputs (land, labour, capital, materials).
- Technology favours large scale, yet economies of scale not fully realised.
- Payments have a negative influence on TFP growth and efficiency in input use, but decoupled payments almost no effect
- Positive effect of investment on TFP



Analytical findings on drivers of productivity growth

- Farm size +
- Education +
- Age not clear
- Removal of quotas +
- Regulations drive innovation
- Investment +
- Payments - (LFA effect needs to be removed)
- Link multiple criteria in current work



Initial findings on drivers of productivity-sustainability (Sauer, forthcoming)

- 7 indexes used to determine farm classes
- Estimation of productivity and components, by farm class
- Correlation between productivity and different characteristics (indexes)
- 4 cases, 5 additional cases planned

| | Dairy farms | | Crop farms | |
|---------------------------------------|------------------------|-------------------------------|------------------------|--------------------|
| Possible correlation ¹ | Estonia (2000-2015) | Czech Republic (2005-2015) | Hungary (2001-2014) | Italy (2008-15) |
| Innovation and productivity | + | + | + | + |
| Size and productivity | + | + | +/- | + |
| Intensity and productivity | + | | | |
| Hired labour and productivity | + | | +/- | + |
| Sustainability and productivity | - | +/- | - | +/- |
| Family farming and sustainability | + | +/- | | +/- |
| Diversity and sustainability | + | | | +/- |
| Intensity and sustainability | - | | | - |
| Less Favoured Area and sustainability | + | + | + | - |



Better information needed

- **Measurement:**
 - productivity and sustainability at the farm level
 - Different aspects of sustainability: resource use, environmental impact, socio-economic aspects
 - Coherence between macro and micro indicators
 - different kinds of innovation
 - Farm diversity and structural change
 - Cross-country comparison
- **Analysis**
 - Drivers of farm performance
 - Response to policies by different types of farmers
 - Productivity-sustainability trade-offs



List of published studies from cooperation in the FLA network

- Bokusheva, R. and L. Čechura (2017), "Evaluating dynamics, sources and drivers of productivity growth at the farm level", OECD Food, Agriculture and Fisheries Papers, No. 106, <http://dx.doi.org/10.1787/5f2d0601-en>
- Sauer, J. (2017), "Estimating the link between farm productivity and innovation in the Netherlands", OECD Food, Agriculture and Fisheries Papers, No. 102, <http://dx.doi.org/10.1787/2224dad0-en>.
- Bokusheva, R. and S. Kimura (2016), "Cross-Country Comparison of Farm Size Distribution", OECD Food, Agriculture and Fisheries Papers, No. 94, <http://dx.doi.org/10.1787/5jlv81sclr35-en>
- Kimura, S. and J. Sauer (2015), "Dynamics of dairy farm productivity growth: Cross-country comparison", OECD Food, Agriculture and Fisheries Papers, No. 87, <http://dx.doi.org/10.1787/5jrw8ffbzf7l-en>
- Kimura, S. and C. Le Thi (2013), "Cross Country Analysis of Farm Economic Performance", OECD Food, Agriculture and Fisheries Papers, No. 60, <http://dx.doi.org/10.1787/5k46ds9ljxkj-en>
- Kimura, S. and C. Le Thi (2011), "Farm Level Analysis of Risk and Risk Management Strategies and Policies: Technical Note", OECD Food, Agriculture and Fisheries Papers, No. 48, <http://dx.doi.org/10.1787/5kg6z83f0s34-en> Part of wider project and country case studies
- Moreddu, C. (2011), "Distribution of Support and Income in Agriculture", OECD Food, Agriculture and Fisheries Papers, No. 46, OECD Publishing, Paris. <http://dx.doi.org/10.1787/5kgch21wkmbx-en>



For more information

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