RESEARCH & INNOVATION ANALYSIS REPORT

AGROECOLOGY

KARME PETRUTIS & IIRI RAA

30.12.2022

SCAR
Standing Committee
on Agricultural Research

Introduction

The SCAR Strategic Working Group on Agroecology (SCAR-AE) has as its main task in 2022 to prepare the Strategic Research and Innovation Agenda (SRIA) for the future European partnership 'Accelerating farming systems transition: agroecology living labs and research infrastructures' (AELLRI). The objective of this portfolio analysis was to find out, what has already been studied and funded at the European level in the area of agroecology, as well as to analyse the research and innovation needs and gaps identified by those projects. The findings could be feeding into the AELLRI SRIA development process as well as for setting the priorities for the future work plan of the AELLRI partnership.

SCAR-AE Thematic Support Team (AE TST) on the official request of the SCAR-AE co-chairs carried out the portfolio analysis of the Horizon 2020 projects.

This report provides an overview of the selected projects and an explanation of why they are key to the objectives of SCAR-AE. The report summarises the research and innovation gaps, as well as the R&I needs identified in the selected projects.

Disclaimer

Table of contents

Process of project selection

Selection of the 30 relevant projects

The Horizon 2020 projects were analysed in a 2-step process. The criteria for the first step of the analysis were pre-defined and the 30 projects selected by the co-chairs of the SCAR-AE working group.

The following 30 projects, each focusing on a specific aspect of agroecology, were chosen (acronyms): ReMIX, OK-Net Arable, OK-Net EcoFeed, LIVESEED, Organic-PLUS, RELACS, LEGVALUE, AFINET, STARGATE, DIVERSify, UNISECO, BRESOV, TRUE, DIVERFARMING, Inno4Grass, ECOBREED, DiverIMPACTS, SoildiverAgro, IWMPRAISE, EUCLEG, EXCALIBUR, LIFT, Legumes Translated, SUPER-G, EcoStack, HNV-Link, PoshBee, CERERE, MIXED, AGROMIX.

The specific criteria for choosing those 30 projects included the following:

- Horizon 2020 funded project;
- outstanding scientific and practical results;
- excellent co-creation of the research objectives and of the research work;
- excellent European collaboration or an excellent local/regional place based innovative approach;
- relevance to the priorities of the SCAR-AE, in particular that of preparing the future candidate European partnership 'Accelerating farming systems transition: Agroecology living labs and research infrastructures'.
- project theme and topic: including the AE-relevance, covering agroecology from different perspectives and topics;
- the start date of the project: started after 2014;
- project either completed or in progress, but with deliverables already available.

The co-chairs of the SCAR-AE working group presented the initial list with 30 projects to the AE TST for further analysis. During the first step of the analysis, the basic and most relevant information was screened and gathered. Each of the 30 projects were analysed separately.

Selection of the 12 projects

After the workshop to launch the process of developing the SRIA on 29th of April 2022, it was agreed that a minimum of 10 most relevant projects out of the initial 30 should be identified and selected for deeper analysis. AE TST prepared an initial list of the projects for deeper analysis at the beginning of June 2022. This list was briefly discussed with the SCAR-AE co-chair and EC representative, who gave advice on this selection. Finally, the following 12 projects were selected for the deeper analysis (with acronyms): OK-Net EcoFeed, LIVESEED, LEGVALUE, UNISECO, DiverIMPACTS, SoildiverAgro, LIFT, SUPER-G, EcoStack, PoshBee, MIXED, AGROMIX.

The criteria for choosing those 12 projects out of the initial list of 30 were pre-defined by the AE TST. The criteria were as following:

- The theme of the project and relevance for the SRIA: avoid duplication of a theme in several projects and cover as many relevant themes as possible;
- the R&I gaps and needs were mentioned and recommended in the project deliverables;
- the number of project partners and countries represented: projects with higher number of countries and partners were preferred;
- both completed and ongoing projects were taken on board.

Selected 12 projects were falling thematically into 6 categories:

- organic farming,

- nitrogen fixing crops,
- ecological approaches, organic and mixed farming (mixed farming and agroforestry systems),
- climate-smart and resilient farming,
- crop diversification and climate smart farming,
- and socio-economics.

