EVECSA

European Vocational Excellence
for Climate Smart Agriculture

Transnational Report

Overview of needs, resources and competence profiles in Climate Smart Agriculture

Deliverable D2.1

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List of Abbreviations

EVECSA - European Vocational Excellence for Climate Smart Agriculture

EVACSA - European Vocational Alliance for Climate Smart Agriculture

CSA - Climate Smart Agriculture

RC - Regional Captains

C&D - Communication and Dissemination

CoVE - Centers of Vocational Excellence

PoVE - Platform of Vocational Excellence

VET - Vocational Education and Training

agro-VET - Agricultural Vocational Education and Training

CoP - Community of Practice

PPP – Public Private Partnership

AKIS - Agricultural Knowledge and Innovation Systems

EACEA - European Education and Culture Executive Agency

1. Introduction

The present Transnational Report – *Overview of Needs, Resources, and Competence Profiles in Climate-Smart Agriculture* – has been developed as part of Work Package 2 of the EVECSA project. It is the result of a qualitative research and survey conducted to compare the agricultural sector and its practices across the six regions in different European countries involved in the project. More specifically, this Transnational Report (hereafter "the Report") aims to analyse the common needs, resources and skills required in the context of Climate Smart Agriculture education, in particular in the Vocational Education and Training sector.

According to the official FAO definition, Climate-Smart Agriculture (CSA) is an approach that guides actions to transform agrifood systems towards more sustainable and climate-resilient practices. It aims to achieve three main objectives: sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change, and reducing and/or removing greenhouse gas emissions, where possible. This term refers to a large set of practices, more or less shared, in their respective regional contexts. The primary objective of this research was to identify a common definition of Climate-Smart Agriculture as a basis for establishing shared goals.

Figure 1 *The three CSA pillars*

The relevance of conducting a Transnational analysis lies in the fact that - despite distinct regional differences - the agricultural sector in the European countries in many ways operates through comparable mechanisms and purposes: Farmers use knowledge, technology, and natural resources to produce food and other raw materials. In this way the agricultural sector is unique: It operates in a given local context, closely embedded in the local ecosystems (e.g., economy, culture, nature). At the same time, it shares methods, values, and roles - and challenges - at a much larger scale. Despite distinct regional differences, the agro-VET sector in the European

countries must, in many ways, adapt to similar changes in developing the skillset needed for a transition to climate-smart agriculture.
The following sections provide a contextual background for this research, considering its objectives and methodology, as outlined in sections I.I, I.II, and I.III. The second section presents a comprehensive review of the state of the art and regional contexts, with a particular emphasis on our conceptualisation of CSA (Section II.I), previous experiences in various countries (Section II.II), existing stakeholder networks engaged in CSA (Section II.III), and exemplary best practices that serve as sources of inspiration (Section II.IIII). The third section conducts a comparative analysis of key CSA practices across different regional contexts. Finally, the fourth section identifies common gaps, needs, and resources across these contexts, providing insights into potential future developments and strategic directions at the European level.
The Annexes section displays the Regional Reports, focusing on regional needs and analysis. This section has been made with the contribution of Regional Captains.

1.1 What is EVECSA?

The core motivation driving EVECSA is rooted in Europe's commitment to fostering a green transition in agriculture, as outlined in the European Green Deal. To realise these goals, proactive engagement is essential from key stakeholders within agriculture, especially farmers and farm employees, who must implement changes at the farm level. Daily decisions on reducing greenhouse gas emissions, adapting to climate change, and sustaining agricultural productivity and biodiversity require proficiency in Climate Smart Agriculture (CSA), an approach that helps guide actions to transform agri-food systems towards green and climate resilient practices. Vocational Education and Training institutions play a crucial role in providing education and training for farmers across Europe, yet transitioning to green farming poses challenges for both farmers and vocational education and training providers.
EVECSA addresses these challenges by developing and delivering attractive and relevant learning opportunities for CSA, aiming to attract more learners to this field and foster strong cooperation between stakeholders to facilitate the green transition at the farm level in Europe. The project aims to establish new mindsets and models for education, training, and lifelong learning targeted at farmers engaged in CSA.
The EVECSA project aligns with Climate Smart Agriculture objectives, including sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change, and reducing greenhouse gas emissions. Through collaboration among 22 partners across regions in six countries (Catalonia, Denmark, Finland, Poland, Sicily, The Netherlands), EVECSA will establish six Centres of Vocational Excellence (CoVEs) to strengthen the quality, relevance, and attractiveness of vocational-learning offers for CSA. These CoVEs will cooperate via an international Platform of Vocational Excellence (PoVE) to deliver the European Vocational Alliance for

Climate Smart Agriculture— (EVACSA), shaping education policies and practices that foster sustainable food production, job opportunities, and wellbeing for all.

Figure 2 *Geographical distribution of the 6 CoVEs in EVECSA*

In this project, 22 partners included Agro-VET providers, companies, sector representative organisations, universities and knowledge partners, form a PoVE community.

The Regional Partners are:

Denmark CoVE

- 4 VET providers: Bygholm Landbrugsskole, Asmildkloster Landbrugsskole, Kalo Organic, Viden Djurs and Green Academy Arhus
- 1 enterprise partner: Food&Bio Cluster Denmark
- 1 university: Aarhus University

The Netherlands CoVE

- 1 VET provider: AERES MBO
- 1 network partner: Agro-Food Cluster

Central & Southern Ostrobothnia CoVE (Finland)

- 2 VET providers: KPEDU and SEDU
- 1 enterprise: ProAgria Keski-Pohjanmaa
- 1 university: LUAS, University of Applied Sciences

Poland CoVE

- 1 VET provider: ZSCKR
- 1 university: UPWr, Uniwersytet Przyrodniczy
- 1 enterprise: Energia Oz Sp Zoo

Sicily CoVE (Italy)

- 1 VET provider: CORERAS, Consorzio Regionale Per La Ricerca Applicata E La Sperimentazione
- 1 knowledge partner: CESIE ETS
- 1 social enterprise: LAND Impresa Sociale s.r.l.

Catalonia CoVE (Spain)

- 1 VET provider: Escola Agrària de Manresa
- 1 network partner: Boscat Fusta
- 1 knowledge partner: Beta technological centre

Katapult, the Dutch knowledge partner, is not engaged in any CoVE but contributed with its experiences at CoVE and PoVE level.

The project aims to build strong skills ecosystems through Communities of Practice (CoP), fostering stronger relations and more systematic cooperation among key stakeholders in the agricultural skills ecosystem. By ensuring that agro-VET providers are updated on and working with the newest trends in the sector, EVECSA empowers them to become central participants in Agricultural Knowledge and Innovation Systems (AKIS), ultimately meeting the evolving needs of the agricultural sector.

1.2 Research objectives

The objectives of this research are manifold.
The general aim is to identify the needs and map the resources within the agri-food skills ecosystem at regional and transnational level as a basis for tackling current and future challenges related to skills supply for a transition to Climate Smart Agriculture. This research will provide a framework for the regional CoVEs to work on, setting the base for cooperation and defining key areas for educational content development.
Specifically, the analysis focuses on the regional context in relation to the following aspects of CSA:

- To map previous experience that the different stakeholders have in CSA practices. Farmers & companies, the VET sector, knowledge institutions and policymakers deal with CSA in different ways and have different levels of application and familiarity with these practices;
- To compare main trends in CSA across different countries;
- To define main gaps, needs and resources in the education sector (VET sector).

1.3 Research methodology

The methodology employed by the EVECSA partners included both qualitative and quantitative research approaches to ensure a comprehensive and well-structured analysis.
In particular, data collection was carried out through two main channels: semi-structured expert interviews and an online survey targeting key partnerships and relevant stakeholders. The research process lasted six months, during which significant efforts were dedicated to mapping relevant stakeholders and identifying potential participants to be actively involved in the study.
The targets were 10 semi-structured interviews and 15 online survey responses for each CoVE. Below is the number of participants per CoVE for both research methods, broken down by type:

Survey	*Sicily*	*Poland*	*Denmark*	*Central & Southern Ostrobothnia*	*The Netherlands*	*Catalonia*	*Total stakeholders*
Agro-VET	7	2	12	7	2	3	33
Companies & Farmers	2	15	15	11	2	6	51

Knowledge institutions	5	2	5	3	1	2	18
Policy Makers	1	2	4	0	1	1	9
Interviews							
Companies & Farmers	5	5	4	3	6	3	26
Knowledge institutions	3	5	2	3	1	3	17
Policy Makers	1	6	4	1	1	1	14

Each project partner was responsible for selecting seven experts per region as representatives of the climate and smart agriculture sector. Among these, a diverse selection was ensured, including at least three agro-VET professionals, three representatives from agro-companies, and one policymaker. This composition aimed to capture valuable qualitative insights from a range of perspectives.
In addition to the expert interviews, the partnership also conducted an extensive online survey, which was distributed to a broader set of stakeholders. This approach was designed to enhance data volume and ensure more representative collection of responses.
A key strength of the methodology was the constant and structured communication among partners, which ensured alignment and coherence throughout the process. This collaborative approach served as a guiding thread, allowing for a consistent and harmonised interpretation of findings and shaping the final research outcomes effectively.

2. Overview of the regional backgrounds and ecosystem in CSA

2.1 Climate Smart Agriculture, our vision

The vision of Climate Smart Agriculture (CSA) across the six regions reflects a diverse and converging understanding of sustainable agricultural practices.

Responses varied in depth, ranging from general concepts to highly detailed technical approaches. A common theme was the integration of precision farming techniques to optimise resource use, such as limiting pesticides and synthetic fertilisers based on soil analysis and actual needs.

Many stakeholders associated the concept of Climate Smart Agriculture with reducing agriculture's environmental impact, mitigating climate change, and adopting a balanced farming approach. Key priorities included reducing CO_2 emissions, promoting biodiversity, enhancing soil fertility, and utilising renewable energy and biodegradable packaging.

In Denmark, for example, CSA is seen as high-productivity agriculture with minimal climate impact, leveraging advanced knowledge, methods, and technology. Similarly, Finland emphasises sustainable resource use, energy efficiency, and technological advancements such as artificial intelligence and automation. In Catalonia, CSA is widely recognised as a means to improve productivity, enhance climate resilience, reduce emissions, and ensure long-term sustainability by considering natural cycles and local resources. The Netherlands' research involved a range of stakeholders, including agricultural entrepreneurs, researchers, consultants, and educators, who provided insights into CSA implementation across sectors. Sicily's findings align CSA with adaptability to climate change, food security, and the role of emerging technologies such as AI and Agriculture 4.0, with additional focus on ecosystem regeneration, policies, and investments.

While definitions varied, most responses aligned with the Food and Agriculture Organization of the United Nations (FAO)'s three CSA pillars: increasing agricultural productivity, enhancing resilience to climate change, and reducing greenhouse gas emissions.

2.2 Regional backgrounds in CSA

The backgrounds among the six partner countries present a varied landscape, shaped by differences in experience, technological advancements, policy frameworks, and economic constraints.

Figure 3 *This graph shows the average of the data collected in each country. Each respondent rated their level of experience with CSA on a scale from 1 to 5*

In Finland, the majority of respondents rate their experience with CSA as moderate, with organisations already integrating climate-smart farming practices such as soil cover cropping and water management. However, financial barriers and limited access to technological expertise present significant challenges to broader adoption. The focus remains on sustainable resource use and improving farming efficiency through precision techniques. The average of respondents has a good level of experience in CSA (3.95 out of 5).

Poland exhibits a similarly intermediate level of experience with CSA (3.35 out of 5). Farmers and agricultural stakeholders are actively exploring innovative approaches such as weather stations, sensors, radar data, and precision irrigation techniques to enhance water management and resource efficiency. Key practices include non-ploughing cultivation methods to preserve soil health, reducing supply chain distances to minimise emissions, and employing rainwater harvesting systems for livestock. Efforts are also directed toward improving soil fertility through organic matter, increasing water retention, and implementing cover crops to maintain soil temperature, prevent erosion, and support biodiversity. Precision agriculture, natural fertilisers, and biological solutions such as disease resistant crops and low-chemical farming are increasingly recognised as crucial components of CSA. Despite these advancements, the variation in self-reported experience levels highlights that some farmers and stakeholders remain at an early stage of adoption, requiring further training and support.

In Denmark, the overall level of CSA experience is notably high, with nearly 70% of respondents reporting advanced familiarity with climate smart practices, while none claim to have no experience (on average, 4 out of 5). Despite this strong foundation, challenges persist, particularly in economic feasibility, documentation of climate effects and navigating complex legislation. The agricultural sector is gradually integrating CSA methodologies, with initial steps taken in crop production, livestock management, and energy systems. Educators in Denmark play a crucial role in shaping future CSA implementation, but only 10% feel fully confident in teaching the subject, while 60% report moderate confidence, suggesting a need for specialised training. Farmers and agro-businesses in Denmark demonstrate a growing interest in biogas plants, artificial intelligence applications, and advisory services aimed at supporting climate-resilient farming. However, financial limitations and regulatory complexities remain significant barriers to scaling these innovations.

Catalonia presents a more structured approach to CSA, with agro-VET institutions actively integrating climate smart principles into their training and continuing education programmes. These institutions focus on diverse agricultural sectors, including new technologies, horticulture, viticulture, and organic farming, ensuring that CSA knowledge is embedded in future agricultural practices. Teachers in Spain demonstrate strong motivation to teach CSA related subjects, though their confidence in delivering these lessons remains moderate. Key practices implemented in Spanish agricultural institutions include rainwater harvesting, drought resistant cultivation, and the use of permanent vegetative cover to prevent soil erosion. Knowledge institutions in Spain, despite approaching CSA from different angles, align in their emphasis on plant production and water management. Their research efforts extend to regenerative agriculture, agroforestry, renewable energy integration, and nutrient management. Spanish farmers and agro-companies actively engage in CSA through diversified production strategies, including mixed and permanent pasture systems, direct seeding, mulching to promote soil microbiology, and cultivating climate-adapted crop varieties. Their efforts aim to enhance resilience to drought conditions while adding value to their products through sustainability-focused branding. However, despite these advancements, challenges such as limited access to specialised machinery, knowledge gaps, and financial uncertainty hinder widespread CSA adoption. The average respondents declared to have a level of experience in CSA of 2.91 out of 5.

In Italy, CSA implementation is fragmented but evolving across multiple sectors, including agro-VET institutions, universities, research centres, farmers, agro-companies, and policymakers. While nearly all agro-VET institutions offer training in the agri-food sector, few provide specific courses on CSA. Many educators feel only moderately confident teaching CSA related topics, though they express a willingness to do so if adequately trained. Universities and research centres in Italy demonstrate a strong commitment to CSA, focusing on agroforestry, agrivoltaic systems, precision agriculture, disease management, carbon sequestration practices, and the integration of smart devices for monitoring abiotic stresses in crops. Some researchers emphasise traditionally rooted CSA practices, such as silvopastoral systems, while others lean toward advanced technological solutions. Italian farmers and agro-companies actively implement various CSA techniques, including biodegradable materials, decision support systems (DSS) to enhance crop management, and arido-culture, a technique designed to optimise agricultural production in arid and semi-arid regions with limited water availability. Their decision-making process regarding CSA practices is primarily influenced by climate conditions, meteorological data, economic feasibility, and knowledge accessibility. However, major obstacles persist, including difficulties adapting CSA technologies to challenging soil conditions, financial constraints, and a lack of specialised knowledge. The average level of knowledge in CSA is 3 out of 5.

The Netherlands already has strict regulations on for example greenhouse gases and fossil energy use. Many of the respondents are working hard to meet targets to research and integrate new techniques. Climate Smart Agriculture experience mentioned in the questionnaire was experience in the field of soil health management, robust crops, weed robots, and regenerative agriculture initiatives, on-farm energy generation and ecological approaches centred on soil health.

Across all six countries, the adoption of CSA is shaped by several common factors, including economic viability, institutional support, technological access, environmental conditions, and policy frameworks. While Denmark and Spain exhibit relatively advanced CSA implementation, Finland and Poland demonstrate a moderate but evolving engagement with climate-smart practices. Italy, though fragmented in its approach, highlights strong research efforts and emerging policy support. Each country faces its own unique challenges, yet collectively, their experiences provide valuable insights into the evolving landscape of CSA. The future of CSA in these regions will likely depend on continued investment in education, research, financial support mechanisms, and technological innovation to enhance agricultural resilience and sustainability in the face of climate change.

2.3 Stakeholders and networks in CSA

Collaboration among stakeholders in Climate Smart Agriculture (CSA) plays a crucial role in advancing sustainable agricultural practices. The collaborations are different among countries but several common themes emerge, including partnerships with vocational education institutions, agricultural organisations, and knowledge institutions.

In Finland, local networks are fundamental in sharing climate-smart agricultural practices, particularly in regions where agriculture is a primary source of livelihood. These networks often include collaborations with local educational organisations, agricultural businesses focused on sustainable innovation, and regional agricultural advisory centres. Respondents highlighted the importance of these partnerships for facilitating the spread of innovative practices and technologies that support climate adaptation.

In Poland, the cooperation landscape is more differentiated. Respondents report strong collaboration with agricultural organisations, which was rated highly on average. However, cooperation with vocational education and knowledge institutions has been more mixed, with lower ratings reflecting challenges in engagement. Vocational education partnerships primarily focus on practical experiences such as internships and training placements, and respondents have expressed a strong interest in working with institutions on projects that introduce climate-friendly technologies. Key obstacles to further collaboration include limited funding, insufficient access to resources, and organisational barriers such as rigid institutional structures and resistance to innovation. Respondents suggested that creating clearer frameworks for cooperation, alongside increased funding and international collaboration, could help to overcome these challenges and encourage more active participation from agricultural stakeholders.

Denmark's CSA network also reveals a broad range of collaborations, particularly with agricultural schools, businesses, and knowledge institutions. These partnerships are essential for the implementation of sustainable technologies in farming practices, particularly in the fields of robotics, IT, and sustainable agriculture. Despite this, time constraints, lack of funding, and limited awareness about the relevant contacts in the CSA field were identified as key barriers. Respondents noted that many agricultural businesses have limited contact with knowledge institutions, and only a small proportion have extensive partnerships. There is, however, a clear desire for more robust collaborations, particularly with companies specialising in sustainable technologies, and greater involvement in data-driven agricultural practices. Respondents also emphasised the importance of promoting more educational programmes and research in partnership with institutions like the Danish Technological Institute and business academies.

In Spain, particularly in Catalonia, the landscape of CSA partnerships is characterised by active engagement with agroVETs, agricultural organisations, and technological innovation institutes. Respondents rated their collaboration with agroVETs and knowledge institutions highly, often focusing on projects related to student and professional internships, as well as innovation and technology development. Despite strong relationships in certain sectors, such as agro-ecology and wine production, there are clear challenges related to the lack of networks, technical staff, and resources dedicated to CSA. Time constraints and funding limitations were consistently mentioned as significant barriers, and many respondents pointed to the need for public-private partnerships and the expansion of European projects to support CSA initiatives. There is a shared belief that creating long-term collaboration frameworks, with a focus on practical and localised solutions, could facilitate the wider adoption of CSA practices.

