



FACCEJPI



Climate Smart Agriculture

FACCE ERA-NET Plus / 2013-2014 / Call for Proposals

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FACCE-JPI Partners

Federal Ministry of Agriculture, Forestry, Environment and Water management, AUSTRIA | University of Natural Resources and Applied Life Sciences, AUSTRIA | Département des programmes de recherche – direction des programmes fédéraux et internationaux, BELGIUM | Flemish Government – Department of Agriculture and fisheries, BELGIUM | Research Promotion Foundation, CYPRUS | Ministry of Agriculture of the Czech Republic, CZECH REPUBLIC | Ministry of Science Technology and Innovation, DENMARK | Estonian Ministry of Agriculture-research and development department, ESTONIA | AKA – Academy of Finland, FINLAND | Ministry of Agriculture and Forestry, department of agriculture, FINLAND | Institut National de la Recherche Agronomique, FRANCE, Coordinator | Agence Nationale de la Recherche, FRANCE | Federal Ministry of Education and Research, GERMANY | Federal Ministry of Food and Agriculture, GERMANY | Ministry of Agriculture and Food development authority, IRELAND | Agriculture Research Organisation from the Volcani Center, ISRAEL | Ministry of Agriculture and Rural Development, ISRAEL | Ministero delle politiche agricole e forestali, ITALY | Ministry of education, university and research, ITALY | Ministerie van Economische Zaken, Landbouw en Innovatie, THE NETHERLANDS | Wageningen University Research, THE NETHERLANDS | Norwegian Ministry of Agriculture and Food, NORWAY | Research Council of Norway, NORWAY | Ministry of Science and Higher Education, POLAND | National Authority for Scientific Research, ROMANIA | Instituto nacional de investigacion y tecnologia agraria y alimentaria, SPAIN | Ministry for Rural affairs, SWEDEN | Swedish Research Council for Environment, Agricultural Sciences and special planning, SWEDEN | Forschungsanstalt Agroscope, SWITZERLAND | Swiss National Science Foundation, SWITZERLAND | Turkiye Bilimsel ve Teknolojik Arastirma Kurumu, TURKEY | Biotechnology and Biological Sciences Research Council, UNITED KINGDOM

From the Coordinator

A growing population, increased affluence, urbanisation, limited resources (water, soil . . .) and climate change are among the main factors contributing to increasing global food insecurity. Until recently, it was expected that despite current patterns of climate change, and the increasing world population, there would be several decades with food surplus, and low prices, ahead (IPCC, 2007). Nevertheless, food insecurity has increased in the context of the inter-linked food and economic crisis since 2008. Actions taken so far are not sufficient to overcome the crisis, let alone reduce the chronic food and nutrition security problems (von Braun 2008).

One approach to the challenge is that of Climate-smart agriculture, forestry and fisheries (CSA). As defined and presented by FAO at the Hague Conference on Agriculture, Food Security and Climate Change in 2010, CSA contributes to the achievement of sustainable development goals. It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. It is composed of three main pillars:

- 1• sustainably increasing agricultural productivity, to support equitable increases in farm incomes, food security and development;
- 2• adapting and building resilience of agricultural and food security systems to climate change at multiple levels; and
- 3• reducing greenhouse gas emissions from agriculture (including crops, livestock and fisheries).

CSA invites to consider these three objectives together at different scales - from farm to landscape – at different levels - from local to global - and over short and long time horizons, taking into account national and local specificities and priorities. It has been described as an approach for “transforming and reorienting agricultural systems to support food security under the new realities of climate change” (Lipper et al. 2014).

When FACCE-JPI first considered the topic for an ERA-NET Plus in 2012, the FACCE Scientific Advisory Board (SAB) took into account the political and scientific context leading to the proposal for a topic for an ERA-NET Plus, including the recommendations of the Commission on Sustainable Agriculture and Climate Change¹, which include progress toward climate smart agriculture. In light of the 5 core research themes of the FACCE – JPI and the included ERA-NETs that already existed, the SAB thus proposed a topic on “Climate smart agriculture: Adaptation of Agricultural Systems in Europe” which was accepted by the Governing Board (GB).

The Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI) brings together 21 countries that are committed to building an integrated European Research Area addressing the interconnected challenges of sustainable agriculture, food security and impacts of climate change. FACCE-JPI provides and steers research to support sustainable agricultural production and economic growth, to contribute to a European bio-based economy, while maintaining and restoring agro-ecosystem services under current and future climate change. This call thus contributes to achieving FACCE goals along with the ever growing portfolio of FACCE-JPI actions that address questions at the intersection of agriculture, food security and climate change.

This call was a real success. It allowed the mobilisation of a great number of funding partners from FACCE-JPI, and led to the funding of 11 projects for a total amount of 16 million euros. These projects were selected on the basis of their scientific excellence.

Finally, we would like to thank the members of the evaluation panel and external reviewers who are key to ensuring a high quality assessment of the submitted proposals and thus the quality of the selected proposals. We also thank the funding organisations participating in the call for all their efforts to make this call possible and to ensure that the greatest number of top-quality research proposals could be funded.

This brochure will give you insights into the implementation of the call from its development to the evaluation process, as well as on submitted proposals and funded projects.

Isabelle Albouy, FACCE ERA-NET Plus Coordinator

¹ https://cgspace.cgiar.org/bitstream/handle/10568/35589/climate_food_commission-final-mar2012.pdf?sequence=1

Professor Sir John Beddington et al.: Achieving food security in the face of climate change: Final report from the Commission on Sustainable Agriculture and Climate Change, March, 2012 https://cgspace.cgiar.org/bitstream/handle/10568/35589/climate_food_commission-final-mar2012.pdf?sequence=1

Summary of the ERA-NET Plus call

Under the ERA-NET Plus action “Climate Smart Agriculture: Adaptation of agricultural systems in Europe” co-funded by the Seventh Framework Programme (FP7) of the European Commission, this call addresses adaptation of European agriculture to climate change in its broad sense. Four areas were highlighted as key to advancing research on genetics and breeding of animals and plants to increase resilience to climate change; pests and diseases of animals and plants linked to climate and posing significant risks; adaptive management of water and soil resources and options for adapting agricultural systems.

Following pre-proposal submission with the deadline of Monday 2nd December 2013, an eligibility check was carried out by the Steering Committee. Pre-proposals were also evaluated to assess their relevance to the scientific scope of this call, whether they match the objectives of FACCE-JPI and have a European Added Value. As a result, 40 coordinators were invited to submit a full proposal with a deadline of April 1, 2014. Of the 39 received, 11 were selected for funding by the Steering Committee on July 1, 2014 following a positive evaluation by an international evaluation committee.

The indicative total available budget amounted to approx. 19 M€ from 22 national funding organisations from 18 countries, and the European Commission.