AE TST team retrieved the data, in particular from CORDIS, about the projects and R&I needs and gaps. The first step of analysis (i.e. incorporating information and data on 30 projects to the excel-database and choosing out 12 projects) was completed in June 2022. The results of the first step of analysis, as well as the information about the next steps were briefly presented to the members of AE-SCAR working group on 10th of June 2022.

Synthesis of R&I needs and gaps

Geographical coverage

In total 27 countries were involved in the selected 12 projects, more specifically (Figure 1):

- France, Germany, and the United Kingdom were involved in 11 projects;
- Italy was partner in 9 projects; Spain, Switzerland and Poland in 8 projects;
- Bulgaria, Czech Republic, Slovenia, Greece, Lithuania, Serbia, and Estonia were partners in up to 3 projects;
- Croatia, Cyprus, Luxembourg, Malta, and Slovakia were not partners in any of the 12 projects;
- Montenegro, Bosnia, and Herzegovina were partners in one project.

The average number of project partners of the 12 projects was 27,5, with the highest 51 and lowest 16 partners per project. Very often, there was more than one partner involved in the same project from the same country. The average number of countries involved per project was 12, with 19 being the highest and 7 the lowest.

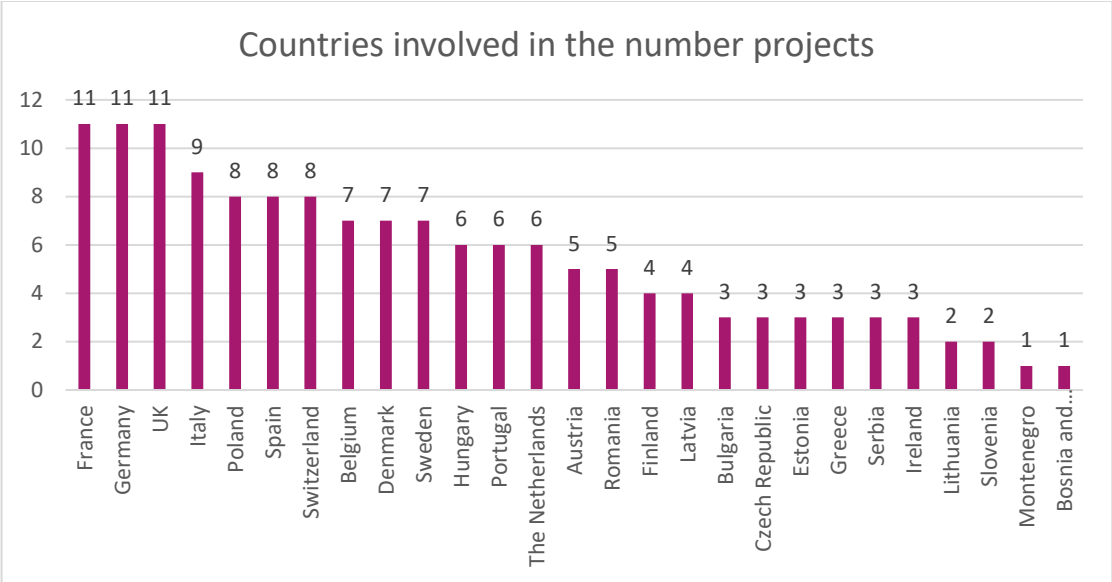

Figure 1. Countries involved in the 12 selected projects

Categorization of the projects

11 projects (92% of the projects) were Research and Innovations Actions (RIA) and one project was a Coordination and Support Actions (CSA) type of project.

Looking at the main topics of the project and in relation to SCAR-AE remit, projects were categorized in six main topics (Figure 2).