Italy presents a somewhat different situation, where there is moderate engagement with CSA stakeholders. While many respondents have connections with agro-companies and vocational education institutions, there is a lack of formal platforms or networks to facilitate collaboration between the various actors. Many agricultural companies expressed reluctance to engage due to limited awareness of the benefits that CSA could bring to their operations, as well as the challenges posed by insufficient expertise and financial resources. The educational and research sectors also face hurdles in fully aligning with industry needs, with only a fraction of respondents reporting strong ties with universities and research centres. In response, several participants suggested promoting cooperation through concrete project agreements and improving communication channels to bring together different stakeholders. The creation of better networking platforms, along with increased educational offerings, is seen as essential for improving CSA adoption.

In the Netherlands, respondents cooperate with various agricultural organisations, such as agricultural advisory centres such as Agrofoodcluster to obtain specialised information, educational institutes for cooperation and knowledge exchange and experience related to traineeships. Respondents also maintain contacts with other knowledge or specialised institutes to engage in cooperation for innovations, development projects or the need for support and counseling.

Despite collaborations, respondents also run into gaps and challenges such as: Lack of skills in technology, data interpretation, and digital innovation in agriculture, slow integration of innovation into education, leading to a disconnect between technological advancements and knowledge dissemination, broad and unclear definitions of CSA hinder the focus on sustainability solutions.

Across all countries surveyed, common barriers to effective cooperation include financial constraints, limited human resources, and a lack of systematic structures to support long-term collaboration. Many respondents also pointed to insufficient communication between the various sectors, which makes it difficult to align priorities and goals. To address these challenges, participants consistently suggested several solutions, including the establishment of clearer frameworks for cooperation, greater funding for joint projects, and improved access to educational and training resources. There is also a shared call for stronger public-private partnerships, greater involvement of government institutions, and a more strategic approach to international cooperation in CSA efforts. The need for continued investment in research, innovation, and the development of climate-smart technologies was emphasised as a key driver for advancing the agricultural sector’s capacity to adapt to climate change and foster sustainability.

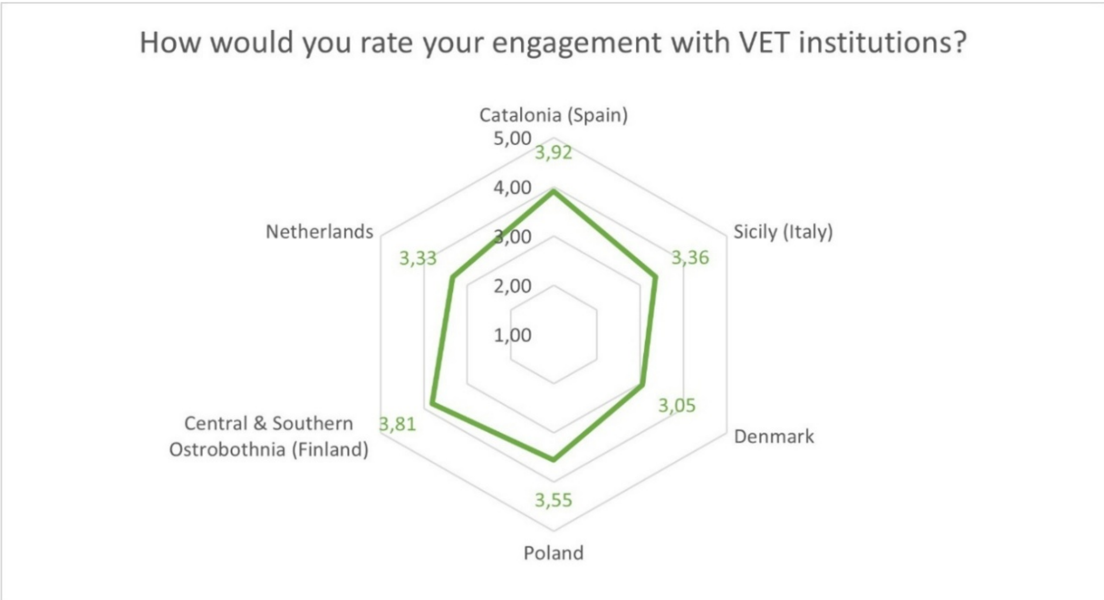

Figure 4 *This graph shows the average of the data collected in each country. Each respondent rated their level of engagement with VET institutions on a scale from 1 to 5*

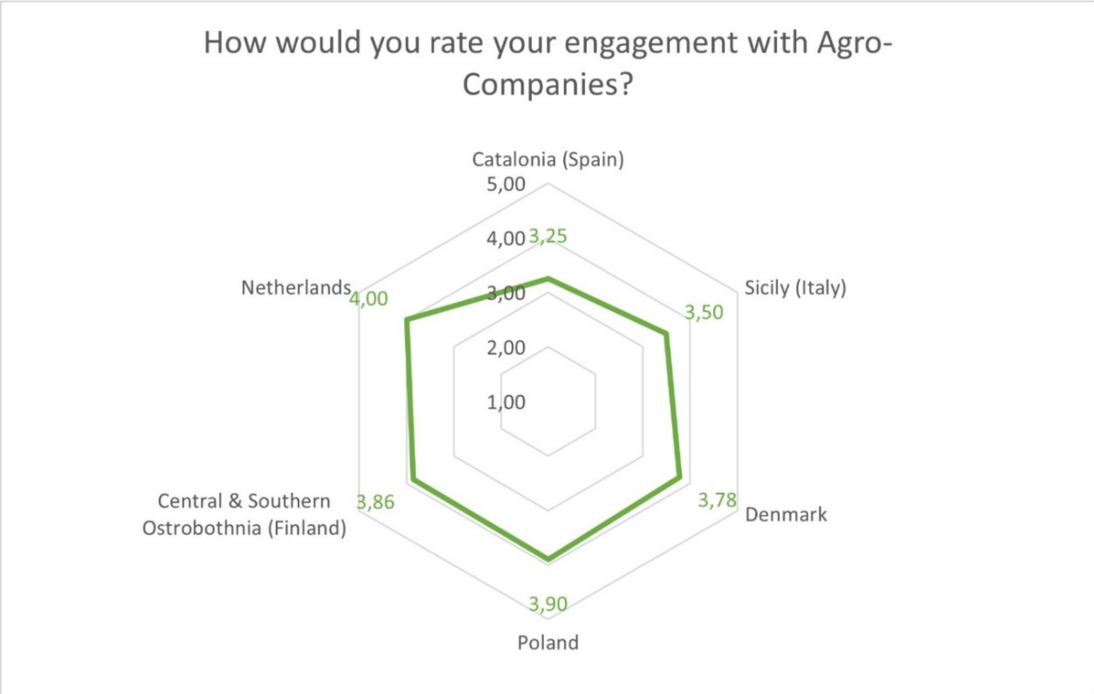

Figure 5 *This graph shows the average of the data collected in each country. Each respondent rated their level of engagement with agro-companies on a scale from 1 to 5*

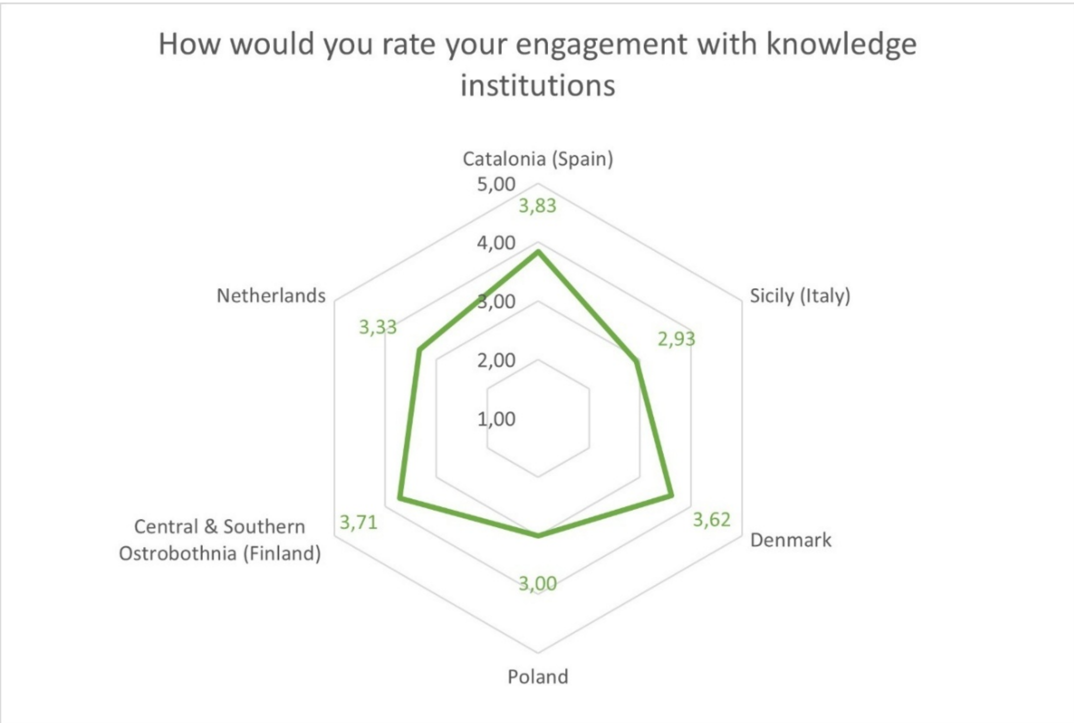

Figure 6 *This graph shows the average of the data collected in each country. Each respondent rated their level of engagement with knowledge institutions on a scale from 1 to 5.*

In summary, while CSA networks and collaborations across these six countries have made notable strides, they face significant challenges that need to be addressed through coordinated efforts, enhanced communication, and increased investment in both human and financial resources. The potential for scaling up CSA practices is clear, but achieving this will require continued collaboration, the development of practical, localised solutions, and a supportive policy environment.

2.4 Best practices

Across different regions it is possible to analyse unique approaches to sustainability and innovation in CSA.

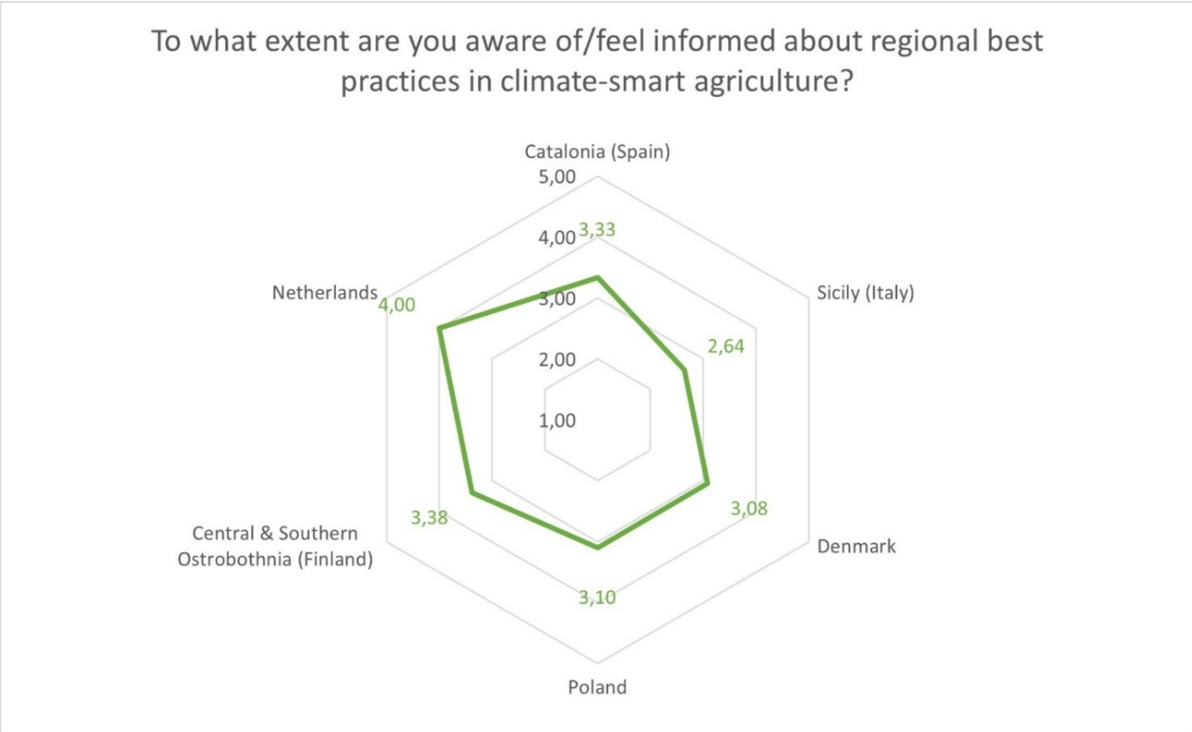

Figure 7 *This graph shows the average of the data collected in each country. Each respondent rated their level of awareness of CSA best practices on a scale from 1 to*

In Finland, key practices include leveraging artificial intelligence and data analytics to optimise farming processes, implementing diverse crop rotations to protect soil health, and utilising advanced water management technologies to mitigate the effects of drought and flooding. Collaboration between educational institutions and businesses also plays a crucial role in fostering innovation.

Poland highlights well-designed crop rotations, cover cropping, intercropping, and the use of natural fertilisers to maintain soil sustainability, alongside precision agriculture techniques such as field mapping, variable-rate fertilisation, and automated equipment to optimise resource use. Effective water management strategies, integrated crop production, and simplified tillage further enhance soil health. However, respondents noted gaps in knowledge-sharing and widespread implementation, emphasising the need for study visits and collaborative learning. Climate smart education trends in the region focus on promoting student and staff mobility, fostering partnerships between educational institutions and agricultural stakeholders, and aligning training programmes with industry needs.

In Denmark, precision fertiliser application, biogas production, and regenerative agriculture are recognised as emerging trends, though they are not yet widely integrated into education. Key skills for students include entrepreneurship, sustainable agricultural knowledge, and technological expertise, but there is a pressing need for professional courses, increased awareness of career opportunities, and updated curricula to align with industry requirements.

Spain reports a strong awareness of agroecological practices such as polycultures, cover crops, direct seeding, rotational grazing, and early-stage agroforestry initiatives. Digital advancements, including sensor-based irrigation management and smart greenhouses, are also gaining traction. However, the practical application of these innovations remains limited, with challenges in knowledge transfer and sector attractiveness for new learners. Catalonia, in particular, emphasises regenerative agriculture, improved water management, and integrated soil fertility management, yet the implementation of these trends in agricultural training is rated low. A significant gap exists between students' technical knowledge and their entrepreneurial and social skills, which are essential for successful entry into the sector.

In Italy, various agro-companies demonstrate innovative approaches to sustainable farming. The Circle, a company specialising in aquaponics, integrates fish farming with soilless plant cultivation to address water scarcity and land limitations. Libera Terra Mediterraneo, a consortium managing land reclaimed from the mafia, prioritises organic farming, crop rotation, and satellite-guided precision agriculture. I-Green Systems focuses on agrivoltaic solutions that balance agricultural and solar energy production, while ALIVE Permacultura applies permaculture principles to reconnect urban life with agriculture. Their experimentation with agroforestry promotes biodiversity, diversified harvests, and sustainable land management. Across all regions, there is a strong push toward climate-smart agriculture, yet challenges remain in education, sharing of knowledge, and practical implementation. Addressing these gaps through improved training, mobility programmes, and industry collaboration will be key to ensuring long term sustainability and resilience in agricultural practices.

In the Netherlands, almost all respondents highlighted examples of best practices they experienced such as drone technology, spot spayer, weeding robot, regenerative agriculture demonstrated at a specific company, Farm of the Future, new hybrid seeds more resistant to drought, mulching implementation of small windmills. For best practices in career the main examples given are the possibilities for learner and staff mobility and integration of agro-VET in skills ecosystems.

3. Main trends & skills in CSA - Comparative analysis

During the transnational meeting held in Nunspeet, the Netherlands on January 21-23 2025, in which all consortium partners participated, key trends and skills in Climate-Smart Agriculture (CSA) were identified across the six partner countries**.** The analysis was conducted through a combination of workshops, brainstorming sessions, and group discussions, enabling an exchange of knowledge and experiences among experts from different contexts. The brainstorming session between the partners had as a starting point the regional research result, on which each partner contributed in defining the underlying macro-categories.

These trends can be categorised into five main areas, which will be detailed in the next paragraphs:

- **Agroecology and regenerative agriculture**: practices aimed at enhancing biodiversity, improving soil health, and fostering ecosystem resilience.
- **Water and soil management**: strategies for optimising water use and preserving soil quality in response to climate change challenges.
- **Renewable energy**: integration of sustainable energy sources into agricultural production to reduce environmental impact.
- **Technology and precision agriculture**: implementation of digital tools, sensors, and AI-driven solutions to increase efficiency and sustainability.
- **Soft & management skills**: competencies related to leadership, collaboration, and decision-making to facilitate the transition to climate-smart practices.

Figure 8 *Brainstorming session during the transnational meeting in the Netherlands (January 2025), where different CoVEs actively exchanged ideas and insights on Climate-Smart Agriculture.*

Figure 9 *Brainstorming session during the transnational meeting in the Netherlands (January 2025), where different CoVEs actively exchanged ideas and insights on Climate-Smart Agriculture.*

***Figure 10** Brainstorming session during the transnational meeting in the Netherlands (January 2025), where different CoVEs actively exchanged ideas and insights on Climate-Smart Agriculture.*

Before analysing in depth, the five main common trends identified by the regional research and the partnership, it is worth mentioning the current level of incorporation of these trends within the training programmes in the different countries.

The graph below shows that the incorporation of CSA trends into training programmes and educational systems is still medium-low, although – as shown above – there is a consistency across countries with regard to the areas and main trends to be taken into account in CSA. The scores suggest a similar level of integration overall, with no region reaching a score of 4 or 5. There are variations among the countries, also due to different educational policies, funding, or industry collaborations but, generally speaking, there is still room for improvement in all countries.