DEVELOPMENT OF THE CALL TEXT

Throughout its existence, FACCE-JPI has worked closely with the European Commission. FACCE also has had many interactions with existing ERA-NETs, having organised two dedicated workshops to interactions between FACCE and existing ERA-NETs in 2011 and 2013. Thus, in November 2011, when Tim Hall, the EC representative in the FACCE-JPI Governing Board (GB), suggested that FACCE might have an ERA-NET Plus in the 2013 call, the GB response was favorable.

Working with the FACCE SAB, the topic on Climate Smart Agriculture was developed and accepted both by FACCE’s Governing Board but also by the European Commission for the 2013 KBBE call.

During the development of the call text, the topic was further refined to address four specific areas considered key to advancing research in this area: i) genetics and breeding of animals and plants to increase resilience to climate change, ii) pests and diseases linked to climate and posing significant risks, iii) adaptive management of water and soil resources and iv) options for adapting agricultural systems.

24 funding agencies from 18 different countries decided to participate in the call

SPW Belgium	MMM Finland	RCN Norway	Netherlands
RPF Cyprus	AKA Finland	UEFISCDI Romania	MIUR Italy
Mze Czech Republic	BLE Germany	INIA Spain	BMBF Germany
DASTI Denmark	JUELICH Germany	FORMAS Sweden	BMELV Germany
EVPM Estonia	TEAGASC Ireland	SNSF Switzerland	BBSRC United Kingdom
ANR France	MOARD Israel	EZ-DAK Netherlands	
INRA France	MIPAAF Italy	NWO The	

The call secretariat was run by JÜLICH and BLE and was supported by ANR for the evaluation process as well as INRA.

The call was published October 1, 2013 and the deadline for full proposals was April 1, 2014.

The evaluation process ran from April until July, 2014. Selected projects were published in the month of July to allow the earliest possible starting date.

Evaluation Committee

Composition of the International Evaluation Committee

Harry Clark, New Zealand, (Chair of the Evaluation Committee)	Dénes Dudits, Hungary	Endla Reintam, Estonia
Vesselin Alexandrov, Bulgaria	Károly Hrotkó, Hungary	David Rogers, England
Emilia Bagnicka, Poland	Sanchez Serrano José Juan, Spain	Alina Syp, Poland
Duffy Brion, Switzerland	Björn Kuhla, Germany	Rafal Wawer, Poland
Jerry Cherney, USA	Peter Langridge, Australia	Cristos Xiloyannis, Italy
	Gianluca Nardone, Italy	Sophie Zechmeister-Boltenstern, Austria

Scientific and administrative follow-up of the funded projects and dissemination of results

A common kick-off meeting of projects funded by this call will be held in France on September 21, 2015. All projects started between October 2014 and February 2015 and will run 3 years.

Analysis of the submitted research projects

• Overall call figures

With 121 pre-proposals submitted that involved 785 teams, the FACCE-ERA-NET Plus call was a successful call.

From the 121 pre-proposals, 40 were selected to go to the full proposal stage. Of these, 39 proposals were received and 11 were funded, for a success rate of 9.1% overall and 28% in the second step.

The preparation of the call plus the flexibility of some of the funders meant that the 86% (16.1M€) of the total initial reserved budget was used.

Nationality of the applicants

The FACCE-ERA-NET Plus call involved 18 European countries and aimed to promote pan-European research. Self-financed partners could also participate in the call.

The majority of teams submitting proposals came from the 18 countries participating in the funding of the call; i.e. Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Israel, Italy, Norway, Romania, Spain, Sweden, Switzerland, the Netherlands and United Kingdom. Self-funded applicants, constituting less than 1% of the applicants, came from Australia, Bulgaria, Canada, Greece and Iran.

Reserved and requested budgets and funding model

The reserved budget for each country participating in the call was published in the call announcement, which may have influenced to some extent the budget requests by applicants. The highest values of reserved budgets were observed for the United Kingdom, Norway, France, Belgium, Denmark, Germany and Sweden. Countries receiving the most funds were the United Kingdom, Germany, Denmark, France and the Netherlands.

In order to prevent unfair distribution of EC funds, during the pre-proposal phase, a guideline was to not exceed three times the national budget in the pre-proposals selected to go on to the full proposal stage. In the end, the flexibility of some of the funders to add additional funding (INRA, ANR) allowed the first 11 ranked projects to be funded, while strictly following the ranking list established by the evaluators.