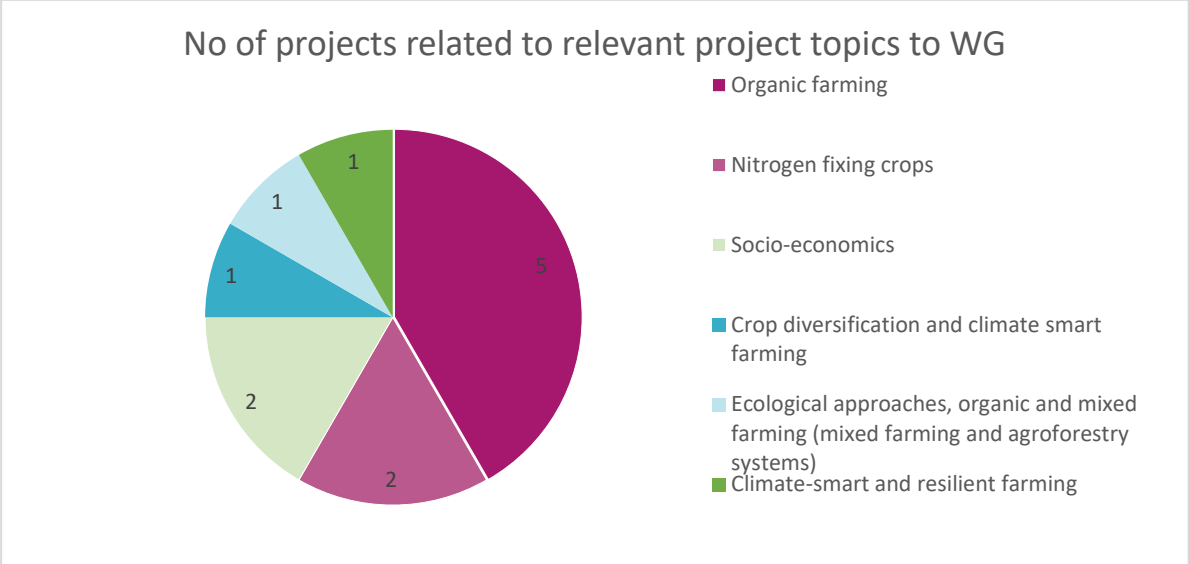

Figure 2. No of projects related to relevant project topics to WG

According to the information available for the TST team, half (6) of those 12 projects were completed and half of them were still in progress (by state of November, 2022). Remarkable results have been achieved by those 12 projects so far, but also many research and innovation needs and gaps have been identified in those projects. Some of the main R&I needs are briefly described here.

Holistic and system approach

Holistic vision on environmental, economic, social, cultural and political sustainability should be applied. Complex challenges require an improved understanding of multiple physical, social, economic, and political processes. The need for a holistic and systematic approach was mentioned in relation to the breeding approach to support diversity, giving the long-term societal and ecological benefits, seed strategy and seed management practices, performance of permanent grasslands, but also in relation to research and advising activities.

Innovation needs should be made more effective through a systems approach, linking incentives, innovation, and education and by further linking innovation measures with sustainability objectives. Holistic decision-support tools and design-aid tools are needed to help with diagnostics and evaluations. In addition, a clear joined-up policy is needed, which is connecting food systems, agriculture, and rural development with animal and human health. For example, the previous policies relevant to grassland management have not fully considered the demand for ecosystem services. When more holistic landscape policies are to be implemented across Europe, there needs to be a more coherent and transparent process that allows also citizens´ interests (e.g. regarding ecosystem services) to be reflected in the policymaking.

Participatory and multi-actor approach

Based on the portfolio analysis, the involvement of different stakeholders and actors in the system is key, in line with the Farm to Fork approach. Participatory coordinated research, co-creation, and co-learning together with farmers in their local conditions, but also industry, advisors, researchers, and other important stakeholders should be involved. Universities and research institutes need to promote multi-stakeholder approaches and give higher priority to providing continued funding for initiatives with demonstrated impact. These institutions need to reward researchers for their involvement in transdisciplinary projects. Also, incentives for stakeholders are needed to keep them involved in research projects and stay active in co-creation. It is essential that a motivated and independent facilitator with a high level of social skills supports cooperation. Researchers could generate new knowledge by undertaking research together with farmers. For example, decentralized participatory variety breeding involving all stakeholders in the process (farmer, value chain, consumers, society) should be encouraged as this improves local adaptation, market-oriented cultivars, and long-term commitment.

However, the consumers, local actors and other stakeholders not directly involved in farming should not be forgotten. For example, the priorities for permanent grassland management are also affected by the attitudes and perceptions of non-farmers. Of course, the attitudes of the decision-makers themselves (farmers) are more influential than the attitudes of those groups who are not directly involved in decision-making (e.g. the public). However, links could be further explored between those two. Research should also explore the attitudes of citizens and consumers. Increasing demand for recreation in natural and especially remote areas will increase the pressure on land, the ecosystem, and its services. It is essential to study on and find strategies to minimise impacts caused by recreation through continuous, interdisciplinary scientific research and in close dialogue with relevant stakeholders.

