Challenges and research gaps in the area of integrated climate change risk assessment for European agriculture and food security

FACCE MACSUR Policy Brief 3

In a nutshell

Priorities in addressing research gaps and challenges should follow the order of importance, which in itself would be a matter of defining goals and metrics of importance, e.g. the extent, impact and likelihood of occurrence. For improving assessments of climate change impacts on agriculture for achieving food security and other sustainable development goals across the European continent, the most ***important research gaps and challenges appear to be the agreement on goals with a wide range of stakeholders from policy, science, producers and society, better reflection of political and societal preferences in the modelling process, and the reflection of economic decisions in farm management within models.*** *These and other challenges could be approached in phase 3 of MACSUR.*

Climate change will affect human well-being and welfare through the impact on agricultural production of food, feed, and bioeconomy resources and as well as on the ecosystem and social services of rural agriculture. Associations among the many facets of agricultural production are non-linear and involve synergies and tradeoffs. In addition, these associations may vary across a heterogeneous, large spatial and political arena like Europe. For improved assessments of climate change impacts, existing modelling and assessment methodologies will have to be extended (or in specific cases new ones developed) to accommodate these heterogeneities and interactions.

Assessments at spatial scales of farm level or greater must include socio-economic aspects at time-scales greater than one year. At these scales, within-year and production-unit (plants, animals, plots) variation is dampened and variation in political settings, consumer attitudes and national economies, availability of resources, and value of products move to the fore.

FACCE MACSUR researchers identified needs for research to improve integrated assessments for information of policy, producers, consumers in five areas: (a) assessment criteria, (b) generalization of existing and new knowledge, (c) political and societal settings, (d) on-farm processes (generation of outputs from available resources, including their variation and disturbances), and (e) assessing implications of sub-optimal and technology-improved food production for global food security.

a) assessment criteria

- goal priorities and goal compatibility determined jointly with stakeholders
- agreement among all stakeholders on metrics for goal achievement
- consideration of place- and time-dependency of goal priorities and metrics
- assessment of food security with all its dimensions (availability, accessibility, affordability, nutritiousness, temporal variability) from the perspective of the consumer
- definition of extreme events from a perspective of food security
- combination of non-extreme events that coalesce to extreme events in terms of food security

b) generalization of existing and new knowledge

- calculations of uncertainty hierarchies at farm level and upward the food value chain

- transfer of knowledge in space, time, and scale: validation and training of existing models for new situations
- linking of models taking more strongly into account the compatibility of model assumptions
- definition of reference categories, especially farms crossed with other reference systems (e.g. climate, socio-economy)

c) political and societal settings

- definition of details of consistent political, economic and societal scenarios for achieving SDGs that allow integration of models and their results
- definition goal priorities for farm production and management from the perspectives of society and farm owner
- accounting for changes in prices for resources for agricultural production
- consumer attitudes towards production methods (e.g. organic, animal welfare, genetically modified) and product preferences (e.g. quality meat, vegetarian, regional)

d) on-farm processes (generation of outputs from available resources, including their variation and disturbances)

- models reflecting to a greater extent and detail the many aspects of agriculture: farm economy, management, mass-balances for carbon, nitrogen, and phosphorus, ecological footprints, especially for mixed and livestock farms
- replacing generic empirical model algorithms by process-based algorithms, especially addressing livestock production and farm management
- improved collection and accessibility to on-farm primary data for model improvement in the areas of farm management and farm economy
- better mechanistic representation of impacts of political settings and regulations (CAP, national agendas)
- accounting more strongly for biological interactions (pests, diseases, symbioses, pollination, nutrient cycles)
- improved reflection of variation by weather extremes, pests and diseases and their interactions with farm management and associated costs
- extending the number of crop species, crop varieties, animal species and breeds in models
- incorporation in models the adaptive management of variation in production and risk management (e.g. insurances, disease management, product diversification)
- stronger consideration of farm-economic and societal effects of implementation of new technologies in farm management or the food-value chain (e.g. robot farming, on-demand farming, food printers)
- stronger reflection of uncertainty, management options and risk management in the economic aspect of integrated farm models

e) assessing implications of sub-optimal and technology-improved food production for global food security

- more explicit representation of areas of technological progress in integrated assessments and economic models
- improved representation of management for assessing implications of sub-optimal production
- more detailed feedbacks between physiological agricultural production and economic models

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Full report: **FACCE MACSUR Reports 10: H0.1-D.** http://ojs.macsur.eu/index.php/Reports/article/view/H0.1-D

Previous policy briefs (at http://macsur.eu/index.php/output/policy-briefs)

1. From diversity to strategy: Livestock research for effective policy in a climate change world
2. Improved crop modelling for supporting policy design on climate change impacts, adaptation and mitigation – CropM in MACSUR

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