FIG-1 > DISTRIBUTION OF THE RESERVED BUDGET IN EACH COUNTRY

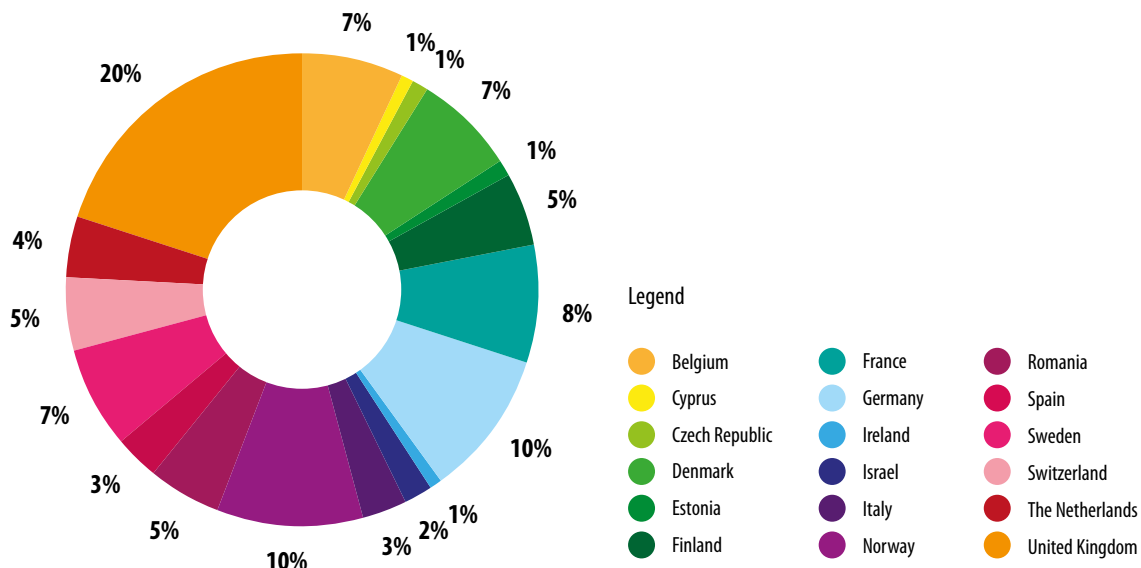


FIG-2 > BUDGET REQUESTED BY APPLICANTS AMONG COUNTRIES IN ABSOLUTE VALUES AT THE PRE-PROPOSAL AND FULL PROPOSAL STAGES

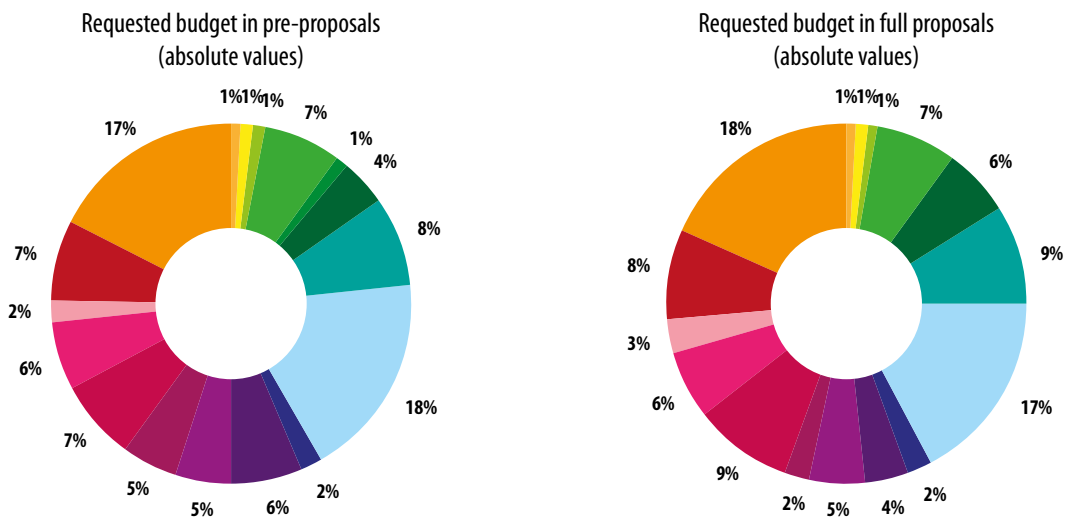
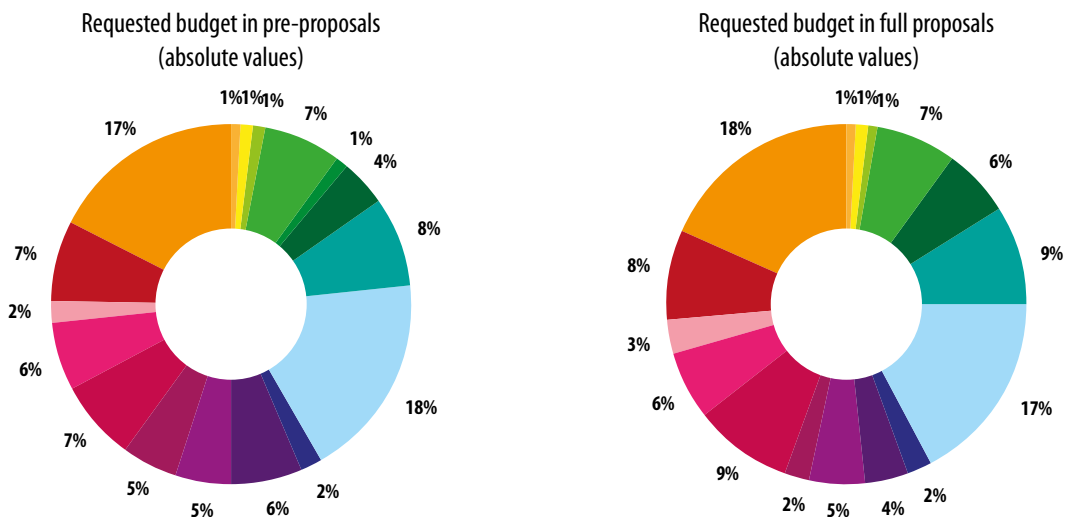


FIG-3 > AWARDED BUDGETS TO SUCCESSFUL APPLICANTS BY COUNTRY IN ABSOLUTE VALUES



The ERA-NET Plus call funded teams from 15 countries which participated in the call. In absolute terms, the countries with the highest budgets generally received the most EU funding (United Kingdom, Germany, France, Denmark).

Success rate per country

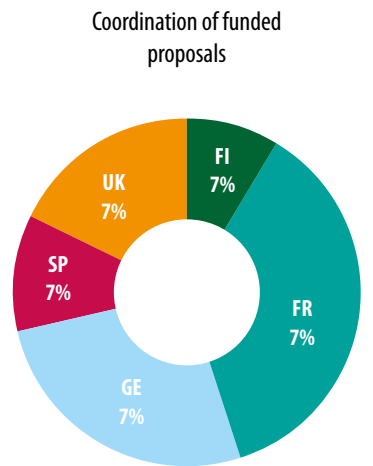
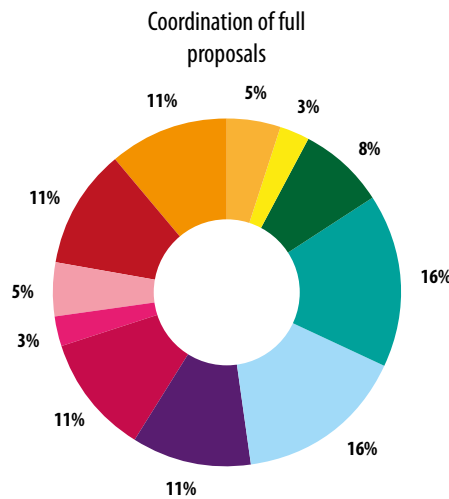
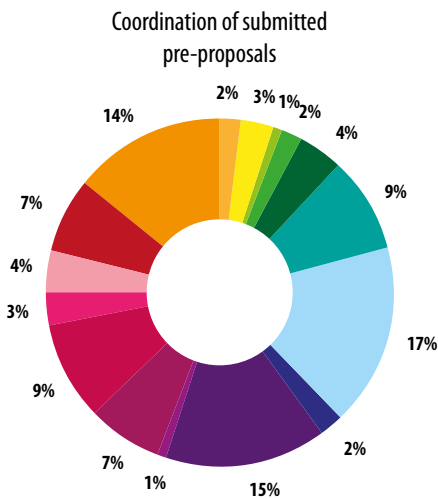
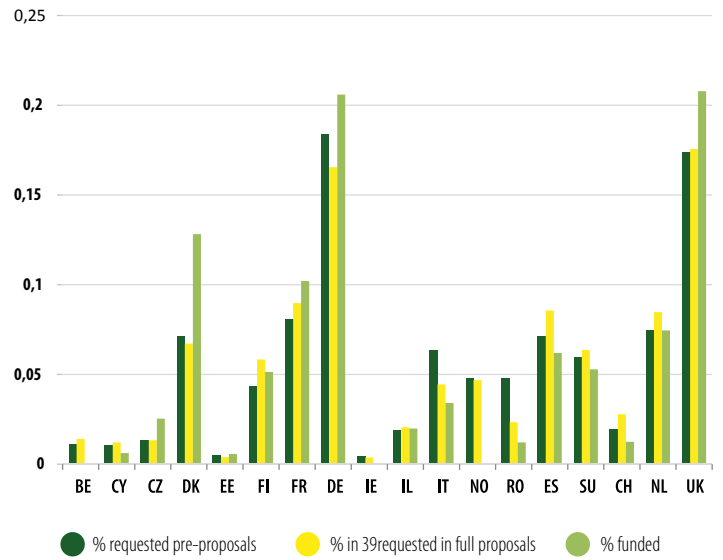
Although 18 countries reserved funding for this call, not all these countries had projects selected for funding. Teams from Belgium, Ireland and Norway were not present in any of the funded projects. In addition to the 15 countries funded in the call, an Australian team was involved in one of the funded projects.

