MACSUR IMPROVES and INTEGRATES models of crop and livestock production, farms, and national & international agri-food markets through interdisciplinary collaboration;

DEMONSTRATES integrated model-based analysis for representative farming systems in selected regions;

ANALYSES effects of climate change on the major farming systems in Europe;

IDENTIFIES climate-induced risks to farming, and jointly with different stakeholders develops effective adaptation and mitigation options.

ASSESSES in regional case studies the consequences of adaptation and mitigation measures for farming competitiveness, the environment and rural development at multiple scales (farm, regional, national and European);

BUILDS research capacity and hands-on-training in integrative modelling for junior and senior researchers;

AIMS at bolstering European capacity in responding to the challenges of food security and climate change and at assisting countries outside Europe in their endeavours to attain food security under climate change.

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Modelling European Agriculture with Climate Change for Food Security

Farming systems provide the food and many of the ecosystem services that our society relies on. This vital role is affected by environmental, socio-economic and policy change.

Models help us to recognise threats to farming systems and to develop efficient solutions to ensure the provision of food and ecosystem services in the future.

MACSUR is a network of more than 300 scientists in 18 countries, established in 2012. We develop methodologies for assessing how much more food can be produced sustainably in Europe under conditions of changes in climate and markets in the future.

Key findings for Europe
MACSUR’s achievements and key findings

European positioning: MACSUR created an active community of >300 scientists representing c. 80 research groups from 18 countries (Europe and Israel). It has a unique position in assessing risks and opportunities for agriculture and food security due to climate change. It is the only agricultural system modelling community with top subject matter specialists covering the majority of relevant disciplines (crop science/agronomy, livestock, farming, agricultural markets and trade) to both, generate information to feed societal debates on climate, agricultural and land use policies, and achieve scientific excellence. Shown by numerous publications in prestigious journals.

Global positioning: MACSUR has a unique position globally in science coordination, advancements, knowledge sharing and capacity building with respect to pivotal research topics (e.g. scaling methods, multi-scale integrated assessment of adapting agrifood systems, crop rotation modelling, etc.). MACSUR considers that this position also brings a responsibility to share and apply its knowledge and tools for tackling global challenges; currently this is done jointly with AgMIP on global food and nutrition security – yet, research partnerships could also be established with and directly benefit partners on other continents, e.g. Africa.

Crop modelling: MACSUR established an inventory of crop models and data for conducting quality evaluations. We assessed the sensitivity of several crop species to projected climate change, the effects of explicitly considering crop rotations in models and what information is lost when scaling yields from points to regions. Crop modellers contributed significantly to graduate and postgraduate-level courses in modelling.

Livestock & grasslands: MACSUR identified and carried out comparisons of grassland and farm models to improve our capacity to understand the impacts of climate change on grasslands and livestock systems. Activities included assessing the effect of changing climate on grass yields, modelling cow health and GHG emissions intensity, and modelling the health impacts of high temperatures on cow mortality and milk production. With GRA and other initiatives, future activities will explore topics including the modelling of climate change impacts on livestock disease and health, grassland quality and vulnerability, and the modelling of adaptation strategies.

Trade modelling: Farm and sector level economic models have been developed as integrative platforms that, together with crop models, can simulate future development of crop yields and land use consistent with climate scenarios and changing prices. This provides novel insights on food security, agricultural development and its risks. Projected trends of global food production, areas of agricultural land use, consumption, prices and trade patterns indicate that socio-economic and demographic trends appear to be at least as important as climate change on issues related to human well-being.

Regional case studies (currently in Finland, Austria and Sardinia; to be extended) are flexible (including in modelling approaches), multi-scale (farm, region, sector), cross-disciplinary (drawing from economic, crop and livestock modelling) and interactive (including stakeholder interaction). Upscaling regional case studies to the European level could identify options for climate-smart agriculture, balance mitigation and adaptation strategies and maintain productivity of European agriculture. Our case studies suggest that a simple climate envelope approach (moving production zones of crops northward) neglects important interactions with soils (water holding capacity) and effects on landscape function/ecosystem services and rural livelihoods. Farmers often consider adaptation to administrative regulations more challenging than adaptation to climate change. Overall, the case studies provide a diverse picture of climate change effects with opportunities and challenges across Europe.