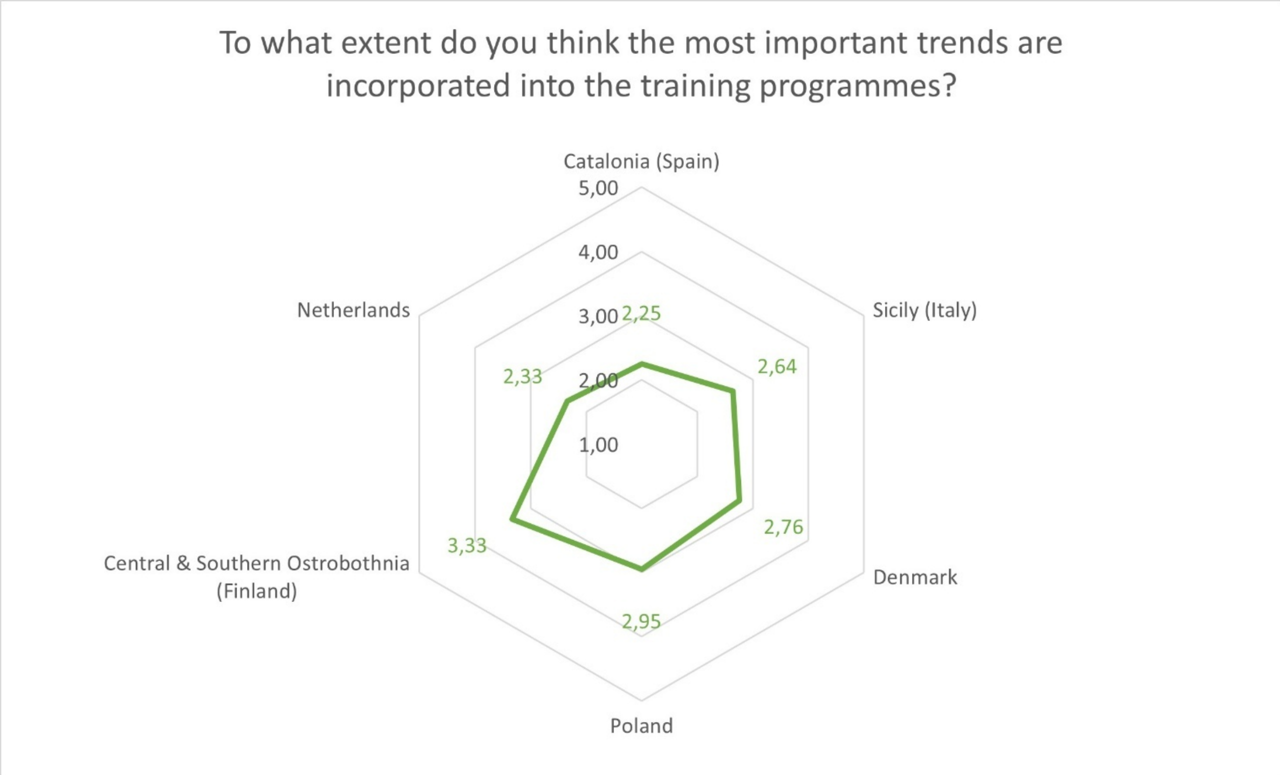

Figure 11 *This graph shows the average of the data collected in each country. Each respondent rated on a scale from 1 to 5 how main trends in CSA are incorporated into training programmes.*

3.1 Agroecology and regenerative agriculture

There is a strong shift toward **regenerative agriculture and agroecology** in several countries. In Italy, sustainable practices such as agroforestry, permaculture, and hydroponics are gaining traction. The Netherlands is adopting regenerative techniques and transitioning toward "Nature-Positive Food Systems" which emphasise biodiversity and soil health. Denmark is addressing agroecology and regenerative agriculture focusing on rebuilding soil fertility and enhancing biodiversity. In Poland, regenerative farming methods such as intercropping, crop rotations, and natural fertilisation are widely practiced, while Spain integrates agroecological principles through local variety cultivation, cover cropping, and silvopasture systems.

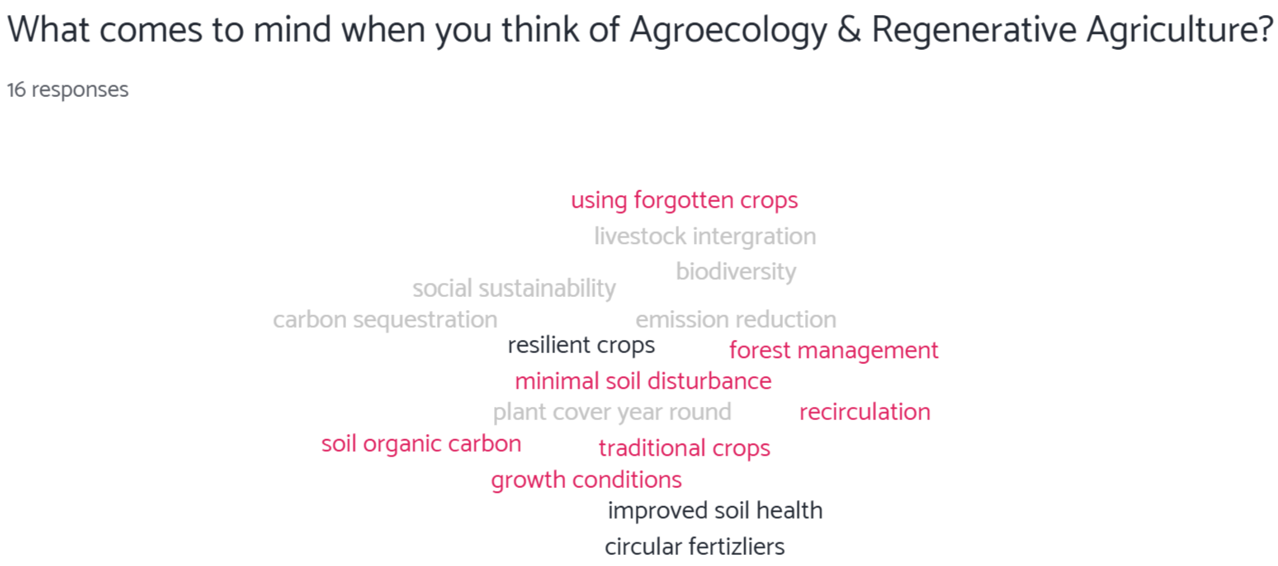

Figure 12 *This infographic represents insights from the partnership connected to the CSA trend: Agroecology and Regenerative Agriculture*.

Required skills can be classified mostly as Agronomic and Ecological Skills, such as:

Soil Health Management – Understanding soil biology, fertility, and regenerative practices like composting, cover cropping, and minimal tillage.

Agroecological Design – Applying principles of permaculture, agroforestry, and crop diversification.

Integration of Livestock - Crop production and animal farming are combined in a way that benefits both.

Biodiversity Conservation – Knowledge of pollinators, beneficial organisms, and habitat restoration techniques. Special focus on researching traditional crops and animals.

3.2 Water and soil management

Efficient **water and soil management** are critical concerns across all regions. In Italy, research institutions emphasise water conservation techniques and soil-friendly technologies, recognising the need for advanced irrigation methods. The need is a consequence of the climate crisis and the desertification of the region, especially the regions of the south of Italy, such as Sicily. The same is true for Spain that actively integrates adaptive soil fertility methods alongside advanced water conservation techniques. The Netherlands prioritises soil health as a means to improve water retention and prevent heat stress in livestock. In Finland, diverse crop rotations help protect soil structure, while innovative water management technologies mitigate drought and flooding risks. Denmark is increasingly focused on soil resilience to climate change, recognising the importance of sustainable farming practices to prevent erosion and degradation. Meanwhile, Poland maintains soil health through natural fertilisers and cover cropping.

Figure 13 *This infographic represents insights from the partnership connected to the CSA trend: Water & Soil management.*

Necessary skills to acquire expertise in water and soil management are:

Soil Health Assessment – Understanding soil composition, organic matter, and biological activity.

Soil Fertility and Regeneration – Mastering crop rotations, composting, biochar application, and agroforestry techniques.

Erosion Control – Implementing contour farming, no-till agriculture, and vegetative buffers.

Carbon Sequestration – Utilising regenerative practices to enhance soil carbon storage.

Drought and Flood Management – Developing water retention landscapes, wetlands, and buffer zones.

Hydrology and Watershed Management – Understanding water cycles, aquifers, and river basin dynamics.

Desertification Mitigation – Implementing soil moisture conservation techniques and sustainable land-use planning.

3.3 Renewable energy

The integration of renewable energy sources into agriculture is expanding all over Europe. In particular, in Italy, agrivoltaic systems that combine solar energy with farming are being implemented, taking advantage of the massive presence of sun in the region. The Netherlands is developing CO_2 measurement systems alongside sustainable energy infrastructure. In Poland, there is a strong push toward biogas production, wind farms, and photovoltaic energy. Spain is exploring sustainable energy solutions in agroforestry and CSA training programmes to support green transitions. These efforts align with European policies such as the Green Deal and Agenda 2030, which promote energy efficiency in agriculture.

Figure 14 *This infographic represents insights from the partnership connected to the CSA trend: Renewable energy.*

Key skills concerning renewable energy involve:

Agrivoltaics & Dual-Use Farming – Combining solar energy with crop production to optimise land use. Understanding the design, installation, and maintenance of solar panels in agricultural settings.

Sustainable Greenhouses – Implementing geothermal, solar, and wind solutions in controlled-environment agriculture.

Climate-Resilient Farming Practices – Using renewable energy for irrigation, soil management, and temperature regulation.

Biogas & Biomass Energy – Expertise in anaerobic digestion, biofuel production, and organic waste management.

3.4 Technology and precision agriculture

Technological advancements play a major role in optimising CSA. In Italy, artificial intelligence (AI), Decision Support Systems (DSS), and digital farming tools are being integrated to enhance production efficiency. However, experts caution that technology should not be used as a "quick fix" without sufficient knowledge. The Netherlands leads in AI-driven farming, robotics, and precision agriculture, helping farmers make data-informed decisions. In Finland, AI and data analytics optimise farming processes, while Denmark invests in automation, sensors, and drones to reduce environmental impact. Poland has widely adopted field mapping, automated crop protection, and variable-rate fertilisation, showcasing a strong commitment to precision agriculture.

Figure 15 This infographic represents insights from the partnership connected to the CSA trend: Precision agriculture.

Key skills to be integrated are:

Artificial Intelligence (AI) & Machine Learning – Understanding predictive analytics, yield forecasting, and automated decision-making. Using AI-powered tools to optimise planting, irrigation, and fertilisation strategies (Decision Support Systems - DDS)

Big Data & Analytics – Managing large datasets related to soil health, weather conditions, and crop performance.

Geographic Information Systems (GIS) & Remote Sensing – Using satellite imagery and drones for field mapping and resource allocation.

Internet of Things (IoT) & Sensor Technology – Implementing real-time monitoring of soil moisture, temperature, and crop growth.

Automated Crop Protection & Variable-Rate Application – Mastering drones, robotics, and targeted fertilisation/pesticide application.

Climate Adaptation Strategies – Using technology to mitigate climate risks (e.g., precision irrigation during droughts).

Ethical Use of Technology – Ensuring responsible AI applications and avoiding over-reliance on automation.

3.5 Change management skills

Beyond technical advancements, soft and management skills are crucial for fostering a resilient CSA sector. Italy emphasises the need for public-private partnerships to create effective agricultural networks, while the Netherlands incorporates business-oriented training models to support farmers. In Finland, collaboration between educational institutions and businesses helps drive innovation. Denmark highlights the importance of policy support and cross-sector collaboration to accelerate the transition to climate-smart agriculture. Spain places a strong focus on education and continuous professional development, ensuring that CSA remains an attractive and sustainable career choice for future generations.

These trends illustrate the dynamic evolution of CSA across European partner countries, highlighting the shared commitment to sustainable, technology-driven, and resource-efficient agricultural practices.

Figure 16 *This infographic represents insights from the partnership connected to the CSA trend: Change management skills.*

The main skills found are:

Public-Private Partnership Development – Building networks between government, businesses, and farmers (**Italy**).

Business-Oriented Training & Financial Literacy – Supporting farmers in developing business plans, accessing funding, and improving economic resilience (**Netherlands**).

Cross-Sector Collaboration – Engaging policymakers, educational institutions, and private stakeholders to drive CSA innovation (**Denmark, Finland**).

Interdisciplinary Coordination – Connecting expertise from agronomy, technology, and economics to implement sustainable solutions (**Denmark**).

Sustainable Business Models – Developing eco-friendly production and market strategies.

Circular Economy & Waste Management – Integrating closed-loop farming systems and resource efficiency.

Supply Chain Management – Navigating farm-to-table logistics and ethical sourcing.

4. Gap, needs and resources - Common features & EU added value

4.1 Educational & training needs

There is a growing recognition of the need to enhance agricultural education and training to equip future workers with the necessary skills. In **Italy**, the demand for training programmes focused on technology, financial literacy, and management skills is evident, alongside a need for specific education in the sector, with a focus on local environmental challenges. In the **Netherlands**, the slow integration of innovation into educational systems is a concern, as it delays knowledge dissemination and limits farmers' ability to adopt new technologies effectively. **Finland** highlights the importance of integrating entrepreneurial and collaborative skills into schools and universities curricula, ensuring students can adapt to climate-smart agriculture demands. **Denmark** emphasises the necessity for interdisciplinary education that combines biology, technology, and economics, with particular focus on sustainability and regenerative methods. **Poland** calls for intensifying CSA education, covering technical, digital, and soft skills to prepare workers for the evolving agricultural landscape. **Catalonia** underlines the need to invest in research, development, and innovation in the agricultural and forestry sectors, fostering long-term practice-oriented training initiatives.

Common features

Most of the countries have recognised the importance of enhancing agricultural education and training, indicating a willingness to develop improved curricula and training programmes. A common focus is on integrating **technical, digital, and management skills** into agricultural training.

The growing acknowledgment of the role of digitalisation and precision agriculture in CSA opens opportunities for leveraging technological advancements in education. The incorporation of technological advancement in training programmes varies from country to country, even though all countries experienced a low level of integration of innovation in the educational systems. Most of the countries also recognised the importance of interdisciplinary and holistic approaches, combining **biology, technology, economics, and sustainability**. The focus is also on entrepreneurial, collaborative, and financial literacy skills as crucial for modern agricultural professionals. Increased awareness on **investment in R&D and innovation is also**

crucial, a concern indirectly reflected in other countries through their focus on **technology-driven training**.

EU Added Value

- ➢ The European Union can facilitate knowledge exchange and best practices between countries to accelerate the integration of CSA education.
- ➢ EU funding and policies, such as the Green Deal and Horizon Europe, can support interdisciplinary and practice-oriented training initiatives, promoting innovation and sustainability in agricultural education across member states.
- ➢ The Pact for Skills, under the European Skills Agenda, supports upskilling and reskilling to navigate the green and digital transitions. By fostering lifelong learning and collaboration, it strengthens the EU's commitment to sustainable competitiveness, social fairness, and resilience, ultimately it reinforces interdisciplinary and practice-oriented training for Climate-Smart Agriculture.

4.2 Use & incorporation of technology

The incorporation of technology in agriculture presents both opportunities and challenges across European countries. **Italy** underscores the necessity of improving digitalisation and access to advanced monitoring tools, particularly in soil and water management. However, gaps persist due to limited public awareness and resistance to change. **The Netherlands** faces a skills shortage in digital innovation, data interpretation, and the practical application of IT systems in agriculture. **Finland** stresses the importance of integrating AI and data analytics into farming, ensuring that technology aligns with sustainability goals. **Denmark** identifies a critical need for farmers to understand and utilise digital technologies, such as AI and autonomous systems, to optimise production and reduce carbon emissions. In **Poland**, agribusinesses recognise the need for digital tools in precision agriculture, but implementation is hindered by insufficient funding and regulatory challenges. **Catalonia** supports increased research into technological advancements in agriculture and forestry, promoting practical applications through field experiments and innovation networks.

Common features

As far as new technologies applied to agriculture are concerned, the results of the research revealed first of all a variety of starting situations in the six countries: in some cases, the level of technologisation is already good, farms make regular use of certain technologies to make production more efficient, thanks to government support and adaptability to new solutions that require new technological knowledge; in other countries, the use of technology in agriculture, although potentially seen as an aid to production, is not already applied on a large scale. The reasons behind this relate to various factors: a relocation of farms that prevents a massive shift towards the adoption of new technologies (the transfer of knowledge is less effective and the fragmentation of various farms hampers the transition); a lack of digitalisation in agriculture that can guarantee a connection to rural areas and adequate IT infrastructure; resistance to adopting changes in agriculture that are not certain to succeed on the farm; and a general view of technology as a support to other already sustainable agricultural practices.

Generally speaking, all countries recognise the **importance of digital tools** in optimising agricultural practices, particularly in **soil and water management, precision farming, and sustainability efforts** (Italy, Poland, Spain). There is a widespread **shortage of digital skills** among farmers, including **data interpretation, AI integration, and the practical use of IT systems** (Netherlands, Denmark, Finland). Countries emphasise the role of **R&D and innovation hubs** in promoting **technological advancements and field experiments.** All countries perceive a lack of integration of these new technologies in the education sector.

EU added value

- Facilitating Technology Adoption: Providing financial incentives and policy frameworks to overcome funding and regulatory barriers, ensuring uniform access to smart agriculture tools.
- Promoting digitalisation through the CAP: The Common Agricultural Policy (CAP) acknowledges the critical role of digitalisation in modernising agriculture and rural areas, fostering the integration of digital technologies and data-driven approaches to enhance sustainability, efficiency, and competitiveness in the sector.
- At the same time, ensuring Ethical Sustainability Alignment: Encouraging the **responsible** integration of AI and digital technologies to support climate resilience and low-carbon agriculture across member states. Allow a more flexible approach to balance new technologies and traditional approaches.

4.3 Traditional knowledge and experiences

While technological advancements are essential, the preservation and integration of traditional agricultural knowledge remain crucial. Italy highlights the importance of natural farming practices, such as permaculture and agroforestry, which can enhance sustainability while minimising chemical use. The Netherlands are transitioning from CSA to "Nature-Positive Food Systems," integrating traditional ecological knowledge with modern precision farming techniques. Finland stresses the need to protect traditional soil conservation practices, such as diverse crop rotations, which support long-term agricultural sustainability. Denmark acknowledges that regenerative agricultural practices, including cover cropping and reduced tillage, are fundamental to rebuilding soil health and biodiversity. Poland emphasises well-designed crop rotations and the use of natural fertilisers as core elements of sustainable agriculture, aligning traditional methods with modern precision techniques. Spain promotes adaptive forestry management and silvopasture as effective strategies for environmental conservation while maintaining agricultural productivity.

Common features

All countries emphasise the value of traditional agricultural knowledge in enhancing sustainability, biodiversity, and soil health while reducing dependence on chemical inputs (Italy, Finland, Denmark, Poland). On the one hand, countries are increasingly merging traditional ecological practices with modern precision farming to improve resource efficiency and climate resilience (Netherlands, Poland). But also, countries stress the importance of adaptive land-use strategies, including agroforestry, silvopasture, and forestry management, to balance agricultural productivity with environmental conservation (Italy, Spain).

The variety of responses with which modern farmers act (tradition-oriented but not only) depends on the fact that we are also in a very particular historical-environmental moment. In some respects, climate change - exponentially fast and sudden - makes the use of past knowledge less impactful: there is no longer the certainty of the past that allowed the farmer, once he knew the land and its climate, to act accordingly with well-defined agricultural practices. The risk, due to uncertainty at the climatic level, is that a mechanism can be established whereby past experience is unable to help the farmer in interpreting the present (and especially the future), leaving farmers in a state of greater uncertainty (also at the economic level). On the other side, using technology for its own sake would not be a more coherent solution. The use of new technologies, which are more expendable and accessible, can create an instant defence mechanism for the farmers in the face of the difficulties caused by climate change but, since they do not presuppose a deep knowledge of the territory or the problem, they may prove to be non-essential in the long term or merely palliative.