Multidisciplinary projects

The social dimension and the relations between farmers, advisors, teachers, and other important stakeholders, as well as the multi-level socio-technical systems, should be considered and involved in the research projects. This would bring out key needs, but also attitudes and influencing factors to improve the system. Those factors, which influence farmers' decision-making, may be significantly understudied. Cultural ecosystem services related to farm management practices are severely understudied. Further understanding of the drivers and on-farm working conditions and their interactions is necessary, such as for example the time since the start of the ecological transition, the type and the combination of ecological practices used, farmers' own attitude or objectives, and their skills and attitude toward experimenting. The socio-economic impact studies of ecological farming should be expanded to more countries across and beyond Europe to increase the generality of the results. For example, land rights are significantly different in different parts of Europe.

Diversity research on all levels

There is a strong need for new farming practices that could balance productivity and biodiversity. Most of the analysed projects stress, that there is a clear need for increased genetic diversity within cultivars and mixed cropping systems (e.g. agroforestry) to support farm diversification. Also, organic plant breeding efforts should concentrate on the objective to deliver increased agrobiodiversity. In animal research, there is a need for breeds that are better suited to the organic production systems with longer lifetimes and more outdoor foraging, like slow-growing breeds, dual-purpose breeds, and breeds with more expressed natural foraging behaviour.

More information is needed about potential benefits of "diversity of species", "allopathy of cover crops", "biocontrol and biostimulants", but also about functional biodiversity (i.e. that part of biodiversity, which provides benefits to the farming systems) and the resilience of new cultivar types with increased genetic diversity. The research projects have to move from single species pest–parasitoid dynamics studies to multiplex networks that incorporate plant–host, plant–pollinator, host–parasitoid, predator–prey, and even microbial interactions, as well as multiple habitat types. This would deepen understanding of the impacts of environmental change on agroecosystems and will provide new ways of actively improving management practices to enhance resilience and maximise multiple ecosystem service provision.
Quantitative information on plant protection products, water use, and management of own-produced manure and landscape features would greatly improve the ability of FADN to provide a fuller picture of the environmental performance of individual holdings. From an ecological point of view, the presence of semi-natural habitats on farm is essential for halting and reversing biodiversity loss in agricultural areas.

Research on ecosystem services

With the growing pressures on land use, an understanding of how organisms and ecosystem services are connected is extremely important. For example, knowledge of how parasitoids fit within ecosystems in terms of their direct and indirect interactions with other species is lacking. Moving from single-species pest–parasitoid dynamics studies to multiplex networks will maximise multiple ecosystem service provisions.

The importance of studying the relationship between a mixture of natural habitats and agricultural arable land is stressed several times from different angles. For pollinating insects the relationship between natural habitats at the edges of crops is a matter of both alternative sources of food during the blossoming of the crops, and filling potential nutritional gaps at the end of the flowering periods of the crops. Promoting wildflower species in agricultural landscapes may contribute to increasing access to pollen diets of different quality and therefore reduce honeybees´ sensitivity to pesticides.

In addition, there is a need for introducing cultural ecosystem services (CES) into all future ecosystem service frameworks and policies. CES can be a powerful approach to support the aim of the new EU biodiversity strategy. Integrating CES into policy frameworks offers opportunities for improved understanding and assessment of how ecosystems can benefit human well-being. For example, conserving and improving CES would need a multi-actor approach in which rural development and traditional knowledge are integrated.

Regional and local level

Each region has a different socio-economic, environmental and cultural context, thus there is no 'one-size-fits-all' solutions in the transition to sustainable farming. Instead, agroecology works best when tailored to local needs. In most of the projects, the importance of regionally-based solutions is stressed. Projects and solutions for regionally relevant topics should be developed in the respective regions and in collaboration with stakeholders, rather than aiming for a general solution across Europe. In addition, regional and local governments need to invest in training and capacity building for farmers.

There is a need for relevant information, which is specific to each agro-environmental context and that can come from the results of on-farm trials. The project Super-G is gathering data and information from the Mediterranean, Atlantic, Continental, Alpine, Pannonian, and Boreal regions to benchmark and model the ability of permanent grasslands to deliver farm productivity, profitability, and key ecosystem services within those selected regions. It is also important to develop a strategic approach to policy, which reflects regional contexts and demonstrates the added value of integrated sustainable choices to the value chain.