In general, the partition of requested budget did not change greatly from the pre-proposal to the full proposal stage. Four countries were particularly successful Denmark, France, Germany and the United Kingdom.

Proposal Coordination

At the submission stage, 16 of the 18 countries were represented among project coordinators (the exceptions being Estonia and Ireland). At the full proposal stage 11 countries were represented among project coordinators. At the end, coordinators came from only Spain, Finland, United Kingdom, Germany and France while 15 countries were represented all together.

FIG-4 : COMPARISON OF THE PERCENTAGE OF BUDGETS IN PRE-PROPOSALS, PROPOSALS AND FUNDED PROJECTS BETWEEN COUNTRIES



Funded Projects



1

CAOS: Climate-Smart Agriculture on Organic Soils

Our project “Climate smart Agriculture on Organic Soils” (CAOS) aims to generate the knowledge to design climate smart agricultural systems for organic soils adapted to the diverse regional conditions of Europe. Drought spells and extreme precipitation events are likely to increase in a changing climate and endanger the stability of agricultural production. Drainage fosters mineralization of organic soils and deteriorates the soil and water quality, inducing a high risk of crop failure. Due to subsidence, the remaining lifetime of such systems is limited by the (rising) sea water level and underlying low-quality soil layers. Organic soils are the hotspots of vulnerability, adaptation needs and GHG emissions in temperate and boreal Europe. We propose that wet organic soils could be used as risk insurance in dry periods on farm or regional level, while water and soil management could prevent yield losses due to trafficability problems in wet conditions. CAOS will provide and distribute evidence that climate smart management improves yield stability and quality as well as resilience to climate change while providing strong GHG mitigation and improved soil and water quality. We expect that the strong potential for adaptation to increased climatic variability on farmed organic soil will facilitate mitigation of the largest GHG source from agriculture in Central and Northern Europe. Study regions represent typical land use systems and unique challenges in six regions in Europe with a large share of organic soils drained for agriculture. In each study region, on-farm evidence of past climate smart management is synthesised, including farm surveys and expert knowledge. In four study regions, we will conduct field experiments with innovative climate smart management options comprising active water management, soil management (sand addition), and wetness-tolerant species for bioenergy use. Cross-cutting for all study regions, we will gather and analyze data on agro-economy, biomass quantity and quality, soil quality, water management, and water levels. We will derive indicators for a successful and climate smart implementation of water and soil management. Process-based modelling will be used to synthesize the data and to evaluate the adaptation through soil and water management under a changing climate. We will also perform scenario analysis of climate change risk abatement compared to unregulated drainage, analyse costs and test various policy instruments to support the future implementation of climate smart management of organic soils. Synergies with GHG mitigation and water quality will be quantified. Stakeholders will be involved in bi-directional manner as regional partners, by workshops and questionnaires, and results will be disseminated widely to the scientific community, practitioners, decision makers, media and the general public.



COORDINATOR:

Bärbel Tiemeyer, Johann Heinrich von Thünen Institute - Federal Research Institute for Rural Areas, Forestry and Fisheries - Thünen Institute of Climate-Smart Agriculture, Germany

CONSORTIUM:

Kristiina Regina, Natural Resources Institute Finland (Luke), Finland

Ülo Mander, University of Tartu, Estonia

Poul Erik Lærke, Aarhus University, Denmark

Norbert Röder, Johann Heinrich von Thünen Institute - Federal Research Institute for Rural Areas, Forestry and Fisheries - Thünen Institute of Rural Studies, Germany

Kerstin Berglund, Swedish University of Agricultural Sciences, Sweden

Jan van den Akker, Stichting Dienst Landbouwkundig Onderzoek (DLO-Alterra), The Netherlands

REQUESTED FUNDING: 1242K€

CINDERELLA: Comparative analysis, INtegration and ExemplaRy implEmentation of cLimate smart LAnd use practices on organic soils: Progressing paludicultures after centuries of peatland destruction and neglect

Conventional agriculture and forestry on drained peatlands cause peat degradation, subsidence (up to 2 cm annually), enormous greenhouse gas (GHG) emissions (20–40 t CO₂ per ha and year annually) and eventually often a loss of productive land. Rewetting reduces these effects and simultaneously restores other ecosystem services including water and nutrient retention, water purification, flood control and mesoclimatic cooling. Paludiculture (lat. palus – swamp) is an innovative concept that allows rewetted peatlands to remain productively used. Paludiculture comprises a change to adapted crop species (Reed, Cattail, Reed Canary Grass, Sedges), harvesting machinery and biomass utilisation options. The goals of the CINDERELLA project include: I. maximising biomass production in paludiculture II. minimising GHG emissions and nutrient release III. incorporating ecosystem services; IV. developing management strategies and transferring them from lab to field and V. disseminating this innovative concept over Europe. The transdisciplinary research approach builds on the experience and expertise of the involved partners. The project links information on soil–water–crops interactions as a basis for biomass productivity with genetics related to the productivity of genotypes under different (changing climatic) conditions. The role of nutrient removal, retention and supply is taken into account to improve productivity and to address other ecosystem services. Micro-economic studies of site management, harvest and bioenergy use potentials in various European regions are combined with Life Cycle Assessments to assess sustainability capability and the provision of ecosystem services. A review of political and legal boundary conditions will show current opportunities and constraints for large scale implementation of paludiculture and allows recommendations on how to support paludiculture. The project will involve close communication with and dissemination of project results to stakeholders – farmers, scientist, practitioners, authorities, consultants – from participating countries, e.g. by demonstrating various aspects of wet peatland use at pilot sites. Also other European regions are taken into consideration to introduce wet peatland use. Agriculture on organic soils under wet conditions is innovative. The project wants to develop and strengthen farming techniques and economic tools to make it work as a basis for large scale implementation. With a strong science based transdisciplinary approach the project will facilitate this innovative strategy to adapt to climate change – with sustainable peatland utilisation becoming part of resilient agricultural regions.