In an attempt to strike a balance between the implementation of traditional practices and the inclusion of new technologies, the crisis at the micro level must be taken as an opportunity to push the farmer to go deeper into the macro level. Nowadays, we have an inordinate amount of information that can direct us towards agricultural choices that were - until a few decades ago - non-existent. In the past, the lack of information was dealt with as knowledge that was based solely on observation. Now we have other means, including technological ones, that can support observation but do not have to replace it.

EU added value

- Encouraging Sustainable Agricultural Policies: Aligning EU regulations and funding schemes with the promotion of agroecological and regenerative farming practices.
- Enhancing Education & Training: Developing training programmes that incorporate both traditional knowledge and modern CSA technologies, ensuring that farmers can adopt holistic, climate-smart solutions.

4.4 Strengthening cooperation, partnership & networks

Collaboration and knowledge exchange are critical for addressing challenges in CSA. Italy highlights the importance of fostering cooperation among farmers, research institutions, and policymakers to create local market opportunities and enhance resource sharing. The Netherlands stresses the need for partnerships that accelerate technological innovation and ensure that knowledge transfer keeps the rhythm with the progress. Finland emphasises the role of collaboration between educational institutions and businesses to develop practical solutions for sustainable farming. Denmark sees significant potential in strengthening cooperation between agricultural colleges, research institutions, and agribusinesses to drive innovation and support the green transition. Poland recognises that greater coordination between stakeholders, including government bodies and local farmers, is necessary to implement CSA effectively and increase public awareness. Spain underscores the importance of establishing long-term local and international networks to facilitate practical knowledge-sharing and labour market integration in the agricultural sector.

By addressing these gaps, keeping into consideration the needs and being aware of the resources, it is possible to strengthen the cooperation across Europe. This can lead to the creation of a more resilient, innovative, and sustainable agricultural sector that balances modern advancements with traditional knowledge, ensuring long-term food security and environmental sustainability.

Common features

All countries recognise the necessity of cooperation among farmers, research institutions, policymakers, and businesses to foster innovation and improve resource sharing (Italy, Denmark, Finland, Poland). Also, there is a widespread emphasis on translating research into practical agricultural applications to ensure that technological advancements align with real-world needs (Netherlands, Finland, Denmark). Countries stress the importance of efficient knowledge-sharing mechanisms to ensure that farmers stay updated on CSA advancements (Netherlands, Poland, Spain). Increasing public awareness and labour market integration is also seen as crucial for CSA adoption (Poland, Spain). A common theme is the need for long-term collaboration at both local and international levels to facilitate the exchange of best practices and enhance market opportunities (Spain, Italy, Netherlands).

EU added value

- Promoting Public-Private Partnerships: Encouraging joint initiatives between research institutions, agribusinesses, and policymakers to accelerate CSA adoption.
- Ensuring Inclusive and Sustainable Growth: Aligning local and international cooperation efforts with the Green Deal and Farm to Fork Strategy to create a resilient, sustainable, and innovative agricultural sector.
- The EU can foster cross-border collaboration by supporting regional networks and expanding funding for joint research and training. Streamlining knowledge transfer from research to practice will ensure that farmers and agribusinesses can quickly adopt CSA innovations, enhancing productivity and sustainability.

Conclusion

The present research investigates how the Climate Smart Agriculture approach is more or less successfully applied in the six different regions and contexts involved in the EVECSA project. With 111 questionnaires and 57 semi-structured interviews across the regions, a vast range of stakeholders working within the agricultural & educational sectors have been involved in the process. Specifically, agro-companies and farmers, agro-VET institutions, universities/knowledge institutions and policymakers contributed to define a common ecosystem in Climate Smart Agriculture.

Different perspectives and backgrounds within each CoVE contributed to build a common language necessary to share values and set future objectives and directions within the CSA domain.

As such, the research deepens and maps the current situation in CSA at two levels:

1) To understand existing experiences and agro-practices in the various contexts;

2) To study how different educational systems are reacting and/or incorporating new approaches in Climate Smart Agriculture.

As far as the experiences and agro-practices are concerned, the premise on which the research is based assumes that the different environmental and climatic contexts could require different and tailor-made courses of action, due to the fact that climate change is affecting different countries with a specific impact.

The results of the research revealed that, even if both local contexts and climate change challenges (as one of the most evident examples, some countries experience droughts while others experience flooding due to sudden heavy rains) differ, there is a European consensus on the need for more efficient Climate Smart Agricultural practices implementation toward a green transition. In other words, different climatic issues, but leaning on common similar solutions. In particular, common paths have been identified among the countries: *agroecology and regenerative practices, water and soil management, renewable energies, technology and precision agriculture and change management skills.*

Concerning the incorporation of the Climate Smart Agriculture approach into educational systems, the research showed that all stakeholders have acknowledged the significance of advancing agricultural education and training, demonstrating a commitment to developing enhanced curricula and training programmes. A prevalent emphasis is placed on incorporating technical, digital, and managerial competencies into agricultural training.

In particular, the profile of a future agricultural worker in the context of this project will require specific training and skills, ranging from *Agroecological Design, Soil Health Management, Biodiversity Conservation, Drought and Flood Management* to *Biogas & Biomass Energy, Agrivoltaics management, Geographic Information Systems (GIS) & Remote Sensing, Climate Adaptation Strategies and planning.* All of the countries also strongly agree about the need to include Change Management skills in the curricula.

To conclude, climate change must be seen as a critical turning point and an opportunity to deepen and to rethink our way to produce and to work within our local and global agricultural ecosystems.

At the micro level, encompassing businesses, educational institutions, and farmers, the crisis necessitates a comprehensive reflection that prioritises the holistic management of challenges associated with climate change, rather than a series of isolated responses to individual climatic disasters. This type of management implies well-defined planning based not only on the knowledge and new information available to us compared to the past, but also on direct observation.

On a macro level, encompassing our economic model and political system, there is a strong need to foster partnerships and promote the exchange of knowledge and best practices among countries, ensuring cross fertilisation of expertise in CSA.

The need for **partnerships (both locally and at the EU level) and the need to work towards a systemic level** emerged clearly from the research, including from a varied range of stakeholders.

Some macro needs at the systemic level have indeed been identified:

- Integrating technical, digital, and management skills into agricultural training.
- Integrating digital tools in day-to-day agriculture.
- Merging traditional ecological practices with modern precision farming to improve resource efficiency and climate resilience.
- Reinforce cooperation between farmers, research institutions, policymakers, and businesses to foster innovation and improve resource sharing.

What's next?

The results of this research will inform the next steps of the EVECSA project, i.e., developing and enriching the learning offer for Climate Smart Agriculture in each CoVE, ensuring the transfer of knowledge for climate smart action through strong Public

Private Partnerships (PPP) and capacity building within agro-VET providers, and strengthening the knowledge of vocational training aimed at climate smart agriculture and increasing learner recruitment.

Annexes

Annex 1 – Poland CoVE Regional Report

Executive Summary

This document presents the results of an online survey and semi-structured interviews on knowledge, practices, and needs related to Climate Smart Agriculture (CSA) in the regional context of Poland CoVE. The main objective was to assess the current awareness of representatives from the agricultural sector, companies, educational institutions, research organisations, and government officials regarding CSA. Additionally, the survey aimed to identify current CSA practices, as well as the threats, opportunities, perspectives, and needs related to the adoption of Climate Smart Farming. The first part of the document summarises the online questionnaire distributed among various entities related to agriculture. The second part provides a summary of interviews conducted with representatives of agricultural businesses, educational and research institutions, as well as government circles. The results of these needs assessments highlight the need for a more prominent presence of CSA-related issues in the public sphere, particularly in agricultural education.

Analysis of the results - Online questionnaire

Climate Smart Agriculture vision

Results collected in part of the survey regarding vision of Climate Smart Agriculture vision were of differentiated quality. Level of detail was ranging from no answer at all to extensive, detailed answers with precise techniques to use in Climate Smart Agriculture proposed. Vision of Climate Smart Agriculture was usually connected to precise farming, limiting use of production materials like pesticides and synthetic fertilizers, adjustment of use of these materials to actual needs by using techniques based on initial analysis and considering heterogeneity of soil. Many responses were characterizing Climate Smart Agriculture as limitation of negative impact of farming on environment, activities targeted to mitigate change of climate, balanced approach in farming. Responses were mentioning limitation of CO_2 emission in agricultural production and using of biodegradable packaging and renewable sources of energy. Climate Smart Agriculture was associated for one respondent with high quality production.

Experiences in Climate Smart Agriculture

Experiences in Climate Smart Agriculture are estimated on an intermediate level, with average above 3/5 and responses ranging from the lowest to highest grades (0 – 5). As examples of Climate Smart Practices, respondents proposed use of weather stations, sensors, and radar data for precise water management, which is crucial for both crop efficiency and sustainable resource use. Additionally, non-ploughing farming techniques, shortening of supply chains from producer to consumer, and internal water-saving initiatives (including rainwater utilization for livestock) are helping farmers optimize resources. There is also a focus on reducing bureaucracy, improving soil fertility through organic matter, and enhancing water retention through appropriate farming techniques. Climate monitoring and water conservation systems, like rainwater storage at the source, further support sustainable agricultural practices. Seeding of cover crops and intercrops plays a crucial role in lowering soil temperature, improving its properties, and maintaining optimal nutrient levels for soil organisms, enhancing crop rotation efficiency as well as reducing water loss and soil erosion. Farmers emphasize crop diversification, conservation farming techniques, and the use of natural and organic fertilizers, alongside precision agriculture systems. The introduction of biological solutions, such as disease-resistant crops and minimal chemical use, is also key. No-plough cultivation, timely agricultural procedures, and increasing organic matter in the soil contribute to better water retention and soil fertility. Integrated crop production combines biological and mechanical methods. Furthermore, conservation farming, the use of GPS for variable-rate fertilization, and the implementation of new plant varieties enhance ecosystem services and reduce greenhouse gas emissions, all while improving soil health. Despite quite rich examples of experiences in Climate Smart Agriculture variation in self-assessment results shows that some respondents have much less experience with Climate Smart Agriculture.

Network of local contacts

Assessment of cooperation between our responders and institutions relevant for Climate Smart Agriculture conception was differentiated. The best rating has cooperation of respondents with agricultural organizations (average around 4/5), further cooperation with vocational education institutions (average around 3.5/5) and the worse rating had cooperation of our respondents with knowledge institutions (average below 3/5).

Cooperations with vocational education organizations

Respondents cooperate with various agricultural education organizations, including universities and agricultural advisory centers, primarily focusing on practical experiences such as student internships and vocational placements. In this part of survey some respondents did not correctly classified organizations – vocational education institutions were mixed with knowledge institutions. Respondents value partnerships with institutions like the Uniwersytet Przyrodniczy we Wrocławiu (Wrocław University of Environmental and Life Sciences, UPWr) and Łódzki Ośrodek Doradztwa Rolniczego (Łódzkie Center for Agricultural Consueling, ŁODR), seeking collaboration on innovations and developmental projects, particularly in implementing climate-friendly agricultural technologies. The desire for vocational counseling is evident, as respondents seek guidance in career development and the application of sustainable practices. Some also express interest in analysing the context for developing new technologies in sustainable agriculture. Several respondents, mostly individual farmers, they have not any cooperation with vocational education and in previous answers they mentioned internet portals as main source of self-development.

The main factors interrupting cooperation with vocational education institutions, based on the responses, include lack of access, uncertain land leases, and limited funding or grants. Other barriers include distance and transportation costs, as well as a lack of adequately trained staff in advisory organizations such as ŁODR for example. Some respondents point out insufficient practical training in education, which tends to focus more on theory. Additionally, formal and legal requirements, organizational barriers, and a lack of clear cooperation frameworks further hinder collaboration, which go along with skeptical approach to such initiatives. Several respondents also mention a lack of time and inflexibility from partnering institutions.

Key factors that could support cooperation with vocational education institutions include developing new joint projects addressing practical challenges, intensifying student training collaborations, and creating networks to foster partnerships. Funding and study trips were also highlighted as potential supports. Other suggestions include training programs for farmers, knowledge transfer between academia and business, and initiating research and development projects. There is also a need for clearer systems and guidelines for cooperation, as well as measures to facilitate communication. Some respondents emphasized the importance of increasing engagement and creating a more supportive environment for climate-friendly agriculture education.

Cooperations with agricultural organizations

When it comes to respondents' answers regarding cooperation with agricultural institutions most of them mention cooperation with companies supplying agricultural production sources, including machinery, fertilizers, pesticides distributors, companies processing milk, agricultural advising companies etc. Desired new institutions for cooperation in agricultural sector there are mentioned also companies offering solutions related to climate smart agriculture principles. Respondents expressed interest in cooperating with agricultural institutions in several key areas. These include the implementation of climate-friendly agricultural technologies, particularly related to plant protection and sustainable farming practices. Some respondents are focused on innovation and development projects, while others are interested in analysing the context of new technologies for sustainable agriculture. Additionally, many highlighted the importance of vocational counselling and student internships or professional training. A few mentioned partnerships related to supply of production inputs, and product distribution. However, several respondents reported no wish or ideas for new collaborations.

Respondents identified several factors limiting cooperation with agricultural organizations. Key obstacles include uncertain land leases, financial barriers, and a lack of available or qualified personnel, especially in organizations like ŁODR. Other respondents pointed to insufficient knowledge about technological advancements or the scope of company operations. Additionally, limited time, organizational challenges, and a lack of a cohesive system for integrating decision-makers, science, and education into practical climate-friendly agricultural solutions were also noted. Some respondents highlighted the lack of promotion and the slow development of Polish companies in research and technology implementation in Climate Smart Farming as further barriers.

Respondents offered various ideas for improving cooperation with agricultural organizations. Key suggestions include maintaining current cooperation levels, initiating new projects, and creating networks to strengthen connections. They also proposed organizing more meetings with companies and providing training in relevant areas. Some respondents highlighted the need for international collaboration, free testing of new solutions, and better communication with smaller farmers. Suggestions also focused on institutional support for climate-friendly initiatives, such as trainings and funding, as well as creating platforms to consolidate new technologies and promoting systemic solutions for better cooperation. Others mentioned integrating meetings and leveraging the Łukasiewicz network (national organization created to plan and coordinate research and development) to find implementation partners.

Cooperations with agricultural knowledge institutions

The respondents currently cooperate with a range of agricultural knowledge institutions, such as Universities of Life Sciences in Warsaw, Wrocław and Poznań, COBORU (Center for Crop Research), and ODR (Agricultural Advisory Centers). In terms of future cooperation, respondents expressed interest in working with higher education institutions in Poland and abroad, research institutes focused on agriculture 4.0, and organizations like the Ministry of Agriculture, Centres of Vocational Excellence (CoVE), and training companies. Several also seek partnerships with universities and schools that are implementing practical, climate-friendly agricultural solutions. Others are looking for institutions that prioritize collaborations that do not generate big costs. Finally, some respondents do not have any cooperations or ideas for cooperations.

Currently, respondents engage in cooperation with knowledge institutions in several key areas, such as innovation and development projects, the analysis of new technologies for sustainable agriculture, vocational counseling, and student internships or professional practices however significant number of asked groups does not have any current cooperations with knowledge institutions. Looking to the future, respondents expressed a desire to expand their collaboration by developing and implementing training programs, introducing existing technologies related to climate-friendly agriculture, participating in more innovation and development projects, and continuing vocational counseling. Additionally, they hope to increase opportunities for student internships and practices, as well as deepen the analysis of new technologies for sustainable farming.

The cooperation between respondents and knowledge institutions is hindered by several limitations, primarily financial and organizational challenges. Key barriers include inadequate funding for institutions and projects, uncertainty in land leases, lack of awareness of relevant knowledge institutions, and limited time for engagement. Additionally, respondents noted resistance to change and innovation, insufficient collaboration proposals, and a lack of systematized solutions for fostering cooperation.

To improve collaboration, respondents suggested several ideas, such as increasing financial support for joint projects, establishing communication networks, and creating systems to streamline information exchange. There is also a call for stronger partnerships between farmers and universities, more training opportunities, and greater involvement from government institutions like the Ministry of Agriculture and Rural Development (MRiRW) and European bodies to support and fund these initiatives. Other proposals included promoting existing achievements and implementing new technologies to optimize work efficiency while benefiting the environment. Lastly, respondents emphasized the need for a structured, mandatory system to facilitate ongoing cooperation.

Best practices and career in Climate Smart Agriculture

The responses highlight several best practices in climate-smart agriculture within the region, although some participants noted a lack of familiarity with specific examples. Key practices include well-designed crop rotations, cover crops, intercropping, and the use of natural fertilizers, all essential for maintaining soil health and sustainability. Precision agriculture, featuring field mapping, variable-rate fertilization, and automated equipment, aims to optimize resource use and boost productivity. Effective water management techniques, such as water retention strategies and proper fertilizer adjustments, enhance water efficiency, while integrated crop production and simplified tillage improve soil management. Additionally, increasing organic matter through crop selection and manure application is vital for soil health, and establishing biogas facilities for agricultural by-products offers sustainable waste and energy solutions. Respondents indicated challenges in information flow and a lack of widespread solutions, emphasizing the need for study visits and sharing successful practices to enhance the understanding and adoption of climate-smart agriculture methods. Overall, while recognized practices exist, there is a clear call for improved knowledge exchange and greater implementation of these methods in the region.

The main practices in climate-smart farming education and training focus on promoting student and staff mobility and internationalization strategies, fostering partnerships between educational institutions and agricultural stakeholders. This collaboration aligns training programs with industry needs while emphasizing high-quality educational activities tailored to climate-friendly agriculture. Additionally, integrating competencies and skills within the agricultural education system is crucial for ensuring relevant and up-to-date curricula. Innovative approaches are needed to attract more students to both initial and continuous education in agriculture, ultimately enhancing the effectiveness of climate-smart agriculture training. The main trends in climate-smart agriculture in the local environment include the adoption of weather-index-based insurance practices, which help mitigate risks associated with climate variability. Regenerative agriculture is gaining traction, focusing on improving soil health and ecosystem resilience. Precision agriculture techniques are also prominent, with an emphasis on precise irrigation methods and intelligent pest and disease management to optimize resource use and enhance crop productivity. Improved water management technologies play a crucial role in enhancing water efficiency in farming practices. Additionally, there is a strong focus on cultivating climate-resilient plant varieties, as well as implementing conservation and sustainable farming practices to promote environmental sustainability. Overall, these trends reflect a concerted effort to adapt agricultural practices to changing climatic conditions while ensuring long-term sustainability.

