Simulation Models for Agricultural Policy Analysis and Assessment: Use and Challenges

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Content

1. Use of simulation models for agricultural policy analysis and evaluation (practical applications; chain of procedures; indicative examples)
2. Model challenges: key problems
3. Conclusions (core messages; future prospects)

1. Use of simulation models for agricultural policy analysis & evaluation

- Practical applications:
  - Policy Design: Assess the effects of planned / proposed policy interventions (e.g., subsidies for specific crops).
  - Impact Evaluation: Assess outcomes after implementation (e.g., changes in yields after a restriction in the use of pesticides)
  - Scenario Analysis: Explore long-term effects (e.g., effects of climate scenarios for 2050 on wheat production)
- Process: 6 subsequent steps

1. Use of simulation models for agricultural policy analysis & evaluation

- Step 1: Define problem / issue to investigate
- Step 2: Data collection
  - Gather relevant data (e.g., economic, agricultural, environmental)
  - Sources: EUROSTAT, FAOSTAT, SAM, etc.
  - Ensure data consistency and quality
- Step 3: Model selection and calibration
  - Choose model based on scope and data availability
  - Calibrate model parameters using collected data
  - Validate model against historical trends
- Step 4: Scenario Definition
  - Define baseline scenario (current trends, no policy change) - proceed with current conditions
  - Define policy change scenarios (e.g., CAP reform, trade policy) - adjust model variables (e.g., subsidies, tariffs, etc.)
  - Specify time-horizon (e.g., 2025-2035).

1. Use of simulation models for agricultural policy analysis & evaluation

- Step 5: Simulation and analysis
  - Run simulations for each scenario
  - Analyze model outputs (e.g., production, prices, emissions, etc.)
  - Compare baseline vs policy impacts
- Step 6: Reporting results
  - Compile results (tables, graphs, maps)
  - Present findings to policymakers and stakeholders
  - Provide policy recommendations

1. Use of simulation models for agricultural policy analysis & evaluation

- Application Examples: Impact Assessment of the EU's Farm to Fork Strategy (2020) through CAPRI
  - Study Context: The JRC used CAPRI to evaluate the agricultural implications of the Farm to Fork (F2F) Strategy, part of the European Green Deal, announced in 2020. The strategy aimed to make food systems sustainable by targeting reductions in pesticide use (50%), fertilizer use (20%), and greenhouse gas emissions, alongside increasing organic farming to 25% of EU farmland by 2030.
  - Objective: Assess the strategy's effects on EU agricultural production, trade, farmer income, and environmental indicators by 2030, compared to a business-as-usual (BAU) baseline.
  - Methodology:
    - Baseline: CAPRI established a 2030 BAU scenario using DG AGRI's Agricultural Outlook (2018–2030), reflecting CAP 2014–2020 policies and existing trends.
    - Scenarios: Simulated F2F targets by adjusting model parameters:
      - Reduced fertilizer and pesticide inputs in the supply module, impacting yields and costs
      - Expanded organic farming areas, altering land use and production patterns.
      - Introduced emission constraints in the environmental sub-module.
      - Scope: Covered all EU-27 NUTS 2 regions and global trade impacts via the market module.

1. Use of simulation models for agricultural policy analysis & evaluation

- Application Examples: Impact Assessment of the EU’s Farm to Fork Strategy (2020) through CAPRI
  - Key Findings:
    - Production: Crop production (e.g., cereals) projected to decline by 5–15% due to lower input use, with livestock output dropping 2–10% from reduced feed availability.
    - Trade: EU agri-food exports to fall by 20%, while imports to rise by 10%, reflecting competitiveness losses (e.g., higher costs vs. non-EU producers).
    - Income: Farmer income to decrease by 5–10% on average, with sharper drops in input-intensive regions (e.g., northern Germany), mitigated slightly by organic price premiums.
    - Environment: Nitrogen surplus to fall by 15–25%, and GHG emissions from agriculture to drop 10–15%, aligning with F2F goals but not fully meeting them without additional measures.
  - Details:
    - Regional Variation: Organic farming gains were strongest in Mediterranean regions (e.g., Italy, Spain), while cereal-heavy areas (e.g., France) saw bigger output declines.
    - Data: Relied on Eurostat, FADN, and IPCC emission factors, downscaled to a 1x1 km grid for environmental outputs.
  - Source: Published in JRC Technical Reports (e.g., “Modelling the Farm to Fork Strategy,” 2021) and cited in EU policy discussions.
  - Significance: Highlighted trade-offs between sustainability and economic viability, informing debates on CAP adjustments (e.g., eco-schemes in the 2023–2027 CAP)

2. Challenges of simulation models for agricultural policy analysis & evaluation

- Data limitations:
  - Availability: Gaps in regional or very recent data (e.g., farm statistics) or disaggregate data; this can often affect the choice of model or/and its structure.
  - Quality: Inaccuracies or outdated inputs can influence estimates
- Model complexity:
  - Trade-off between detail and usability: Overly complex models may confuse policymakers
  - Assumptions: Simplifications (e.g., uniform farmer behavior) can misrepresent reality
- Interpretation and Communication:
  - Risk of misinterpretation: Technical outputs may not translate to actionable policy
  - Stakeholder skepticism: Lack of trust in “black box” models
- External factors:
  - Uncertainty: Unpredictable events (e.g., pandemics, geopolitical shifts) challenge forecasts
  - Cost: High resource demands for development and maintenance.

3. Conclusions

- Core messages:
  - Simulation models offer broad scope and high relevance, practical uses in policy, but face challenges.
  - They are expensive to build and require significant know-how and advanced skills
  - When used thoughtfully, they're powerful tools for evidence-based agriculture policy.
  - They must be paired with good data and clear communication.
- Future prospects - how to address challenges:
  - Advances in AI and big data should improve model accuracy and accessibility.
  - Messages to MAs and Researchers:
    - Explore open-source models (e.g., APSIM, DSSAT, SWAT, FARMIS, CAPRI, etc.) or/and collaborate with research institutions.
    - Pay attention to the availability and accessibility of reliable data.
    - Make sure that contractors focus on interpretation and actionable (operational) policy options. Monitor them intensively!