COORDINATOR:

Hans Joosten, Ernst Moritz Arndt University of Greifswald, Germany

CONSORTIUM:

Stefan Weisner, Högskolan i Halmstad, Sweden

Leon P.M. Lamers, Radboud University Nijmegen, The Netherlands

Hans Brix, Aarhus University, Denmark

REQUESTED FUNDING: 1421K €

3

ClimBar: An integrated approach to evaluate and utilise genetic diversity for breeding climate-resilient barley

Barley is a major grain worldwide. Europe produces the greatest share (~60 MT/yr), of which ~20% underpins its brewing industry that generates annual government revenues of ~€ 50-60 bn and supports 150,000 farmers. Barley has potential as a health-promoting functional food, given its high content of sterols, stenols, arabinoxylans, and beta glucans. It is an important break crop and animal feed, and its straw has a role in animal welfare and nutrition, in bioenergy and in carbon capture. However, yield increase has flattened over recent years and future harvests are threatened by climate change. European agriculture anticipates a combination of stress factors, production threats and quality needs that breeders have not encountered before. Climate-Smart Agriculture requires both the conservation of genetic resources and their effective use to develop regional varieties with sufficient resilience to deliver yield, quality and stability under increased and different seasonal stresses and decreased inputs. ClimBar will identify genome regions, genes, and alleles conferring the traits needed to breed resilient barley varieties adapted to the four climate change scenarios modelled for NE, NW, Mediterranean, and Central European grain producing zones by 2070. Resilience will require combining multiple traits and responses that include plant architecture, physiology, and metabolism. These are determined by the unique allelic combinations that comprise the genome, the specific genomic marks of the epigenome, and their combined interactions with the external environment. CWRs (crop wild relatives) and landraces contain a vast pool of (epi-) genetic diversity and interactions naturally selected for resilience against local environmental pressures. We will impose drought, flooding, temperature, and fungal challenges predicted to occur under each scenario and use precision phenotyping to measure the responses of a core representative set of modern and old varieties, landraces, and wild barley. Combined these genetic and phenomic data will provide a platform for incorporating both in situ and ex situ allelic diversity into programs for breeding increased resilience to climate change in barley, increasing genetic richness of the cultivar set, and forming a basis for multi-varietal cultivation. Adapted, resilient germplasm created using ClimBar data, tools and models will provide food-chain security, economic stability and environmental sustainability.



COORDINATOR:

Alan Schulman, MTT Agrifood Science Finland, Finland

CONSORTIUM:

Søren K. Rasmussen, University of Copenhagen, Denmark

Menachem Moshelion, The Hebrew University of Jerusalem, Israel

Alessandro Tondelli, CRA - Consiglio per la Ricerca e la Sperimentazione in Agricoltura, Italy

Tamas Dalmay, University of East Anglia, United Kingdom

Laura Rossini, Università degli Studi di Milano, Italy

Ana Casas, CSIC, Spain

Patrick Schweizer, Leibniz-Institute of Plant Genetics and Crop Plant Research (IPK), Germany

Robbie Waugh, The University of Dundee, United Kingdom

REQUESTED FUNDING: 1824K€

4

Climate CAFÉ: Climate Change Adaptability of cropping and Farming systems for Europe

The Climate-CAFE project focuses on increasing the “adaptive capacity” of arable and forage crops to climate change (CC). We will use an interdisciplinary approach to evaluate traditional and more novel regional adaptation and mitigation strategies along a North-South climate gradient in the EU and propose new farming system designs for adaptation to CC. The evaluation includes synergies and trade-offs between strategies using different scales and indicators for IPCC scenarios in 2050 and 2100. Synthesis of existing data from experimentation and expert knowledge (advisors and farmers) will be used to propose adaptation measures for a selection of Adaptation Pilots based on representative regional cropping and farming systems located in consortium countries. These pilots will be defined and used to design and evaluate adaptation strategies based on multicriteria economic and environmental analyses. The proposed adaptation strategies will focus on improved soil and water management via ecological intensification, including new cultivars, novel rotations, alternative tillage options, and the inclusion of legumes and intercrops, to enhance the buffering capacity of the soil-crop system and capitalize on emerging value chains in the bio-economy. The STICS and DAYCENT models will be used to simulate scenarios at the cropping system level (plot scale and rotation duration). Existing long-term experiments, including FACE and Ecotron specific experiments will be used for analyzing the quality of predictions and where necessary models will be improved to accommodate new processes (e.g. introduction of O₃ effects in STICS). Over the short/medium-term, the STICS soil-crop model will be run on the RECORD modelling and software platform to make multiple simulations for testing the potential efficiency of proposed CC adaptation measures for maintaining crop production without degrading environmental impacts. In addition, the DAYCENT soil model will be used to evaluate the long-term impact of adaptation measures on soil carbon sequestration and greenhouse gas emissions (CO₂, N₂O, and CH₄). The Modam and Farm-design models will be used to assess the impact of CC adaptation measures on the farms’ economic and environmental performances. In addition, the Farm-design model will be applied to evaluate these outcomes at the supra-farm level, considering the regional constraints of agri-food chain organization and pedoclimatic conditions. The expected results of the Climate-CAFE project are: i) an overview of potential CC adaptation measures in accordance with farm constraints, ii) simulation of adaptation measures and their ranking in terms of efficiency and costs, iii) simulation of the impact of IPCC scenarios 2050 and 2100 in interaction with adaptation measures on European agriculture production, considering a wide range of EU countries representing a North-South climate gradient in Europe.



COORDINATOR:

Eric Justes, INRA, France

CONSORTIUM:

Peter Zander, ZALF, Leibniz Centre for Agricultural Landscape Research, Germany

Christine Watson, SRUC, United Kingdom

Erik Steen Jensen, SLU, Sweden

Walter Rossing, WU, The Netherlands

Henrik Hauggaard-Nielsen, Technical University of Denmark (DTU), Denmark

Johan Six, ETH Zurich, Switzerland

Helena Gomez-Macpherson, CSIC (Agencia Estatal Consejo Superior de Investigaciones Científicas), Spain

Fred Stoddard, University of Helsinki, Finland

Raphaël Charles, Agroscope, Switzerland

Marjoleine Hanegraaf, Nutrient Management Institute, The Netherlands

Chris Koopmans, Louis Bolk Institute, The Netherlands

REQUESTED FUNDING: 2391K€

5

CLIMGEN: Climate Genomics for farm animal adaptation

ClimGen is a project that focuses on the identification and use of omics technology for building livestock resilience to climate change. Bringing together previous and ongoing national, EU and global efforts to understand livestock adaptation to climatic extremes, the project will seek to identify genomic tools and biomarkers that can be used to predict adaptation in livestock populations to thermal and related challenges. Alongside scientific investigation, ClimGen will also develop and assess the efficacy of modified breeding strategies that use omics information to rapidly equip livestock populations with the resilience that will be required to withstand the predicted negative effects of climate change in the short, medium and long-term. ClimGen will also act as a source of relevant information for Stakeholders, who will both participate in and influence the development of the project. ClimGen's activities can be divided into three. First we will carry out a data-mining and gap filling exercise for identifying genomic targets of selection in cattle, sheep and goat populations that occur in challenging climates throughout Europe and in northern and central Africa. Replicated climate contrast data will be analysed from across Europe, including new samples in the Carpathian region, data for cattle and sheep in the extreme north and data for sheep and goats in the extreme south (Morocco). In this way ClimGen will make maximum use of data that have already been generated but not analysed to detect adaptation across climates and will only concentrate on producing data in hotspot regions where it is most needed. Second, we will carry out three case study experiments to find biomarkers of climate adaptation within the transcriptome and epigenome. These studies will analyse contrasting systems and seek to detect profile changes in 1) sheep and goats in contrasting thermal environments, 2) in pigs under thermal stress with controlled temperature environments and 3) in red-legged partridges under immune and thermal stress. Biomarker responses will be compared among these diverse systems and compared with the selection targets identified in the first activity. Finally, these data will be used in an assessment of new strategies for breeding climate resilience into livestock populations using state-of-the-art simulations, assuming different approaches such as admixture and genomic selection, which will be compared with more traditional breeding methods in terms of their comparative efficiency over short, medium and longer timescales.