Analysis of the results - Semi structured interviews

Agro-Companies

The survey responses reveal a diverse range of agricultural companies with varying sizes, from small local businesses and family farms to large international operations. Agrocom is a small company with fewer than 50 employees, operating exclusively in Poland. It is not part of an international corporation, and employee retention is high, with workers typically staying for many years. The company specializes in innovative digital solutions for plant production and livestock, particularly dairy and meat cattle. Ośrodek Hodowli Zarodowej „Przerzeczyn Zdrój" employs around 62 people and focuses on cattle breeding, including both dairy and meat cattle. It operates within Poland, with long employee tenure and minimal turnover. TopFarms, with over 500 employees, operates in Poland, Romania, and the UK. It specializes in both plant production and animal husbandry, including dairy and meat cattle. Employee turnover is very low, reflecting strong retention and stability. Emil Malewski runs a farm, focusing on dairy cattle on 70 hectares of land. Dominik Tymieniecki operates as a sole proprietor on 90 hectares, specializing in crop production with no-till farming methods. Both farm owners do not formally employ workers besides occasional seasonal works, and while farms do not engage in direct international trade, their products are indirectly involved through intermediaries.

Regarding skills required in the workforce, there is a clear distinction between short-term, medium-term, and long-term needs. In the short term, employees are expected to have proficiency in operating machinery, responsibility, and an understanding of health and safety protocols. Medium-term requirements include communication skills, proficiency in English, and knowledge of basic agronomy. Looking toward the long-term, companies emphasized the importance of adaptability to seasonal changes, as well as digital literacy and the ability to work with new machinery and emerging technologies in the agriculture sector. Companies also highlighted a noticeable gap in essential skills, such as working under pressure, organizing tasks in fluctuating conditions, and utilizing advanced agricultural technologies, particularly in terms of new machinery and complex agricultural processes.

Training is an area of focus, with many companies providing internal training programs. These programs often center around machinery operation, farm management software, and precision farming techniques. For example, Agrocom mentioned the need for training in GIS (Geographical Information Systems), soil scanning, and precision agriculture technologies. Despite this, some companies reported a lack of practical training opportunities in the current educational system, leading them to focus more on internal training programs to fill this gap. Digital skills are also becoming increasingly important, as future employees will need to be proficient in tools such as spreadsheets and farm management software. However, there is a demand for more advanced skills, particularly in the use of automated systems for agriculture, livestock management, and environmental monitoring.

Soft skills such as teamwork, communication, problem-solving, and responsibility are regarded as essential. These qualities enable employees to effectively manage both the human and technological aspects of modern farming. Recruitment for agricultural roles generally happens locally, with companies relying on word of mouth, announcements, and Internet platforms. When it comes to training, many companies reported using internal resources or external suppliers, with a focus on hands-on, practical training. Companies such as TopFarms and Agrocom emphasize the importance of in-house, formal training programs to ensure that employees are well-prepared for the technical demands of their roles.

In the context of climate smart agriculture, some companies are already incorporating sustainable practices. TopFarms, for example, is leveraging precision farming technologies, such as GNSS (Global Navigation Satellite System)-based systems, for autonomous tractors and sprayers, and is optimizing livestock feed to reduce methane emissions. This aligns with the growing demand for incorporating climate smart strategies into agricultural operations. Companies recognize the need to train future employees in these advanced technologies, particularly those related to precision agriculture and the use of digital tools for managing crops and livestock. Training programs are expected to cover not only machinery operation but also the broader integration of technology into agricultural practices.

To meet these evolving needs, companies stress the importance of a multidisciplinary approach to education, combining agronomy, IT, and engineering knowledge to prepare employees for the technological demands of modern agriculture. There is also an emphasis on the development of practical skills, particularly in handling new machinery and digital tools. Soft skills, which are crucial for effective teamwork and problem-solving, are also considered essential. This holistic approach to education and training will ensure that future agricultural workers are prepared to navigate the technological and environmental challenges of modern farming.

Educational institutions

Wrocław University of Environmental Sciences (UPWr) besides its activity in research and higher education provides a wide range of courses and training, particularly in integrated crop production, plant protection advisory services, the use of plant protection products, and the testing of equipment designed for their application. In contrast, agricultural schools such as ZSCKU in Wojsławice and ZSCKR in Sędziejowice offer vocational and technical courses, including agricultural technician, agricultural mechanization and agrotechnology technician, nutrition and gastronomic services technician, as well as qualifying vocational courses for farmers, chefs, meat processors, confectioners, and beekeepers.

Regarding courses related to climate smart agriculture, both UPWr and the agricultural schools ZSCKU and ZSCKR currently do not offer specialized training in this area.

As for the qualification of courses, both UPWr and the agricultural schools ZSCKU and ZSCKR emphasize the need for proper professional qualifications. In the case of the vocational courses offered at the agricultural schools, these are typically validated by teachers in the schools or through commercial institutions. However, courses related to CSA do not yet have formal qualification frameworks or national/international standards in Poland.

Regarding admission requirements, at UPWr and in the agricultural schools ZSCKU and ZSCKR, the basic requirement for vocational courses is the completion of primary school.

The equipment used in the agricultural training courses at ZSCKU and ZSCKR includes tools and devices available at the schools, such as agricultural and horticultural sprayers, stations for testing sprayer uniformity, and equipment for testing machinery. However, no specific equipment for CSA courses is available, as such courses are not yet offered.

Regarding internal training programs, the agricultural schools design their training based on applicable laws and regulations concerning plant protection. Vocational courses in agricultural schools focus on relevant skills, objectives, work methods, and achievement evaluation. These courses end with an exam, which is conducted by an appointed committee.

In terms of course participants and success rates, both UPWr, ZSCKU and ZSCKR report varying group sizes. At the UPWr almost every participant successfully completes course. ZSCKU in Wojsławice typically enrolls 30-40 students in technical courses, with 25-35 students successfully completing them, indicating a completion rate of around 80-90%. ZSCKR in Sędziejowice reports that about 20-25 students start the courses, with 18-22 finishing them, reflecting a completion rate of approximately 72-88%. This data illustrates that while there are fluctuations in group size and completion rates, the agricultural schools generally report a relatively high success rate for course participants.

Regarding cooperation with companies, Wrocław University of Environmental Sciences (UPWr) currently does not report any specific collaboration with companies for internships. At ZSCKU, there is cooperation with the company Farmasz, while ZSCKR in Sędziejowice works with the company Bromex, which promotes herb cultivation. However, in relation to CSA courses, there is no current collaboration with companies, as there are no CSA-specific courses offered at the moment.

Policy makers

Among the respondents in the survey were representatives of local administration, including the head of the application service department at the Marshal's Office, mayors, village heads, and the deputy starost of the Zduńskowolski district. Their role in promoting climate-friendly agricultural policy was related to managing and implementing programs funded by the European Union and national funds, such as ARiMR (Agency for Restructuring and Modernization of Agriculture) and WFOŚiGW (Voivodeship Fund for Environmental Protection and Water Management). Local government representatives actively engaged in the protection of environmental resources such as water, soil, and air, implementing investments in renewable energy sources, including photovoltaic systems and biogas plants, and conducting educational activities in local communities on ecology.

The objectives of the climate-agriculture policies implemented in the region included rationalizing energy consumption, reducing CO2 emissions, improving the quality of the natural environment through the construction of home sewage treatment plants, implementing the "Clean Air" program, removing asbestos, and increasing energy efficiency through the creation of energy cooperatives and local renewable energy production. A key element of the policy was also addressing the effects of climate change, such as the construction of retention tanks and adaptation to drought.

These policies were implemented at various levels. Local governments introduced financial programs and organized informational meetings, supporting farmers in obtaining grants for pro-ecological investments. Municipalities carried out projects such as building biogas plants, photovoltaic installations, and creating water retention systems. The district, on the other hand, supported municipalities in their applications for ecological investments and promoted pro-ecological activities within local communities.

Despite progress in implementing climate-agriculture policies, several challenges and barriers were encountered. Respondents pointed out social resistance to some investments, such as biogas plants, as well as insufficient funding and unclear legal regulations, for example, regarding energy cooperatives. There was also a problem with low public awareness of climate change and the accessibility of modern technologies, which hindered effective implementation of the policy's objectives.

The success of the current climate-agriculture policies was measured by analyzing the interest of residents and local governments in ecological programs, the growth of local renewable energy production, and the improvement in air quality. Furthermore, increasing ecological awareness and reducing the carbon footprint in food production were important aspects of the evaluation.

Conclusions regarding the future of agriculture in the region point to the need for intensifying the education of future workers in the agricultural sector, focusing on technical skills such as operating biogas plants and renewable energy installations, as well as knowledge of climate change and its impact on agricultural production. Strengthening agricultural advisory services and supporting farmers in implementing CSA (Climate smart Agriculture) technologies is also essential. Moreover, social campaigns and educational fairs can contribute to raising local community awareness of the benefits of pro-ecological activities.

Knowledge institutions

The study conducted among representatives of higher education institutions and research institutes aimed to gather information about the role of these institutions in research on climate smart agriculture, with an emphasis on introducing farming practices in line with sustainable development principles in the context of climate change. The results indicate the growing importance of this research area and the activity in developing innovative solutions in various fields of agriculture.

Institutions such as the Warsaw University of Life Sciences (SGGW) and the University of Environmental and Life Sciences in Wrocław point to the increasing role of research in regenerative agriculture, biogas plants, and renewable energy sources. These studies aim to reduce the negative environmental impact of agricultural activities through the use of technologies that promote soil quality improvement and water resource management. Institutes like the European Regional Centre for Ecohydrology of the Polish Academy of Sciences focus on ecohydrology research and water management, which is particularly significant in the context of adapting agriculture to changing climatic conditions.

Among the main research objectives, reducing greenhouse gas emissions, improving soil quality, and increasing the efficiency of plant production stand out. In this context, biogas plants play an important role by enabling the use of organic waste for energy production, simultaneously reducing methane and other greenhouse gas emissions. The introduction of digestate from biogas plants as natural fertilizers aims to improve soil structure and reduce the need for chemical fertilizers, which in turn supports the sustainable development of agriculture.

Polish research institutions are also involved in the development of innovative technologies that can support farmers in transitioning to more ecological practices. An example of such actions is the LivingSoilLL project, which focuses on improving soil health in permanent crops such as vineyards, olive groves, and apple orchards. The project’s goal is to develop and implement soil management practices that will help prevent erosion and improve soil resistance to degradation. Additionally, the development of technologies supporting the monitoring of crop fertilizer needs, such as the use of satellite and hyperspectral data, aims to optimize fertilization and increase the efficiency of plant production while reducing the negative impact of excessive fertilizer use.

In conclusion, research on climate smart agriculture conducted by universities and research institutes shows great potential for technological innovations that can contribute to the sustainable development of agriculture. Special importance is given to studies on improving soil quality, reducing greenhouse gas emissions, and water management, which are key elements in the fight against climate change. Projects like LivingSoilLL and technologies supporting the monitoring of crop fertilizer needs are concrete examples of actions that can help farmers adapt to new climate challenges and carry out activities in a more sustainable manner.

Main findings and conclusion

The survey results highlight the diverse needs of agricultural companies, educational institutions, and policy makers in the context of Climate Smart Agriculture (CSA). Agricultural companies emphasize the importance of technical skills in machinery operation, digital skills, and adaptability to new technologies, while also noting the shortage of CSA-specific training in the current educational system. Educational institutions, including Wrocław University of Environmental Sciences and vocational schools, currently offer programs, with training primarily centered on traditional agricultural practices and only tangentially related to CSA. Policy makers are actively promoting eco-friendly agricultural policies but face challenges such as resistance to investments and insufficient funding. The conclusion stresses the need for enhanced education and training in climate smart agriculture, particularly focusing on technical, digital, and soft skills to prepare future workers for the evolving demands of the agricultural sector. Collaboration between education providers, businesses, and government is essential to foster a climate-resilient agricultural workforce.

Annex 2 – Denmark CoVE Regional Report

In the autumn of 2024, qualitative and quantitative data were collected across all European regions participating in the EVECSA project. The aim was to conduct both regional and cross-European resource and needs analyses. This document serves as the Danish contribution to this effort and is based on data collected in Denmark. The objective of this summary is to provide insights into the skills and competencies identified as necessary within climate-smart agriculture, as indicated by the Danish data collection. Additionally, the summary highlights regional trends shaping the understanding of climate-smart agriculture.

The summary is based partly on a questionnaire survey distributed to a range of stakeholders selected by the six Danish partners in the EVECSA project and partly on 10 semi-structured interviews. Among the respondents are experts in the agricultural sector, agro-business owners, educators and leaders in agricultural education, policymakers, representatives from interest organizations, and others. The questionnaire survey and interview guide were developed by the organization LAND in Italy and are used by all European partners in the EVECSA project. Consequently, this Danish summary will also form part of a comprehensive resource and needs analysis, which includes contributions from the other project partners.

Executive summary

A total of 37 responses were received from the questionnaire survey in the Danish CoVE. The respondents included representatives from agricultural schools, farmers, foundations, interest organizations, public authorities, agro-businesses, umbrella associations, and others. Additionally, 10 semi-structured interviews were conducted. The participants included a student, educational leaders, farmers, business owners, and experts.

Regarding the **questionnaire survey**, there is a strong interest in climate-smart agriculture among the respondents, who all have a certain level of experience with climate-smart practices. However, the responses indicate that the implementation of climate-smart practices is generally still at an early stage.

The respondents expressed a desire to collaborate more across the sector. The main barriers to increased collaboration are time, money, lack of knowledge, or lack of awareness about potential contacts.

The respondents highlight that the most important skills for students in climate-smart agriculture involve entrepreneurship, agricultural expertise and technological competencies.

Regarding the **semi-structured interviews**, the responses indicate a clear need for technological innovation, enhanced education, and political support to ensure an effective transition to climate-smart agriculture. The interviewees emphasize that climate-smart agriculture is an inevitable part of the future of farming and that farmers who engage in this development will have better opportunities to remain competitive.

The agricultural trends identified in the interviews point towards the following themes:

Regenerative agriculture, sustainable production and reductions of emissions, climate adaptation and resilience, and precision farming.

The agriculture of the future will require both technological innovation and a more holistic approach to resource production and management.

Analysis of the result - Online questionnaire

Climate Smart Agriculture vision

There are many different suggestions for a definition, but most align with the following: Agricultural production with high productivity and minimal climate impact, based on knowledge, methods, and technologise. This includes a focus on reducing greenhouse gas emissions, promoting biodiversity on and between cultivated areas, soil fertility and climate resilience.

Experiences in Climate Smart Agriculture

Nearly 70% of respondents indicate that they have a high or very high level of experience with climate-smart agriculture, while none report having no experience at all.

Educators' confidence in teaching climate-smart agriculture. Approximately 10% of educators feel very confident teaching climate-smart agriculture, while nearly 60% report a medium level of confidence on a scale from 1 to 5.

Teachers' motivation to teach climate-smart agriculture. Responses are divided, with about 50% feeling eager or very eager to teach climate-smart agriculture, while the remaining respondents are more hesitant.

Implementation of climate-smart agricultural practices in organizations. Several respondents indicate that climate-smart practices have been implemented, though most assess that they are still in an early phase.
The first steps are primarily reported within crop production, but there are also examples of initiatives in livestock and energy sectors.

Farmers' experience with climate-smart agriculture. Farmers and agro-businesses participating in the survey primarily have experience with climate-smart practices related to crops and livestock. The agro-businesses work on a wide range of solutions, including financing, biogas plants, artificial intelligence, and consultancy.

Challenges in implementing climate-smart agriculture. Respondents identify economic challenges as a significant barrier, as many climate-smart solutions involve high investment and operational costs. Additional challenges include a lack of documentation on climate effects, complex legislation, time and technical constraints, and limited access to research and support schemes.

Network of local contacts

Collaboration with vocational education institutions. Collaboration between the agricultural sector and vocational education institutions varies significantly. Some respondents report no collaboration, while others experience close partnerships, particularly in development projects and the implementation of new technologies. There is a desire for further collaboration, especially with schools specializing in robotics, IT, and the food sector.

Connections with agricultural companies and knowledge institutions. There is substantial collaboration between agricultural schools and agricultural businesses, ranging from farmers to knowledge institutions, advisory firms, slaughterhouses, feedstuff business, dairies, and providers of technologies and machinery.

There is a desire to work more closely with companies specializing in sustainable technologies and data and implementing these in agriculture. Additionally, there is interest in collaborating with farmers utilizing climate-smart solutions.

The main barriers to increased collaboration are time, funding, and a lack of knowledge about relevant contacts.

Approximately one-third of respondents indicate they have extensive contact with knowledge institutions, while around 40% report low to moderate levels of contact.

Collaboration spans a range of partners, including universities, SEGES, the Danish Technological Institute, business academies, and others.

Best practices and career in Climate Smart Agriculture

Respondents mention several examples of best practices in climate-smart agriculture, including precision fertilizer application and biogas production. Regenerative agriculture is a prominent trend, but these trends are only limitedly incorporated into education. The key skills for students regarding climate-smart agriculture include entrepreneurship, agricultural expertise, and competencies in sustainable agriculture and technology.

Overall, the responses suggest that:

- There is a lack of courses for professionals to update their knowledge on climate-smart agriculture.
- Vocationally trained individuals need to be made more aware of career opportunities in climate-smart agriculture.
- Students should be better equipped to adapt to climate-smart innovations in the agricultural industry.
- Curricula need to be adjusted to the knowledge and skills required.

Analysis of interviews

The ten interviews shed light on key themes within sustainability, climate-smart agriculture (CSA), and the necessary competencies in agriculture. The participants included a student, educational and school leaders, farmers, agro-business owners, and experts, who discussed practical challenges and political frameworks for climate-smart farming.

Skills and competencies in agriculture. The interviewees agreed that farmers and agricultural workers need both practical and interdisciplinary skills. In the short term, basic skills in agricultural work, machinery, and soil conditions are required. In the medium term, it is necessary to combine knowledge of biology, technology, and economics. In the long term, strategic management skills are essential, particularly to drive the green transition and ensure the sustainability of agriculture.

Challenges in implementing climate-smart agriculture. One of the biggest challenges pointed out by interviewees is the generational transition, as many farms lack a new generation of farmers. Additionally, there are political and market barriers, such as limited access to capital and support for young farmers.

Another challenge is the negative image of agriculture in society, which discourages young people from choosing farming as a career.

Sustainability in agriculture. All interviewees emphasized that sustainable solutions and CO2 reduction are central elements of the future of agriculture. For example, Arla actively works with technologies like FarmAhead™, which helps farmers reduce their CO2 footprint through systematic reporting and process optimization. Other actors, such as Danish Agriculture & Food Council and the Agricultural Education Council, support farmers in learning and implementing sustainable practices through education and knowledge sharing.

The role of technology in agriculture. Digitalization and technology play a crucial role in the green transition. It was pointed out that farmers need to understand and use IT systems and data to optimize production and reduce CO2 emissions. Future farming will require an understanding of technologies such as artificial intelligence and autonomous systems. This poses a challenge for both farmers and their employees, who must be ready to adopt technological tools.