Empowering rural communities

Ecological agriculture must be assessed with the aim of promoting the improved performance and sustainability of farms, rural environment, rural societies, and economies. Also, landowners and other actors in rural communities and value chains should be included in the research activities. If agroecology is to succeed, the capacity of local actors should be increased.

Knowledge, information, and communication

More information sharing and knowledge around sustainability principles and better practices are needed on all levels. Scientists have a role in supporting farmers change their image with consumers, by providing scientific information on sustainable farming practices. Scientific information on beneficial agroecological practices is needed to enable farmers to deliver robust and credible messages to consumers.

Knowledge and skill gaps have been identified in most of the projects and on different levels and topics, starting from basic sustainability principles up to very specific needs. For example, more information is needed on key barriers to crop diversification and the dynamic nature of crop diversification in relation to introducing new crops at farm level. At the field scale, stakeholders pointed out the lack of fundamental knowledge about the soil-plant-organism interactions, lack of technical references, info about local varieties, sowing densities (especially for intercrops), machinery settings, appropriate soil tillage and so. More research and knowledge are needed on soils, manure, better management of permanent grasslands, use of innovative technologies, biodiversity, scientific evidence of positive/negative effects of agroecological practices, information on risks of new practices and technologies, and management tools to handle those risks and so.

Continued education, training, and knowledge exchanges remain to be very important. There is still a lack of reliable information and insufficient training opportunities related to sustainable and ecological practices. More understanding is needed about regenerative farming practices, showing the importance of increasing access to these educational programmes as part of the upscaling of mixed farming and agroforestry.

Advisors ask for information about new tools and methods to help diagnostics and evaluations, as well as holistic decision-support and design-aid tools; info about new practices and the "quantification of benefits". It is very important to foster better knowledge exchanges between researchers and advisory services to ensure more and "updated" information related to the use of practices that favour biodiversity (e.g. breeding, technological and biological crop protection methods). In addition, much work is needed to increase advisory services, carry out research in pilot farms, establish living labs for farmer-to-farmer learning, and to strengthen farmers' networks.

Also, control authorities need new insights: for example, if exploratory research studies provided a better understanding of pesticide toxicity in honeybees, the next objective would be to translate the most relevant behavioural and reproductive endpoints into regulatory test methods. This will require more comparative studies and improving their ecological relevance.

Dissemination of scientific knowledge is changing and digital technologies and tools (e.g. MOOCs), as well as other innovative means (evidence-based serious games, knowledge exchange hubs, test models, and pilot projects), enable faster transfer of knowledge to students, facilitators, extension agents, educators, but also to consumers. Those new innovative dissemination tools should be further developed and used.

Regulatory test methods, to support policy

As already mentioned before, there is a clear need for a holistic view and joined-up policy. The dialogue between researchers and policymakers is vital. Policymakers need more information on the sustainability

impacts of different combinations of agroecological practices, the contexts in which combinations of practices are effective, and how their implementation can be promoted through policy. The living labs approach is being promoted under Horizon Europe. Understanding how to engage farmers in living labs is key to ensuring successful engagement in these schemes. The analyses and tools developed for example in the LIFT project inform policymakers whether ecological farms perform differently and have different trade-offs and synergies than standard farms. Targeted policies, further research, and further development of databases in this direction are needed to realise a broad adoption of agroecology in Europe.

Conclusion

Several projects mention common needs for a holistic vision of environmental, economic, social, cultural, and political sustainability as key factors. Another unlocking key is the participatory approach for any future activities (including scientific research). In general, there are some good practice examples existing currently, but these can be improved, shared, and adapted elsewhere in the coming years. Several projects mention networks as important tools having great importance in actively increasing the visibility of good practices, specifically farmers' networks.

In the closest future, an ecological transition of the entire European farming sector is needed, covering not only farms in specific contexts already open for such change, but also standard conventional farms. There is an urgent need to improve the understanding of the social and political factors relevant to overcoming barriers to the adoption of agroecological practices. The social dimension is becoming more and more apparent: there is a need for socially acceptable solutions and socially sustainable food production.