COORDINATOR:

Michael Bruford, Cardiff University, United Kingdom

CONSORTIUM:

Licia Colli, Università Cattolica del Sacro Cuore, Italy

Alessandra Stella, Fondazione Parco Tecnologico Padano, Italy

Francois Pompanon, Université Joseph Fourier, France

Agustin Vlaic, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania

Javier Cañon, Universidad Complutense de Madrid, Spain

Juha Kantanen, MTT Agrifood Research Finland, Finland

REQUESTED FUNDING: 1023K€

6

GENOMITE: New generation sustainable tools to control emerging mite pests under climate change

Climate change (CC) will have serious and profound impacts on pests and diseases of agricultural crops in Europe and it is vital that new tools and management methods are developed to tackle the problems that will increasingly threaten EU food production as a result. •In this project, for the first time, comprehensive state-of-the-art genomic, metabolomic and modelling methods will be used to develop the necessary tools and management methods for tackling spider mites that are increasingly serious pests of many important crops throughout the EU. •This will not only be an outstanding contribution to spider mite management under climate change but crucially be an example, demonstrating how the best and most advanced modelling and molecular methods can be applied to the vast array of other important pests and diseases that will develop because of climate change. •Spider mite outbreaks and crop damage are strongly favoured by high temperatures and drought stress caused by (CC) (especially in combination) that will have serious impacts not only in southern Europe, but throughout the continent because of more extreme and variable weather events including heat waves and droughts. The two-spotted spider mite, *Tetranychus urticae* (TSSM), is a highly polyphagous species which attacks many crops and is adapting to attack several important new crops including grape vines and corn. *Tetranychus evansi* (TE) is a recently arrived alien invasive pest that is spreading through Europe and attacks important solanaceous crops including tomato and potato. •Phytoseiid predatory mites are the main natural predators that regulate spider mite populations and are introduced as biocontrol agents in crops. They are harmed by broad-spectrum insecticides and the increasing use of these to control other alien invasive pests, e.g. spotted wing Drosophila and brown marmorated stink bug, lead to more serious outbreaks of spider mites. •In this project, teams from 7 EU countries and Canada will model the tritrophic interactions between crops, populations of spider mite pests and their predators under CC. Crucially, this will be accompanied by determination and modelling of the reciprocal transcriptional and metabolomic changes in the crop and the pest and their interactions under CC. •This holistic study will be done on a model annual and a model perennial crop plant (tomato and strawberry) and with two contrasting spider mite species, TSSM and TE. In addition, we will search for elicitors and effectors of TSSM and TE that are capable of modulating plant defences. Using systems biology approaches, we will link the performance of plants and mites with genome-wide changes in their responses. •This comprehensive knowledge will be an invaluable resource for new tools and methods for climate-smart pest control including markers for breeding resistant varieties, predicting pest outbreaks and biocontrol and metabolites with that can be used as biopesticides.



COORDINATOR:

Jerry Cross, East Malling Research, United Kingdom

CONSORTIUM:

Maria Navajas, Institut National de la Recherche Agronomique, France

Lothar Willmitzer, metaSysX GmbH, Germany

Menelaos Stavrinos, Cyprus University of Technology, Cyprus

Thomas Van Leeuwen, University of Amsterdam, The Netherlands

Yves van de Peer, VIB, University of Gent, Belgium

Isabel Diaz, Universidad Politecnica de Madrid, Spain

Pedro Castañera, Consejo Superior de Investigaciones (CSIC), Centro de Investigaciones Biológicas, Spain

Miodrag Grbic, The University of Western Ontario, Canada

REQUESTED FUNDING: 1745K€

Grasslandscape: Bridging landscape genomics and quantitative genetics for a regional adaptation of European grasslands to climate change

In the next decades, grasslands as important ecosystems and basis of dairy and meat production are likely to experience damages and subsequent production losses due to changing climate. Recent events (e.g. severe drought in Western Europe in 2003) highlighted an insufficient capacity in local populations of grassland species to cope with unusual climatic events. However, most grassland species show a large ecotypic diversity over wide environmental ranges. We consider that this large ecotypic diversity could be used to recombine natural climatic adaptations and value for services to create improved populations of grassland species adapted to the foreseen future regional climates. To implement this strategy, it is necessary to have extended knowledge of the adaptive diversity existing in grassland species. With this aim, we intend to use an innovative methodological frame (landscape genomics) to screen the natural diversity of a grassland species (perennial ryegrass) in order to discover genetic variability involved in environmental adaptation, and more specifically in climatic adaptation. The landscape genomics approach is based on the combined use of methods correlating genomic polymorphisms and environmental variations at sites of origin of genotypes and of tests of signature of selection. To implement this frame, we will use a genotyping method based on massively parallel sequencing technology applied to 550 populations of perennial ryegrass sampled across the whole area of primary expansion of this species (Europe, Northern Africa and Near East). These populations will be taken out from gene banks of plant breeding institutes or collected in situ across Europe. Our genotyping protocol is expected to deliver several tens thousands of polymorphisms sites along perennial ryegrass genome. We will furthermore phenotype these populations in fields and in controlled environment to record agronomic and eco-physiological traits. Association models between genomic polymorphisms and environmental variations will be used to map the spatial distribution of genomic markers linked to adaptive diversity in present climatic conditions and to foresee possible shifts in the spatial range fitting these markers in the context of several climate change scenarios based on the four Representative Concentration Pathways of IPCC AR5. Based on these results, we will define allelic profiles of perennial ryegrass expected to provide climatic adaptation at regional scale over Europe under the future climatic conditions foreseen by climate models. We will consider combining climatic adaptation and value for services by genetic recombination. We will finally design a number of genetic pools mixing different natural populations. These genetic pools will be the basis to initiate breeding programmes aiming to deliver improved populations adapted to future regional climates. These improved populations will enable to restore grasslands degraded by future climatic disruptions.