Education and training in agriculture. The interviews indicate that the educational system plays a central role in preparing the next generation of farmers. There is a clear need to strengthen agricultural education so that it is better aligned with the sustainable demands and technological advancements that agriculture faces. Agricultural schools and internship programs must not only focus on technical skills but also on leadership, teamwork, and communication to develop a holistic approach to agricultural work.

Collaboration with stakeholders. Interviewees pointed out the importance of emphasizing collaboration between various stakeholders in the development of policies for climate-smart agriculture to succeed in the green transition. Employer and employee organizations, agricultural schools, and youth organizations must work closely together to ensure that farmers receive the necessary education and support. Collaboration at the EU level is also crucial for creating common frameworks and standards for sustainable agriculture.

Future agriculture. It was highlighted that future agriculture will be heavily influenced by technological innovations and sustainable production methods. There is growing interest in plant-based products and the circular economy, which could become an important part of the agricultural sector. To remain competitive, farmers must adapt to the new sustainability requirements that will continue to emerge.

Recruitment and retention of employees. To meet the demand for qualified labor, farms must focus on recruiting employees with both technical knowledge and personal maturity. It is important to create a positive work environment where employees feel engaged and have opportunities to develop their skills. One interview emphasized the need for agricultural schools to work more closely with farmers' associations to develop relevant continuing education courses and attract more participants. Another interview mentioned the need to look at recruiting new types of apprentices from urban areas, adult career changers, and international students.

Agricultural trends

Here are some of the key agricultural trends highlighted in the interviews.

Precision agriculture and technology: Advanced technologies such as sensors, drones, and AI are being used to optimize production and reduce environmental impact. Digitalization and automation are expected to play an even more significant role in the future.

Sustainable production and reductions of emissions: There is a focus on reducing emissions, circular economy practices, and green solutions such as afforestation, agroforestry, and promoting biodiversity.

Climate adaptation and resilience: Agriculture is facing climate challenges such as droughts, floods, and extreme weather, and there is growing recognition of the need to withstand climate change. This includes a focus on selecting resilient crops and adjusting cultivation methods.

Regenerative agricultural practices: A significant trend is the increasing interest in regenerative agriculture, which focuses on rebuilding soil health and biodiversity.

Summary of interviews

The interviews conducted provide a clear picture of the need for technological innovation, strengthened education, and political support to ensure an effective transition to climate-smart agriculture. The interviewees emphasize that climate-smart agriculture is an inevitable part of the future of farming, and that farmers who engage in this development will have better opportunities to remain competitive.

The agricultural trends in the interviews highlight the development of technologies and methods aimed at reducing environmental impact and increasing the sustainability of agriculture. Furthermore, future agriculture will require a more holistic approach to production and resource management.

Main findings and conclusion

Interest and experience with climate-smart agriculture:

- There is significant interest in climate-smart agriculture across respondents. Initial Stage: The implementation of climate-smart solutions still seems to be in an early phase.

Barriers and challenges:

- Economy and time: High costs, time constraints, and complex legislation hinder widespread implementation.
- Lack of knowledge: Limited access to documentation and research impedes progress.
- Generation transition: The lack of attraction for young farmers and the recruitment of qualified workers is a major challenge.

Competence needs and education:

- Necessary skills: Entrepreneurship, technological skills, and agricultural knowledge are crucial for future employees in agriculture.
- Curriculum adjustment: educational systems need strengthening with a focus on technology, sustainability, and leadership.
- Practical skills: Students need better preparation for the technological and green transition.

Role of technology:

- Digitalization: Digitalization and precision agriculture, including the use of AI, drones, and sensors, play a key role in future agriculture.
- Regenerative methods: There is a need to focus on regenerative methods like cover crops and reduced soil tillage.

Cross-sector collaboration:

- Great potential: The survey highlights significant potential for increased collaboration between agricultural colleges, research institutions, and agro-businesses.

Sustainability and future agriculture:

- Reductions and focus on biodiversity: The transition to a more climate-smart agricultural sector should focus on reductions in emissions, biodiversity, climate adaptation, and circular economy.
- Holistic approach: Future agriculture will require innovation in production, resource management, and the working environment.

Conclusions and recommendations

Technological innovation

The development and implementation of advanced technology are crucial for reducing the climate footprint and ensuring productivity. There is a need for future employees in agriculture to enhance their competencies in digital systems and tools.

Strengthened education

Educational institutions must be updated with courses and teaching focused on climate-smart agriculture. Key trends highlighted by respondents include:

- Regenerative agriculture
- Sustainable production and emission reduction
- Climate adaptation and resilience
- Precision agriculture

Network building

Establishing platforms for knowledge sharing and cross-sector collaboration can strengthen development in the sector.

Focus on recruitment

Initiatives should be launched to attract young people and career switchers to agriculture through positive storytelling and development opportunities.

Annex 3 – Central & Southern Ostrobothnia (Finland) CoVE Regional Report

Executive summary

What should we take into consideration while improving climate-smart agriculture in the future? Enhance collaboration across sectors: Strengthen partnerships between vocational education institutions, research bodies, agricultural businesses, and policymakers to bridge the gap between theoretical knowledge and practical applications. Foster regional and international collaboration to exchange best practices and innovations.

Focus on digital and technological integration:

Promote the use of advanced technologies such as artificial intelligence, automation, precision farming, and data analytics to optimize farming processes and improve resource efficiency.

Provide training for both students and professionals on digital tools and sustainable practices to align with evolving industry needs.

Address skill gaps in the workforce:

Focus on building entrepreneurial skills (creativity, critical thinking, and problem-solving) alongside traditional agricultural knowledge.

Develop soft skills such as communication, teamwork, and adaptability to meet the multidisciplinary demands of climate-smart agriculture.

Ensure education programs include hands-on training and practical demonstrations in collaboration with farms and businesses.

Invest in infrastructure and resources:

Modernize outdated infrastructure in vocational schools and agricultural organizations to better support innovative CSA practices. Increase financial support for regional and local initiatives, including the adoption of renewable energy systems like biochar and biogas reactors.

Align policies with practical implementation:

Develop policies that prioritize sustainability and align with farm-level realities, balancing food production goals with environmental responsibility.

Integrate CSA as a key focus in regional and national agricultural strategies, emphasizing practical, financially viable solutions.

Regional and local focus:

Encourage region-specific solutions like controlled drainage, renewable energy systems, and diverse crop rotations to address unique agricultural challenges.

Build strong local networks for knowledge-sharing and recruitment, ensuring alignment with community needs and sustainability goals.

Scale CSA education:

Expand CSA-focused curricula in vocational education, including dedicated courses on emerging technologies and sustainable practices.

Promote long-term strategies to make CSA education a standard component of agricultural training programs by 2025 and beyond.

In summary, improving climate-smart agriculture requires an integrated approach involving education, technology, policy, and local innovation. Focus on equipping the workforce with multidisciplinary skills and practical experience while leveraging digital tools and collaborative networks to address the challenges of sustainable agriculture effectively.

Analysis of Results - Online questionnaire

The survey received responses from a diverse group of 21 participants, including representatives of agricultural educational institutions, farmers, and agricultural businesses. Most respondents recognized the concept of climate-smart agriculture and emphasized sustainability, efficiency, and the use of technology.

The roles of the participants were distributed as follows:

Employees and farmers were prominent among the respondents.

The respondents' organizations were mainly located in Finland, in various municipalities such as Ilmajoki, Kokkola, and Helsinki.

Climate Smart Agriculture – our vision

The vision of climate-smart agriculture highlighted the following:

Sustainable agriculture that takes into account the impacts of climate change.

Efficient use of resources and energy efficiency.

Utilization of technologies such as artificial intelligence and automation in agricultural processes.

Emphasis on sustainable use of soil and water resources.

For example, the responses suggest that climate-smart agriculture is "sustainable farming that leverages innovations and considers environmental impacts."

Experiences with Climate Smart Agriculture

Participants' experiences with climate-smart agriculture varied:

Most rated their experience as moderate (3–4 on a scale of 1–5).

Many organizations already employ climate-smart farming practices, such as soil cover crops and water management.

Challenges include financial constraints and a lack of technological expertise.

Network of local contacts

Local networks play a significant role in sharing climate-smart practices. Many respondents mentioned collaboration with:

Local educational organizations.

Agricultural businesses, some of which focus on innovations in sustainable agriculture.

Networks are particularly prominent in regions where agriculture is a key livelihood.

Best practices and career in CSA

Based on the survey, the best climate-smart practices identified were:

Using artificial intelligence and data analytics to optimize farming processes.

Protecting soil through diverse crop rotations.

Technologies for water management that mitigate the effects of drought and flooding.

Collaboration between educational institutions and businesses to develop new innovations.

Additionally, the key skills identified for students included:

- Entrepreneurial skills (creativity and critical thinking).
- Sustainability expertise and technology management.
- Enhanced interpersonal skills (e.g., teamwork and communication).

A Deeper analysis of skills and skill gaps in climate-smart agriculture revealed that:

The most frequently highlighted skill was "Basic agricultural skills", indicating that fundamental knowledge and competencies in agricultural processes remain critical for starting a career.

Other notable skills included entrepreneurial abilities (creativity, problem-solving, and critical thinking) and sustainability management expertise.

Skill gaps:

"Entrepreneurial abilities" (creativity, critical thinking, and problem-solving) were the most commonly mentioned skill gap. This underscores the need to develop students' capacity for strategic thinking and applying innovative solutions in practice.

Other significant skill gaps included interpersonal skills, such as empathy and effective communication.

To conclude, there are the main current and future needs in CSA:

- Current Needs: Mastery of fundamental skills is still critical. Integrating technology and sustainability into practical farming is key to addressing immediate challenges.
- Future Needs: Curricula should place greater emphasis on developing entrepreneurial and collaborative skills to ensure graduates can adapt to the growing demands of climate-smart agriculture.

Analysis of the results - Semi structured interviews

Document Summaries from EVECSA Semi-Structured Interviews

NO 1. EVECSA WP2 Interview - Ala-Fossi MTY

Interviewee: Olli Fält

Organization: Ala-Fossi MTY (Dairy Farm)

Key Findings on CSA:

Limited focus on CSA-specific practices due to operational constraints.

Existing digital tools include livestock management and crop rotation software.

Workforce Availability and Skill Needs:

Recruitment primarily through local networks; most employees are students or new graduates.

Employees need communication skills, basic agricultural knowledge, and digital competency.

Regional Specifics: The farm's location aids recruitment due to accessibility.

Summary: Ala-Fossi MTY highlights the importance of multidisciplinary skills and strong onboarding practices to maintain workforce quality in a competitive market.

NO 2. EVECSA WP2 Interview - Vuoksi

Interviewee: Esko Lehtimäki

Organization: Suupohja Education and Employment Consortium (Vuoksi)

Key Findings on CSA:

Limited formal CSA education but practical initiatives, such as precision farming and water management, are in place.

Collaboration with ProAgria and Seinäjoki University strengthens efforts.

Workforce Availability and Skill Needs:

Graduates often become self-employed or work in farming; higher education is an alternative.

Practical skills and adaptation to CSA practices are emphasized.

Regional Specifics: Use of controlled drainage and renewable energy (solar panels, wood chips) aligns with regional sustainability goals.

Summary: Vuoksi demonstrates incremental steps toward integrating CSA into vocational training, with a focus on sustainable practices and collaboration.

NO 3. EVECSA Interview - Sasky

Interviewee: Erkki Kemppi

Organization: Sasky Vocational Education and Training Consortium

Key Findings on CSA:

CSA efforts are at an early stage, with some experimentation (e.g., biochar, solar panels).

Energy efficiency and local self-sufficiency are priorities.

Workforce Availability and Skill Needs:

Low dropout rates suggest strong student engagement.

Limited resources and outdated infrastructure are barriers to skill development.

Regional Specifics: Biochar and cooperation with Satakunta University highlight region-specific innovation.

Summary: Sasky underscores the importance of financial investment and collaboration to advance CSA practices and integrate them into vocational education.

NO 4. EVECSA WP2 Interview - MTK Keski-Pohjanmaa

Interviewee: Niko Hyppönen

Organization: MTK Keski-Pohjanmaa, farmer’s union

Key Findings on CSA:

Emphasizes precision farming, automation, and data utilization.

CSA's alignment with food production efficiency is critical for acceptance.

Workforce Availability and Skill Needs:

Strong emphasis on digital skills and understanding of sustainable practices.

Need for leadership and multidisciplinary approaches.

Regional Specifics: Focus on leveraging Finland's forestry and agricultural resources sustainably.

Summary: MTK promotes digital transformation and precision farming while highlighting CSA's role in balancing productivity and environmental responsibility.

NO 5. EVECSA Interview - Pohjolan Maito (Valio)

Interviewee: Marko Puhto

Organization: Pohjolan Maito Cooperative (Valio, Finland’s biggest dairy company)

Key Findings on CSA:

Monitored climate impact through advanced data systems.

CSA focuses on balancing productivity with environmental responsibility.

Workforce Availability and Skill Needs:

Strong internal training on digital tools and workflows.

Workforce longevity reflects effective employee engagement.

Regional Specifics: Operates as part of Valio, which integrates advanced CSA practices into its operations.

Summary: Pohjolan Maito highlights the role of cooperatives in advancing CSA, leveraging data and technology while retaining a skilled workforce.

NO 6. EVECSA WP2 Interview - Loue Unit (Lappia Vocational School)

Interviewee: Petri Muje

Organization: Lappia Vocational School (Loue Unit)

Key Findings on CSA:

Plans to launch a dedicated CSA course in 2025.

Existing practices include composting and biogas reactors, aligning with regional sustainability goals.

Workforce Availability and Skill Needs:

CSA integrated as a cross-cutting theme during practical training.

Focus on practical competence demonstrations in partnerships with farms.

Regional Specifics: The school emphasizes energy-efficient farming practices and aims to formalize CSA education.

Summary: Loue leads in integrating CSA into education, with upcoming initiatives designed to formalize training and promote regional sustainability.

NO 7. EVECSA WP2 Interview - Antti Kangas

Interviewee: Antti Kangas

Organization: Member of Finnish Parliament, Agriculture and Forestry Committee

Key Findings on Climate Smart Agriculture (CSA):

Current policies focus more on food safety and security than directly addressing climate change.

Biogas and support for farm-level actions could significantly improve CSA.

Research and policy lack practical integration, hindering effective implementation.

Workforce Availability and Skill Needs:

Challenges include a disconnect between research and practical farming needs.

CSA policies should consider efficiency and real-life application.

Regional Specifics: Finland prioritizes climate-focused agriculture but struggles to balance efficiency with sustainability.

Summary: Strong policy advocacy for practical and financially viable CSA measures is needed, with an emphasis on integrating research into everyday farming practices.

Combined summary:

Across all interviews, CSA is recognized as a critical area for development. However, the adoption of CSA practices is hindered by limited funding, outdated infrastructure, and a gap between research and practical implementation. Vocational institutions and companies alike emphasize the need for advanced digital tools, multidisciplinary skills, and practical training. Regional initiatives, such as biochar experimentation and biogas use, illustrate the potential for local innovation. Collaboration among stakeholders is essential to scale CSA education and implementation effectively.

Main Findings and conclusion

Climate-Smart Agriculture (CSA) is increasingly recognized as essential for achieving sustainable agricultural practices in the face of climate change. The findings highlight several critical areas of focus to advance CSA in education, industry, and policy. These insights underline the importance of collaboration, innovation, and targeted skill development to address current gaps and meet future needs.

Key Findings:

Collaboration Is Crucial:

Effective CSA implementation relies on stronger ties between education, research, and industry. Collaborative networks are essential for sharing best practices and integrating new technologies into everyday farming.

Technology and Digital Tools Are Game-Changers:

Technologies such as artificial intelligence, automation, and precision farming tools play a pivotal role in optimizing farming processes and improving resource efficiency. However, access to digital tools and training remains a challenge for many.

Skill Development Is a Priority:

Current skill gaps, particularly in entrepreneurial thinking, critical problem-solving, and communication, must be addressed through updated curricula and practical training programs.

Soft skills such as teamwork and adaptability are becoming as critical as technical expertise in modern agricultural environments.

Local and Regional Innovation Matters:

Region-specific solutions, like biogas reactors, biochar, and water management technologies, demonstrate the potential for localized innovation. These practices should be scaled and adapted to other regions.

Infrastructure and Funding Are Barriers:

Limited funding and outdated infrastructure in vocational institutions and agricultural organizations hinder the widespread adoption of CSA practices.

Policy Needs Practical Integration:

Current policies focus on high-level sustainability goals but lack alignment with farm-level realities. Practical, cost-effective measures are needed to balance productivity with environmental responsibility.

To accelerate the transition to climate-smart agriculture, a multifaceted approach is required:

- **Integrate CSA into vocational education**: Expand dedicated CSA courses and emphasize hands-on, practical training in collaboration with farms and industry.
- **Foster innovation and technology adoption**: Increase access to digital tools and promote their use across all levels of agricultural practice.
- **Build resilient networks**: Enhance collaboration between stakeholders to create unified strategies for sustainable farming practices.
- **Support regional solutions**: Encourage and fund region-specific innovations to address unique challenges and scale effective practices nationally and internationally.
- **Align policies with practice**: Develop actionable policies that prioritize real-world implementation and financial feasibility for farmers and organizations.

By addressing these interconnected priorities, stakeholders can ensure that climate-smart agriculture becomes a cornerstone of sustainable development, enabling the agricultural sector to thrive in a rapidly changing world.

Annex 4 – Sicily (Italy) CoVE Regional Report

Executive Summary

The present document has the objective of presenting the results of the research conducted in the Sicilian territory within the EVECSA project. The survey analysed aims at identifying the needs and map the resources within the agri-food skills ecosystem, engaging different actors operating in the Climate Smart Agriculture ('CSA') panorama. In the first section, more detailed information on the project background is given, with a specific focus on why this research has been carried out and which methodology has been followed. In the following section, the main findings are presented focusing on three different spheres: Climate Smart Agriculture vision, experiences related to CSA and existing network of regional contacts. Lastly, an indepth analysis of the semi-structured interviews conducted within the project will be presented, targeting Agro-Companies experts, Policy maker expert and Knowledge institutions and Research centrer experts.

Analysis of the results - Online Questionnaire

Climate Smart Agriculture vision

The first set of questions wanted to investigate the meaning and significance of Climate Smart Agriculture according to the respondents, to comprehend how much this vision at local and regional level fits with the definition brought by the international organizations and fora. According to the Food and Agriculture Organization (FAO), Climate Smart Agriculture approach has three pillars: Sustainably increase agricultural productivity and incomes, adapt and build resilience of people and food systems to climate change and reduce and/or remove greenhouse gas emissions, where possible. The most recurring key words in the definitions we received revolves around: adaptability to climate change, technology (AI, Agriculture 4.0), food security. Some of the respondents also mentioned other valuable aspects as the ecosystem regeneration and the policy and investments sphere. Most of the definitions partially overlap with official definitions even if no specific references to a higher level of agricultural production and income have been noticed.