COORDINATOR:

Jean-Paul Sampoux, Institut National de la Recherche Agronomique (INRA), France

CONSORTIUM:

Stéphanie Manel, Institut de Recherche pour le Développement (IRD) - Université Aix Marseille, France

Matthew Hegarty, Institute of Biological, Environmental and Rural Sciences (IBERS), Aberystwyth University, United Kingdom

Klaus J. Dehmer, Leibniz Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK), Germany

Isabel Roldan-Ruiz, Institut voor Landbouw- en Visserijonderzoek (ILVO), Belgium

REQUESTED FUNDING: 834K€



GREENRICE: Sustainable and environmental friendly rice cultivation systems in Europe

In Europe, rice (467 000 ha) is grown under permanently flooded (PF) conditions using irrigation waters of major rivers. Climate change, which has led to a greater fluctuation in river flows, is a major challenge to rice production systems, which depend on large and consistent water supplies. This challenge will become more acute in the future, with increased demands for rice both from within Europe (net deficit of 0.86 Mt) and from overseas. Rice yields under existing production practices are therefore threatened by scarcer water availability. In addition, PF rice fields emit greenhouse gases (GHG), such as methane (CH₄), that have a strong global warming potential. Alternate wetting and drying (AWD) is a system in which irrigation is applied to obtain 2 to 5 cm of field water depth, and then turned off. After a short period (normally 2 to 7 days), when the field has dried out, water is re-applied. Preliminary studies suggest that AWD can reduce water use by up to 30 %, with no net loss in yield provided varieties well adapted to AWD are used, while CH₄ emissions can be reduced by up to 48 %. However, uncertainties still remain as to the impacts of AWDS on GHG fluxes (e.g. CO₂, N₂O) and plant-mutualist and plant-pest interactions, which may influence the overall efficacy and viability of this new system. Thus, while AWD represents a potentially exciting alternative water management strategy for European rice production, a more complete agronomic, ecological and biogeochemical assessment of AWD is required to evaluate the benefits of the system. To close these critical knowledge gaps, GreenRice aims to test AWDS in Italy, Spain and France, in regions that are representative of the diversity of European rice growing areas, notably in deltaic areas where rice systems and natural protected wetlands are interdependent. We will evaluate the agronomic and environmental consequences of shifting from a PF to an AWD system, focusing on rice yields, water consumption, soil salinization, plant-soil-microbial interactions and GHG dynamics. We will identify varieties that maintain their productivity under AWDS through whole genome association mapping of a large panel of temperate varieties, using genomic selection to predict the values of additional breeding lines. We will investigate traits determining adaptation to AWDS, such as root development, AM colonisation, salt tolerance and resistance to nematodes; and the role of AM symbiosis in alleviating the impacts of biotic stress. An extensive gene expression study will identify the root types and genes important in transport process and the degree to which they are affected by AWDS. The role of plant functional traits and the soil microbial activity in modulating C, N and GHG fluxes will be investigated in both field-based and controlled environment studies. The results obtained will be disseminated to local stakeholders (primarily farmers and natural park authorities) and to the scientific community.



COORDINATOR:

Brigitte Courtois, Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), France

CONSORTIUM:

Giampiero Valè, Consiglio per la Ricerca e la sperimentazione in agricoltura (CRA), Unità di ricerca per la risicoltura, Italy

Blanca San Segundo, Center for Research in Agricultural Genomics CSIC-IRTA-UAB-UB (CRAG), Spain

Adam Price and Yit Arn Teh, University of Aberdeen (UA), United Kingdom

Paola Bonfante, Università degli Studi di Torino (UT), Italy

Maite Martínez-Eixarch, IRTA (Food and Research Technology), Spain

Cyrille Thomas, Centre Français du Riz (CFR), France

REQUESTED FUNDING: 1443K€



MODCARBOSTRESS: Improving models and plant phenotyping pipelines for a smart agriculture under abiotic stress combination and elevated CO₂

Climate change accelerates the need for a smarter, more efficient, more secure agriculture. Because climate change is predicted to increase spatial and temporal variability, crop models able to predict the best local allele/phenotype combinations within a species, in addition to the best management systems (such as, for instance, species choice, rotations, sowing dates. . .) will be of great value for farmers and breeders worldwide. However, current crop models have large uncertainties in particular under drought and high temperatures that often occur in combination and while their occurrences are likely to increase in several regions of the world. Accounting for the impact of elevated atmospheric CO₂ in the picture will add another level of difficulty with possible positive or negative influences depending on complex interactions. We thus raise the double hypothesis that important reasons for crop model uncertainties are (i) Lack of accurate dataset under combined stresses hampering proper parameterisation. (ii) Inappropriate modelling hypotheses. Crop models can be broadly split into 2 distinct categories depending on whether growth is essentially source or sink limited. However, drought and CO₂ are likely to shift growth limitation from source to sink while elevated temperature could shift growth limitation towards the source. A possibility is thus that both types of models find their limits under stress combinations. Our project will thus assess models of these two types in front of stress combinations. We will both improve model parameterisation thanks to the experiments performed in the frame of this project and evaluate model performance using field data obtained from other consortia (in particular FACE experiments). Because CO₂ control in experimental facilities is the exception rather than the rule, our project will aim at delivering to simple, low cost, principles and solutions for manipulating combined stresses, including elevated CO₂, in experimental set-ups. A final outcome of the project will be to propose model improvements and to run them against climate model projections for Europe. Two crop species, bread wheat (*Triticum aestivum* L.) and oilseed rape (*Brassica napus* L.), will be used but the project intends to revisit crop model rationales in a species independent manner. In both species, a set of genotypes contrasted for stress sensitivity and for which field data are available will be selected.



COORDINATOR:

Bertrand Muller, INRA Montpellier, France

CONSORTIUM:

Fabio Fiorani, Forschungszentrum Juelich GmbH, Germany

Carl-Otto Ottosen, Aarhus University, Denmark

Eva Rosenqvist, Copenhagen University, Denmark

Bernard Genty, CNRS/CEA, France

Xinyou Yin, Wageningen University and Research Centre, The Netherlands

John Doonan, Aberystwyth University, United Kingdom

Pierre Martre, INRA Montpellier, France

REQUESTED FUNDING: 1137K€

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OptiBarn : Optimized animal-specific barn climatization facing temperature rise and increased climate variability

The OptiBarn target is to develop region-specific, sustainable adaptation strategies for dairy housing, focusing on an optimised climatization of naturally ventilated buildings. Naturally ventilated barns (NVB) are particularly vulnerable to climate change since the indoor climate strongly depends on the extremes and variability of the outdoor climate. Without sound adaptation strategies, increased climate variability will result in a sub-optimal thermal environment in many livestock buildings impairing production and well-being of animals. Appropriate construction methods and management of the buildings can improve the thermal control, provided that precise identification of factors affecting the thermal control capacity of the buildings under practical farm conditions is undertaken. In this context, indicators for an optimisation of livestock buildings under climate change will be developed in OptiBarn by: (i) Barn-specific assessment of the influence of outdoor climate on the indoor conditions, (ii) Region-specific risk analysis on how often extreme weather situations will occur, (iii) Monitoring animal-individual stress responses to the indoor conditions, (iv) Development of engineering solutions. (v) Modelling tools to assess environmental and economic cross effects of adaptation alternatives. In this context, close contact and exchange with experts from the industry, stakeholders and the scientific community is ensured over the entire term of the project by establishing an advisory board consisting of a stakeholder panel and a scientific panel. OptiBarn consists of five work packages: • WP1 "Simulation of livestock housing climate for region-specific barn concepts and climate boundary conditions" • WP2 "Development and implementation of adaptive smart NVB and environmental control" • WP3 "Investigation of animal-specific stress in distinct climates" • WP4 "Impact assessment" • WP5 "Coordination and Dissemination" Through these five work packages, OptiBarn will focus on the following innovation aspects: (i) Adaptation potential of livestock housing in NVB in Europe (ii) Animal sensors and closed-loop control (iii) Integrated modelling framework (iv) Uncertainty assessment of results. This holistically designed project will provide primary producers with (1) 'best practice' template of housing design relevant to specific regions within Europe, (2) enhanced management capability of climate systems within NVB via incorporating environmental and animal-based sensors and (3) an integrated modelling framework to assess adaptation strategies for dairy housing. These technological/technical improvements will 'climate proof' primary producers against expected climate variability/extremes in the future and thus will contribute to the long term sustainability of dairy production within Europe.