Experiences in Climate Smart Agriculture

As far as professional experiences in Climate Smart Agriculture are concerned, we asked personalized questions to the four groups of stakeholders. We focus on CSA practices they already implement locally, the type of education and courses offered on the specific subject and CSA initiatives and policy they supported during their daily work. In the next sub-paragraph, we collected the main results per target group.

Agro-VET Institutions

Almost the total number of respondents pertaining to this category affirmed to provide training in the field of agri-food, but not specific courses on CSA (e.g. agritech, training for companies on green transition, circular economy and inno-vation, training to obtain qualifications in the catalogue of the Sicily region). The majority of teachers do not feel confident teaching projects/courses using Climate Smart Agriculture (2-3 on a scale of 5), but if properly trained, are in-clined to. Moreover, the majority of the VET institutions do not implement CSA practices in their own institutions.

Universities and Research Centers

Among the 5 respondents, the main areas considered in their research focus and CSA practices in place in the Sicilian territory focus on water management, crop production, energy, drought management and fish and aquaculture. Among the existing practices mentioned, we found agroforestry, agrivoltaics systems, precision agriculture, disease management, carbon management practic-es and use of soil sensors and drones. All the respondents also report their willingness to open up to different CSA practices in the future. Some more related to technological performance as the use of smart devices for the study of abiotic stresses in plants or platform for optimizing crop choices in cereal farming in arid or desertification-prone envi-ronments. Some other respondents seemed more inclined to traditionally-oriented practices, as silvo-pastoral systems. Some of the respondents already provide courses on CSA. In particular, per-maculture and regenerative agriculture, Master's Degree in Precision Agriculture and integrated water resources management.

Farmers and Agro-companies

The main area of interest and expertise for this category is crop production and drought management.

CSA practices already in place are the following:

1. Use of biodegradable material and organic in nature so as to minimize the use of plastic or d other non-degradable material;

2. Agronomic management supported by DSS Decision Support Systems through a dense network of weather stations so as to have rational and sustainable crop management;

3. Aridoculture, an agricultural practice that focuses on growing crops in arid or semi-arid areas where water resources are limited. This technique is based on the use of efficient irrigation systems and the selection of plants that are resistant to drought and high temperatures. The goal of aridocul- ture is to produce under harsh environmental conditions while reducing the consumption of water and other inputs.

4. Biological production

The decision on which kind of CSA practices they implement is mainly based on climatic and meteorological conditions, knowledge and economic possibili-ties.

The main challenges this target group reported is to adapt technologies to soils that are not always easy to work, financial problems and lack of knowledge.

Policy Makers

CSA policies in Sicily are based first of all on national and EU Agendas (mainly Common Agricultural Policy, 'CAP'). According to our respondent, sustain CSA practices at the regional level mainly consists in promoting calls to minimizing environmental impacts. Specifically, the Sicily region has, in CAP 2014/2022 program, declined CSA principles by including specific measures and scores for companies that commit to being environmentally neutral. Given the centralization of CAP at the national level, the Ministry is the con-trolling and managing authority, and regional mediation is limited only to activat-ing or not activating certain measures of the National Strategic Plan. Nevertheless, there are some best practices and local plans concerning CSA that are currently taking place in Sicily:

• Collaborative pacts for the creation of commercial spaces already in the same area, so that local products are also consumed. An example is heroic agriculture, i.e., production in really inaccessible and often disadvantaged inland areas, on land with steep slopes and with an almost total absence of mechanization. Collaborative pacts lead to a reduction in environmental impact, also related to transportation (Km0 production).

• Forms of marketing that are consortia, with coordination among producers so that prices are profitable and respectful of labor and the environment. A local example can be identified in cereal companies in the areas of Madonie: economic and social problems for farmers arises due to production expenses that exceeded revenues on organic (traders did not pay more than a tot for farmers' production. The cost of wheat corresponds to 18 cents/kg while production expenses 26/kg). Wheat has now become a commodity in global supply chains and is hardly valued as an agricultural product., Organic wheat producers (Cooperativa Probiosi) unite by skip-ping commercial steps, contact a nationwide pasta maker directly, forging trade agreements that allowed them to pay farmers more for wheat, up to 84 cents/kg.

- School canteens and school food policies. Stipulating contracts between municipality and producers.

Network of local contacts

In the last section of the Questionnaire, respondents were asked to rate their en-gagement with other regional stakeholders working in the field of CSA in order to measure the level of interconnectedness between Agro-Companies, VET Institu-tions and Universities and Reseach Centres in Sicily. Most of the respondents (35,7%) declared to have a medium level of engage-ment with Agro-companies (3 on a scale from 1 to 5), 28,6% have a good network with Agro-companies (4 on a scale from 1 to 5) and 21,5% have an excellent en-gagement with Companies (5 on a scale from 1 to 5). The same picture appears concerning local contacts with Agro-VET institu-tions. The majority of the respondents have a medium level of connection with these institutions, but some other declared not to have contacts at all (14,2%). Contrarily, the picture concerning local contact with Universities and Re-search Centers is more blurred: 21,4% and 28.6% respectively stated to have a medium and good level of engagement with them, also a 21,4% declared to have minimum level of engagement with Universities and Research. Generally speaking, the respondents identified some networking challenges in the sphere of CSA actors. First, there is no existing technical panel or platform that connects the different realities (lack of communication between the entities). Second, some actors, as companies, might be reluctant to collaborate and have little knowledge of what the benefits of European projects can be. Third, a gen-eral lack of expertise and knowledge in the field, economic resources and availa-ble staff. Some of the respondents also identify future opportunities: promoting cooper-ation with concrete projects – also concluding agreements between the parts – that meet real needs of enterprises and institutions, creating network to improve educational offer and implement workshops bringing together different farmers and sharing best practices.

Best practices and career in Climate Smart Agriculture

Various agro-companies demonstrate innovative approaches to sustainable farming. The Circle, a company specializing in aquaponics, integrates fish farming with soilless plant cultivation to address water scarcity and land limitations. Libera Terra Mediterraneo, a consortium managing land reclaimed from the mafia, prioritizes organic farming, crop rotation, and satellite-guided precision agriculture. I-Green

Systems focuses on agrivoltaic solutions that balance agricultural and solar energy production, while ALIVE Permacultura applies permaculture principles to reconnect urban life with agriculture. Their experimentation with agroforestry promotes biodiversity, diversified harvests, and sustainable land management. Across all regions, there is a strong push toward climate-smart agriculture, yet challenges remain in education, sharing of knowledge, and practical implementation. Addressing these gaps through improved training, mobility programs, and industry collaboration will be key to ensuring long term sustainability and resilience in agricultural practices.

Analysis of the results - Semi structured interviews

Agro-Companies

Various types of companies and organizations were interviewed, revealing both shared and unique needs among them.

The Circle is a small, innovative company with a focus on sustainable, soilless agriculture through aquaponics, founded in 2007 by four co-founders with PhDs in industrial biotechnology and economics. This technology, identified by the founders as a key solution to water scarcity and limited land availability, integrates ornamental fish farming with soilless plant cultivation systems, such as aeroponics and hydroponics. Waste from freshwater fish, which normally poses a challenge in aquaculture, is transformed into a valuable nutrient source for plants through microorganisms, embracing a natural cycle that eliminates waste. Following this principle, The Circle has developed a microalgae system through grant support and integrates controlled water monitoring and distribution in its vertical farming systems. They intentionally avoid focusing on low-cost crop production, as they consider this an unsustainable model.

Libera Terra Mediterraneo is a consortium of nine social cooperatives managing lands confiscated from the mafia in Italy. These cooperatives promote sustainable agricultural practices and adhere to principles of social equity and environmental responsibility. Key practices include crop rotation, organic farming, use of biodegradable materials, and soil-friendly techniques like no-till farming and aridoculture, particularly suited to water-scarce regions. The consortium implements innovative methods, including satellite-guided tractors, biodegradable mulching, and Decision Support Systems (DSS) informed by meteorological data to optimize crop management.

I-Green Systems, an agro-company born in 2023, is the result of merging two companies - Ecoenergia (with a focus on energy production) and RomagnaImpianti (with a more agricultural focus). Four partners combine skills to establish a new company for agrivoltaic system development. Agrivoltaic systems combine the two productions, favoring agronomic and agricultural aspects even at the expense of electrical production (through solar panels).

ALIVE Permacultura is a Social Promotion Association (APS) that was founded in the family olive grove, where permaculture principles are applied. The project aims to reconnect urban life with agriculture, promoting community development. An important aspect for them is to anchor the project in the local territory. They manage the soil and trees respectfully, treating them as a system, since their vision is to see everything as part of an interconnected whole, where each element performs multiple functions. Currently they are experimenting agroforestry in the section of the citrus grove that was affected by a fire. Agroforestry allows to shift from monoculture to polyculture, with shrub and tree species that serve multiple functions: increasing biodiversity, ensuring harvests at different times of the year, and using species not only for fruit but also fast-growing plants for mulching the soil.

Trends

Several key trends are emerging in the sector. Firstly, there is an increasing necessity for active collaboration between public and private entities to establish robust and effective networks. Furthermore, there is a growing focus on research into advanced technologies, with particular attention to adopting soil-friendly techniques and promoting sustainable agriculture. Organizations are also placing greater emphasis on leveraging available opportunities and optimizing production processes to address water scarcity. Lastly, the integration of artificial intelligence throughout the design and production cycle is becoming more prevalent.

Companies already implement sustinable good practices such as: hydroponics, aridoculture, Decision Support Systems (DSS), agrivoltaic systems, permaculture principles, agroforestry.

Needs

To address current challenges, several specific needs have been identified. These include the installation of soil monitoring stations to enhance sustainability and the development of sector-specific training programs. These programs should also include the cultivation of transversal skills, such as English language proficiency, familiarity with new technologies, financial literacy, agroeconomy, and management capabilities. But also, soil, plants, facilitation, non-violent communication. Additionally, ensuring adequate access to funding is crucial for experimenting with and implementing innovative practices.

Gaps

Despite the progress being made, certain gaps continue to hinder the sector's development. Chief among these are limited access to funding and advanced technologies, as well as a lack of public awareness regarding the benefits and potential of new technologies. Furthermore, high investment requirements pose a significant challenge to effectively addressing rising costs.

Knowledge Institutions

Massimo Ferro is a researcher from the University of Palermo Department of Agricultural, Food and Forestry science. His research grant focuses on the study of Mediterranean crops (viticulture) and the application of sensors. In particular,his work concerns optimization of agricultural inputs through assessment and monitoring, and mineral and water nutrition of crops. In addition, he focuses on agronomic models using big data (climate, crop agronomy) for predictive models. The impact of the research being conducted is measured by evaluating the response of crops to treatments (yield, vegetative growth, animal welfare) and by measuring the reduction of the impact of agricultural activities (soil welfare-organic matter content, water retention, gas exchange)

Giovanni Dara Guccione from CREA (Council for Agricultural Research and Economics) : highlithed that agroecology supports ecological practices that strengthen the connections between farms and rural communities. Sicily's adoption of organic farming practices has already reached 30%, signaling a readiness for agroecological approaches that draw from academic research while prioritizing reduced external inputs and promoting self-sufficiency in farming systems. This model only allows synthetic chemicals when strictly necessary, and further incorporates 4.0 technologies—such as drones and water-saving systems—to enhance sustainable practices.

CREA plays an instrumental role in advancing AKIS (Agricultural Knowledge and Innovation Systems) in Sicily by supporting regional agricultural innovation and offering technical assistance related to the new Common Agricultural Policy (CAP).

Massimiliano Pasqui, a physicist and climatologist at Italy's National Research Council (CNR), Istituto per la BioEconomia ex Istituto di Bio Meteorologia (CNR-IBIMET), specializes in meteorology and climate models applied to agriculture. He focuses on bridging climate information with decision-making in agriculture. His work involves climate communication and training through the Regional Training Center (RTC), part of the World Meteorological Organization, where he oversees technical training for meteorologists in Europe and Africa.

Trends

Research centers have identified several key trends shaping the sector.

- There is often a tendency to use technologies as an instant defense mechanism but without deep knowledge it can be a non-essential tool

- Use of technology for farmer association (not a single farmer) In order to become economically viable

- Increased digitization in agriculture, ensuring a good web connection in rural areas, used more as a support than a real alternative to existing agricultural practices. Indeed, the social fabric of Sicily, consisting mainly of small-scale producers and diversified farms, would not allow for changes or introductions of repetitive or blanket technologies as in other economies.

A strong emphasis is being placed on fostering partnerships and promoting knowledge sharing among actors within the field. There is also a clear preference for natural growth methods that avoid the use of chemicals, reflecting a shift toward more sustainable practices. Additionally, the development of water-saving systems is gaining traction as a critical priority. Investments in advanced technologies are also increasing, signaling a commitment to innovation and modernization.

Needs

The needs of research centers are closely aligned with these emerging trends. There is a growing demand for training programs focused on new technologies to enhance efficiency and productivity and accessible education for both young students and farmers, offering them locally relevant content that helps interpret the environmental challenges they face. Another pressing need is the ability to effectively manage uncertainties related to climate change. Research centers also seek greater utilization of technology and sensors for quality monitoring and improved processes.

Furthermore, the involvement of larger companies is seen as essential to scaling efforts, while research and development in resilient crops remain a priority. Enhanced collaboration among field experts is also identified as a crucial step toward driving innovation and addressing complex challenges.

Gaps

Despite the positive trajectory of growing investments, several gaps persist within the sector. One major issue is the lack of innovative and relevant training programs, which hinders progress. Additionally, there is insufficient knowledge about new technologies, coupled with limited public awareness of the climate crisis and its implications. Cultural resistance to adopting new methods and technologies further complicates efforts to drive change. Digitalization remains a challenge, particularly in regions like Sicily, where infrastructure and accessibility issues persist. Finally, inadequate funding and a shortage of specialized professionals continue to constrain the sector's growth and potential.

Policy Makers

Dario Costanzo, president of the GAL (Local Action Group) of the Madonie, has nearly 30 years of experience in local development policies and over 15 years in the LEADER approach. An agronomist by training, he has worked in various fields, including vocational education and training (VET), guidance, consulting, as well as territorial planning and programming. He has also been involved in designing and implementing innovative systems for agro-food production and water and energy saving.

Trends

At the international level, European and global policies, such as the Green Deal and the Agenda 2030 goals, promote frameworks that encourage energy and water savings while fostering economic, social, and environmental sustainability. These frameworks are implemented through programs, measures, and sub-measures that prioritize financial contributions to more sustainable systems. In Sicily, for example, projects based on the collection of climatic and environmental data have guided farmers toward adopting smart technologies.

Needs

To turn these principles into tangible actions, it is essential to act locally, engaging citizens, farmers, and livestock breeders in collaborative agreements. The goal is to create commercial spaces within the territory itself, thereby encouraging the consumption of local products. A notable example is "heroic agriculture," practiced in challenging areas with steep slopes and minimal mechanization. This approach reduces the environmental impact associated with transportation and supports zero-kilometer production. To ensure economic sustainability, it is necessary to develop cooperative marketing models that coordinate producers to achieve fair prices that respect labor and the environment.

Gaps

In the Madonie, the economic challenges faced by farmers are particularly significant. In the cereal sector. This situation led some farmers to form cooperatives that eliminated intermediaries. A crucial element is the educational process aimed at raising environmental and climate awareness. Initiatives like Slow Food serve as exemplary models of awareness-raising, yet the transition from awareness to political action remains complex. Policies often fail to fully translate scientific research findings into concrete actions, as political priorities—focused on immediate consensus—clash with the longer timelines required for systemic changes such as those related to climate policies. This disconnect between science and politics reflects a lack of representation and highlights the difficulty of reconciling sustainability goals with the pressures of short-term political consensus.

Main findings and conclusion

The agro-sector is undergoing significant transformation driven by innovation, collaboration, and the pursuit of sustainability. Key actors, including companies, research institutions, and policymakers, are making strides toward addressing critical challenges such as water scarcity, climate change, and the need for sustainable practices. Shared trends, such as the adoption of advanced technologies, natural growth methods, and water-saving systems, reflect a collective commitment to environmental and economic resilience.

Despite progress, several persistent gaps hinder the sector's full potential. These include limited funding, insufficient training programs, and cultural resistance to new practices. Additionally, the disconnect between scientific research and policy implementation remains a critical issue, particularly in regions like Sicily, where digitalization and infrastructure challenges compound the difficulty of systemic change.

To move forward effectively, it is essential to strengthen collaboration between public and private stakeholders, expand access to education and training, and align local initiatives with international frameworks like the Green Deal and Agenda 2030. By fostering innovation, enhancing public awareness, and bridging the gap between science and policy, the sector can create a sustainable, impact for the future of agricolture.

Annex 5 – Catalonia (Spain) Regional Report

Executive Summary

This document provides both quantitative and qualitative data collected between late 2024 and early 2025 in Catalonia in relation to the EVECSA project, which aims to train current and future professionals of the agricultural sector in climate-smart agriculture (CSA) practices. The data focuses on exploring the sector's needs from the perspectives of production, training, and innovation, which will help CoVE Catalonia define the basis of its activities and strategic directions within the project.

A total of 12 surveys and 7 semi-structured interviews were conducted to agents related to agriculture, livestock farming and forestry fields with a view in CSA. It is important to note that the collected data reflects the perspective of these participants and does not represent the entire population.

Along with the results from the other 5 countries participating in the project, key needs and cross-cutting concerns will be identified and shared, fostering a collaborative exchange of insights that will enhance the proposals from all regions involved.

Analysis of the results - Online Questionnaire

Climate Smart Agriculture vision

The degree of involvement of the agents participating the surveys with the CSA is high, except for the 2 political organizations that are not specifically focused on the field (although the representatives who answered do have a link and interest).

Regarding the conception of all of them of what CSA is, they are generally aligned, and it can be summarized as one that adapts agricultural practices to improve productivity, increase climate resilience, reduce emissions and respect natural cycles, taking advantage of local resources and considering the consequences of the activity in the long term to ensure the sustainability of future generations.

Experiences in Climate Smart Agriculture

The three agroVETs offer training courses and continuing education: one of them is focused on new technologies and horticulture, another on viticulture and oenology and one on organic agriculture, and all the materials they offer are focused on CSA. The teachers in these schools are half-confident in matters related to CSA, and in turn are

100% motivated. The practices implemented in these institutions are essentially based on rainwater harvesting techniques and drought-resistant pots, the use of vegetative cover and permanent cover to minimize erosion, the planting of local and late-ripening varieties, and organic fertilizers.

Referring to knowledge institutions, although they both work on CSA from different perspectives, they coincide in terms of specialization in plant production and water management. From l'Era they focus their practices especially in living soil horticulture, as well as accompanying in the transition to direct seeding in extensive dry plantations with accompanying crops. As for the Beta center, they work in more diversified areas such as mixed and regenerative agriculture, silvopasture and agroforestry, renewable energies, nutrient management and emissions reduction, among others. Both centers would like to start working with CSA practices such as the management of cover crops in woody crops and precision fertilization and irrigation.