COORDINATOR:

Sabrina Hempel, Leibniz institute for agricultural engineering Potsdam-Bornim (ATB) e. V., Germany

CONSORTIUM:

Christoph Menz, Potsdam Institute for Climate Impact Research (PIK) e. V., Germany

Ilan Halachmi, THE AGRICULTURAL RESEARCH ORGANISATION OF ISRAEL - THE VOLCANI CENTRE (ARO), Israel

Guoqiang Zhang, Aarhus University (AU), Denmark

Agustin del Prado, Basque Centre For Climate Change (BC3), Spain

Fernando Estellés, Universitat Politècnica de València (UPV), Spain

Thomas Banhazi, National Centre for Engineering in Agriculture (NCEA), University of Southern Queensland (USQ), Other

REQUESTED FUNDING: 1074K€

SEE ALSO www.optibarn.eu

Sybraclim: Securing yield stability of Brassica crops in changing climate conditions

Extreme and variable climate conditions are expected to become more frequent worldwide with projected climate change. European agriculture is facing the crucial challenge of adapting crop productivity to climate change and will need the development of crops with increased resilience to abiotic stress factors triggered by climate change. Crop yield stability is dependent on the response of key developmental and growth processes to stress conditions. Delayed or accelerated flowering time, alteration of root architecture and growth, and disruption of pod-shattering are common responses displayed by crops exposed to high temperature or drought conditions associated to climate change. SYBRACLIM will evaluate the impact of these environmental factors on developmental and physiological processes directly influencing the yield of oilseed rape, Europe's premium oilseed crop. We will also shed light on the genetic and molecular bases of the tolerance of different rapeseed varieties to increasing temperature and drought stress. The SYBRACLIM consortium is multidisciplinary and includes both commercial breeding companies and leading research groups with high complementarities that cover the fields of genetics, genomics, physiology, breeding and agronomy in Brassica crops along with modeling of crop performance under climate change. Rapeseed is one of the world's most important sources of high-quality vegetable oils for human nutrition and biofuels, and particularly in Europe is also a major contributor to vegetable protein diets for ruminant livestock. SYBRACLIM will implement a multidisciplinary and innovative approach to characterize the phenotypic changes related to flowering time, root development and pod shattering in response to increased temperature and drought, and to analyse the productivity (yield, oil and protein content) in rapeseed varieties. We will also use genomics-assisted selection of stress-tolerance traits in controlled environments and field trials. The relationship between performance and variability of the studied developmental processes will allow us to identify new genetic traits associated with adaptation and use them to design stress tolerant rapeseed crops by complementary plant breeding and biotechnology strategies. Finally, we will integrate all these environmental, phenotypic and productivity data in models that will assess the performance of rapeseed varieties across different climate conditions. These models will be applied to simulate expected performance of rapeseed traits under projected climate change scenarios. Because breeders need decades to develop new varieties, this approach will enable anticipatory breeding for early development of germplasm carrying the necessary genetic variation to cope with climatic changes. SYBRACLIM will provide tools to allow the farmers to design better strategies for adapting cropping systems to climate change, contributing to secure yield of Brassica crops in Europe.



COORDINATOR:

Monica Pernas Ochoa, Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA), Spain

CONSORTIUM:

Lars Østergaard, John Innes Centre (JIC), United Kingdom

Rod Snowdon, Justus-Liebig University, Giessen (JLU), Germany

Jørgen Eivind Olesen, Aarhus University (AU), Denmark

Alain Bouchereau, INRA (Institut National de la Recherche Agronomique) UMR1349 IGEPP (Institute of Genetics, Environment and Plant Protection), France

Gunhild Leckband, NPZ Innovation GmbH i.G. (NPZi), Germany

Miroslav Trnka, Global Change Research Centre AS CR v.v.i. (GCRC), Czech Republic

REQUESTED FUNDING: 1670K€

Perspective for FACCE-JPI

Since the concept of Climate Smart Agriculture started in 2010, there has been a growing movement on different levels to see this become a reality. Following the 3rd scientific conference on CSA in Montpellier France in March 2015², “The Montpellier Statement” has been released on Climate-Smart Agriculture: Towards Sustainable Landscapes and Food Systems. This statement defines three priorities:

- “Agriculture in the future must address the challenges of sustainable food systems and landscapes
- Researchers and practitioners must engage to build evidence and design the trajectories for multiple transformative transitions of climate-smart agriculture and
- The future relies upon policy, institutional and financing decisions.”

The Global Alliance of Climate-Smart Agriculture (GACSA), a voluntary coalition open to governments, international and regional organisations, institutions, civil society, farmers’ organisations and businesses has been created with the aim of making CSA a reality.

The SRA and Implementation Plans of FACCE-JPI describe an action plan for achieving the FACCE goals, which are completely in line with priorities defined in the Montpellier statement. FACCE research actions, including this ERA-NET Plus, seek to bring critical mass to these research challenges, to create synergies between European research groups, to avoid duplications and to fill knowledge gaps. Moreover, to increase the impact of the research, FACCE strives to make connections between its own different research projects and actions as well as between FACCE projects and other European and international projects. For example, projects that include modeling will be strongly encouraged to exchange data and results with the FACCE Knowledge Hub, MACSUR.

With the 11 projects presented in this brochure, FACCE will contribute to the knowledge base on CSA. FACCE will strive to ensure that these projects, as well as others in the FACCE portfolio, will have real impact at the level of science and policy and in turn, our future. Scientific papers, but also policy briefs, scientific meetings, encounters with stakeholders are all expected to be key outcomes from these projects. Moreover, these projects will help foster a strong European research community – ready and able to address the present and future grand challenges.

² <http://csa2015.cirad.fr/>

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FACCEJPI

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For more information

Coordinators:

Isabelle Albouy

Institut National de la Recherche Agronomique

Isabelle.Albouy@paris.inra.fr

PH: +33 (0)1 42 75 94 42

Heather McKhann

Heather.Mckhann@paris.inra.fr

PH: +33 (0)1 42 75 92 78

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