The farmers and agrocompanies that have participated work in various areas of the CSA, but the main ones are plant production and forestry, as well as the common management of water and drought. They do this through practices that offer an added value to their products, whether they are local products, ecological, to make forests more resilient.... Some of them are the mixed and permanent pasture in dry areas as a substitute to tillage, direct seeding, mulching to promote soil microbiology, cultivation of ancient and climate-adapted plants, extensive livestock farming, forestry adapted to more resilient forests and efficient irrigation systems. Each farmer values the implementation of these practices according to their own experience over the years and the forecasts of factors such as rainfall, although factors such as competition from conventional industry, lack of machinery and knowledge, dry conditions and the uncertainty of economic viability added to the lack of funding make it even more difficult.

Network of local contacts

Relationships between the Catalonian survey participants were valued by a rate of around 4/5 regarding to agroVETs as well as knowledge institutions, and of 3,25/5 regarding agricultural organizations.

Cooperations with vocational education organisations

All the participants state that they have established relationships with agroVETs in Catalonia to develop projects in the present or in the past, and that they are open to reconnect with them again to build proposals that respond to the needs of the sector. So far, they have collaborated especially on student and professional internships and innovation and development projects, and would like to put special focus on the definition of training programs, the implementation of existing CSA technologies and the context analysis for the development of new CSA technologies, which focuses future collaborations on innovation and the importance of adopting more resilient measures to face the climate scenario.

Although some participants believe that there are no obstacles to this type of collaboration and that they are completely open to it, most of them say that the lack of human, time and financial resources are decisive limiting factors. In order to solve this situation, there are several ways to do so, such as organizing awareness-raising activities (for example, the implementation of this survey) and increasing European projects on the field to be able to access to resources and expand knowledge through international networking. It is necessary to involve producers with tailored training and to establish stable collaborations between public and private organizations, organized and financed, with a teamwork approach for the common goal of CSA in the sector. Finally, they emphasize that the limiting factor of time can be solved simply by prioritizing resources from each organism, just for the importance these relations have to impact and keep the agricultural sector alive.

Cooperations with agricultural organisations

Regarding the collaboration fields of the different agents with agricultural organizations vary according to their specialization in the agricultural sector. Most of them are private entities or cooperatives in the wine or agro-ecological sector (livestock and extensive agriculture), and the interest in establishing new relationships is based mainly on the motivation of these companies to enter into new projects. However, several agents have emphasized the interest in establishing relationships with agrocompanies in relation with climate-adapted seed production. They emphasize that current collaborations are based mainly on innovation and development projects as well as on the implementation of existing CSA technologies, and that they would like to continue in this line but adding as well context analysis for the development of new CSA technologies and student and professional internships.

The main elements that hinder the relationship between participants and agricultural organizations are the lack of network between the agents, technical personnel and projects focused on CSA, as well as the ones that outstand in the case of relationships with agroVETs: lack of time and funding. In addition to perseverance, one of the key factors that would increase this kind of relationships would be to achieve a higher recognition of the sector, socially and economically speaking, in order to increase the number of agrocompanies that redirect it towards the current needs of the environment (i.e., towards CSA).

Cooperations with agricultural knowledge institutions

The main knowledge institutions that establish links with the participant agents are technological and innovation institutes specialized in the agricultural (IRTA, Eurecat, Beta), forestry (CTFC) and in a lower measure in the wine sector (Incavi, Innovi, Vitec). Several universities are usually involved as well (UB, URV, Uvic and UAB), as well as public knowledge networks such as Xarxa de llavors (seed bank network). Motivations for future collaborations are especially directed to the technological and innovation institutes mentioned above, although some of them are focused on promoting relationships with agroVETs to enable the application of this knowledge. So far, collaborations have generally been based on student and professional internships as well as on innovation and development projects. The vision for the future is to maintain them and implement existing CSA technologies and context analysis for the development of new CSA technologies as well, in concordance with the defined willingness lines to collaborate with agroVETs and agricultural organizations.

Referring to the factors that hinder this kind of collaborations, there is also agreement with those described for relationships with agroVETs and agricultural organizations, being the lack of time, human resources and funding the key factors. In order to improve it, they believe that it is necessary to invest in R&D&i in the agricultural sector, specifically in the field of ecological practices, and that stablishing long-lasting relationship networks is a priority as well.

Best practices and career in climate smart agriculture

Although most of the participants rated being informed about good practices in CSA with a score of 4/5, the average of application in formation means is around 3.25/5. The main known practices in agroecology are polycultures and cultivation of specific varieties, temporary and permanent cover crops, direct seeding, mulching (straw, BRF...), rotational grazing and, although in a very early stage, agroforestry. At the digital level, sensorisation, intelligent irrigation management (digital control, spectral images, etc.) and technified greenhouses have been highlighted.

Regarding the best practices in climate-smart farming education and training, the participants consider that the most successful aspects are a good training offer in relation to CSA and the continuous professional development of teachers, and those that are less well received are innovative forms of collaboration with the labour market, the attractiveness of the sector for new and current learners, and the mobility of students and teachers as well as internationalization strategies in agricultural vocational training. These factors lead us to conclude that it is necessary to promote the transfer of knowledge to the practical field and to build strong networks among agents.

The most relevant CSA trends detected in Catalonia are regenerative agriculture, improved water management technologies and integrated soil fertility management practices, followed by agroforestry, precision farming techniques and cultivation of climate-resistant varieties. It should be noted, however, that the evaluation regarding the implementation of these trends in the training area is 2.25/5, therefore, very low.

Referring to learners' skills, the appreciated as the main ones are those related to knowledge: skills in science, technology and engineering as well as in agriculture and agroecology, followed by computer skills. Corporate sustainability skills, language skills and social and entrepreneurial skills were also considered important. Regarding the skills that students lack when they finish vocational training and are entering the sector, entrepreneurial skills are highlighted, followed by social ones and competences focused on agriculture and agroecology. This last comparison is essential to visualize that although knowledge is indispensable and needs to be further developed, it seems that relational and entrepreneurial skills are being a bit left aside in training and are equally essential for the introduction of learners into the sector.

Analysis of the results - Semi structured interviews

Agro-VET

Pere Dòria was a teacher at Escola Agrària del Pirineu and is currently at the Servei de Formació Agrària (agricultural training service) of DARPA, is part of the team that creates training materials for VETs, transferring knowledge into a pedagogical format for e-learning. The process begins with the identification of training needs and ends with the generation of materials in SCORM format. Regarding the challenges in agricultural training today, he believes that each training modality has its potential, but considers that face-to-face formats with audiovisual resources and interactive activities are more effective in engaging students, even though online training is often preferred for convenience. Additionally, he highlights the need to standardize students' competencies to personalize and improve the learning process, similar to initiatives being implemented in Europe. Another challenge he mentions is the lack of continuity for training materials once created, and he suggests monitoring and creating networks to enrich shared knowledge.

Regarding sector trends, Dòria highlights the MUCAI model (Minimum Applicable and Indivisible Competency Unit), which designs personalized educational pathways based on a competency test. He believes this model could improve the effectiveness of learning. He also points out that agricultural training is moving towards the use of augmented reality and artificial intelligence, but emphasizes that these technologies should be complementary tools that do not disconnect students from their basic competencies.

Regarding the Agro-VET sector Xavier Vidal was also interviewed, teacher from the Escola Agrària de Viticultura i Enologia M. Rossell i Domènech and coordinator of a farm with sustainable practices. Knowledge transfer in the school is primarily done through technical workshops, a more agile format that the sector is more receptive to, as longer courses are often incompatible with the sector's schedules. Resources for practical training are limited, especially for farm and cellar maintenance.

Key challenges that Xavier detect include the costs of regenerative practices, water management for irrigation with significant scarcity, and climate change-related issues such as heavy rains followed by drought. There is also a push for the use of local varieties to cope with drought. Vegetative covers are useful for water retention, but water scarcity remains a major problem. Additionally, the use of wool as a zero-cost cover alternative is being explored. Another challenge is the lack of digital skills in the curricula, as well as the need for joint collaboration and cooperation across the sector to achieve overall improvements.

Francesc Magrané has been as well interviewed as a reference in the forestry sector in central Catalonia, where he trains young people through the Rumiar project in Tarragona. He believes that CSA training should start in primary education. His students are usually between 15 and 30 years old, and he emphasizes the importance of their attitude and soft skills in the recruitment process of the center. Although dropout rates are low (1-20%), physical strain and working conditions can lead to attrition. He believes CSA training should start early, in primary education.

Regarding sector trends, Magrané highlights the mechanization of processes while maintaining traditional values, as well as the use of new machinery and biomass. He also emphasizes the need for machinery certifications and language skills. The main lacks he observes in students entering the sector are team coordination and adaptability, stressing the importance of autonomy, gradual independence, and a proactive attitude.

Agro-companies

Fàtima and Joan are farmers and owners of the Fruits del secà project in Anoia, which started on Joan's family farm with conventional cereal and pig farming. Fourteen years ago, they shifted to organic practices (currently 115 of the 200 hectares are organic) and started growing ancient cereals and legumes for human consumption. They expanded the pig farm to organic management, focusing on animal welfare and using manure to improve soil organic matter and reduce plowing. They control the entire value chain, from cultivation to delivery, to ensure product quality and minimize intermediaries.

The main challenge they've faced in crop management is drought, which they believe will define the sector's future. To cope, they've diversified by growing flour and legumes for human consumption. Designing crop rotations and implementing them at the right time is crucial. They also face administrative hurdles in transitioning to organic farming, having spent over 12 years fighting for permits to expand their pig barn. Despite years of proving organic farming's viability, they still encounter social stigma. They believe the main challenge in training is developing social skills (communication and empathy), with specific knowledge gained through practical experience and technical courses. They also note a lack of connection between farmers seeking work and farms needing staff.

With diverse training backgrounds, both Joan and Fàtima agree that education should provide a foundation, but specific knowledge is gained through hands-on experience and short, targeted courses. They value the opportunities offered by the RuralCat platform. While they see online training as convenient, they prefer in-person training for networking. They view digitalization for administrative tasks as helpful but not essential for farmers, as observation and experimental testing are sufficient for fieldwork.

Tomas Viguurs is the founder of Mycelio, an innovative company in Tavertet (Catalonia) that uses sustainably sourced wood to create mushroom-growing substrates and returns the materials to the land as fertilizer after production. This allows CSA mushroom plantations to be introduced in both industrial parks and urban areas. The company also organizes training and visits for schools, and within the Boletus project, they aim to train farmers in mushroom cultivation.

Viguurs emphasizes the importance of skills such as versatility, adaptability, communication, and teamwork, along with knowledge in automation and specialized training. Mycelio currently hires people with no prior experience and trains them internally. Recruiting is a challenge due to rural depopulation and a lack of attractive job offers for young people. They recruit through volunteer work, word of mouth, and direct contacts.

Looking ahead, Mycelio plans to focus on reusing spent mushroom substrate for composting, incorporating mycology into training, and exploring "on-farm" visits as educational and outreach opportunities.

Policy makers

Maria Josep de Ribot is the head of the Servei d'Innovació Agroalimentària (Agro-food Innovation Service) at DARPA, which facilitates access to training, innovation, and knowledge transfer for the agro-food sector through the RuralCat platform. This platform shares technical workshops, courses, distance learning, professional certificates, and training cycles offered by the network of agricultural schools in Catalonia and other sector actors. The main challenge she identifies in the agricultural sector is the lack of generational renewal. She suggests that a platform linking projects lacking continuity with young entrepreneurs could help resolve part of the problem, although the guarantees and conditions of these relationships would need to be carefully considered. Additionally, in the face of extreme climate conditions, the only solution is to respond with sustainable proposals and promote bioeconomy models through the educational offer. This has been implemented for years, but more widespread efforts are still needed.

Regarding trends, she mentions that the department strives to stay up-to-date with the training needs of the public and adapt to environmental conditions. Since the pandemic, online courses have been prioritized, as they offer access to people who otherwise couldn't attend. In addition to this, the department has started offering knowledge transfer in podcast format, which has been well received. Short-format training, such as technical workshops, is also a good option for farmers with limited time who need very specific content. Regarding the trend of condensed and enriching knowledge, the MUCAI initiative being designed by FAD could represent a paradigm shift. In-person meetings, such as cross-project visits, offer an opportunity for farmers to establish synergies by sharing knowledge and experiences. In response to the challenge of generational renewal and gender inequality in the sector, the department has launched the Young Farmers Mentorship Program, which has been well received and could provide valuable support to emerging generations through existing projects.

Knowledge institutions

Albert Domingo is the head of Innovació i Transferència Tecnològica (Innovation and Technology Transfer) at the Generalitat de Catalunya, focusing on proximity advisory and technology transfer in agriculture. His main interest lies in projects aimed at improving soil structure and resilience to climate change. A key initiative he is involved with is the Pla de Manlleu project, which focuses on applying wood chips to vines and biological inoculants to enhance soil microbiology. The wood chips, used as a protective cover, help retain water, regulate temperature, and promote soil structure, while the biological amendments stimulate soil enrichment.

Albert shares with us the CarbonFlow project, which proposes transferring carbon from forests to agricultural soils to enhance organic matter and improve soil structure. The idea is to use large wood chip mulch (G30), which retains carbon in the soil for longer, increasing its value and extending the life of carbon credits. While large chips are more expensive, medium-sized chips are used for mulching, and finer chips are used for biological amendments to support soil microbiology. This project aims to regenerate and restructure agricultural soils, reducing compaction and particle collapse, thus accelerating soil recovery.

The main challenges of this proposal include high implementation costs, which are seen as an investment for long-term benefits such as soil protection and prevention of erosion. There are also difficulties in transmitting knowledge about these innovative practices, as farmers need to understand how to increase soil biomass and create stable soil structures. Moreover, the existing operational models for funding and support are competitive and not accessible to all farmers, creating a gap in the sector. Albert also highlights the importance of real-life trials and accessible training programs to help farmers become autonomous in implementing these innovations, while addressing bureaucratic barriers that slow down the adoption of new practices.

Main findings and conclusion

The developed surveys and interviews have focused on very diverse stakeholders in the agricultural and forestry sectors with a strong commitment to CSA, which gives us enriching results from various perspectives aligned with EVECSA vision for sustainable practices; furthermore, it is relevant to keep in mind this target represents a minority in the Catalan agroforestry sector, mainly based on conventional practices.

Conclusions from both interviews and surveys in relation with training formats demonstrate a clear focus on: on-site training, short-term courses (training pills, seminars…), audiovisuals and interactivity, tailored curricula, and especially on sharing real case applied practices to strengthen collective knowledge and farmers' autonomy. In relation to digital tools, staying up-to-date in the educational field can contribute to making training more didactic and focused on learners' competencies and interests, increasing engagement.

There is a clear manifestation in relation with training contents to keep enriching the knowledge (science, technology and eco-agroforestry) by transferring already existing materials as well as boosting investigation, and at the same time in investing on social and entrepreneurial skills as a base for learners to get into the labour market. Fostering digital tools for farmers’ administrative tasks through training was as well remarked.

Based on the results, the whole agroforestry sector in Catalonia is being constrained by the lack of financial support, social recognition, generational replacement and rural depopulation. This states a systemic problem that needs to be addressed at its root, maybe by approaching agriculture, livestock and forestry professions to studied publics that can be change makers. Climate extreme conditions such as drought drive farmers to focus in water management systems and soil regenerative practices. Finally, long-lasting national and international relationship networks (such as mobility of students-teachers and innovative forms of collaboration with the labour market) were highlighted as pillars for a change in the dynamics between agroVETs and the agroforestry sector.

Annex 6 – The Netherlands Regional Report

Executive Summary

This document presents the results of interviews on knowledge, practices, and needs related to Climate Smart Agriculture (CSA) in the regional context of The Netherlands CoVE. In late 2024, interviews were conducted with eight respondents from diverse sectors, including farm-related entrepreneurs, research organizations, consultancies, and educational institutions, to identify key trends, practices, gaps, and insights in agriculture. The findings revealed significant shifts toward regenerative agriculture, technological innovation, and sustainability-focused practices.

Analysis of the results

The interviews were taken with eight respondents. Of the respondents were two farm related entrepreneurs, one in crop protection business and one in biological dairy. There were 2 research organisations and 2 advisory / consultancies one in livestock and one in plant production. The remaining two was educational and sustainable development organisations.

Climate Smart Agriculture vision

The survey outcomes were very diverse, mainly because the surveys were conducted among different stakeholders. Respondents indicated different kind of visions to Climate Smart Agriculture such as:

- Adoption of regenerative agriculture and precision farming techniques.
- Integration of AI and robotics in data-driven farming and crop guidance.
- Emphasis on soil and water management, healthy soil promoting water retention, and heat stress prevention in livestock.
- Exploration of sustainable energy infrastructure and CO_2 measurement approaches.
- Use of hybrid seeds with improved drought and heat resistance, coupled with training as a business model.
- Transition from "Climate Smart Agriculture (CSA)" to "Nature-Positive Food Systems."
- Need for early warning systems integrating weather reporting with actionable advice for farmers.

Experiences In Climate Smart Agriculture

The Netherlands already has strict regulations on for example greenhouse gases and fossil energy use. Many of the respondents are working hard to meet targets to research and integrate new techniques. Climate Smart Agriculture experience mentioned in the questionnaire was experience in the field of soil health management, robust crops, weed robots, and regenerative agriculture initiatives, on-farm energy generation and ecological approaches centered on soil health

Network of local contacts

Respondents cooperate with various agricultural organizations, such as agricultural advisory centres such as Agrofoodcluster to obtain specialised information, educational institutes for cooperation and knowledge exchange and experience related to traineeships. Respondents also maintain contacts with other knowledge or specialised institutes to engage in cooperation for innovations, development projects or the need for support and counselling.

Despite collaborations, respondents also run into gaps and challenges such as:

- Lack of skills in technology, data interpretation, and digital innovation in agriculture.
- Slow integration of innovation into education, leading to a disconnect between technological advancements and knowledge dissemination.
- Broad and unclear definitions of CSA hinder the focus on sustainability solutions.
- Highlighting vulnerable areas to drought and floods via mapping could aid in targeted interventions.

This research underscores the need for skill-building, better knowledge exchange, and accelerated adoption of sustainable and innovative agricultural practices to address emerging challenges and ensure a resilient agricultural future.

Best practices and career in Climate Smart Agriculture

Almost all respondents highlighted examples of best practices they experienced such as drone technology, spot sprayer, weeding robot, regenerative agriculture demonstrated at a specific company, Farm of the Future, new hybrid seeds more resistant to drought, mulching implementation of small windmills.

For best practices in career the main examples given are the possibilities for learner and staff mobility and integration of agro-VET in skills ecosystems.

Main findings and conclusion

Main trends

The interview results showed the following distinct patterns in main trends:

- Moving to regenerate Agriculture
- Robotization innovation with AI steering data exchange and growing guidance
- precision farming providing livestock exactly what it needs
- Soil management and water management systems by increase of organic matter less ploughing. Making soils spongy
- Healthy soil with large capacity to hold water.
- Recognition and prevention of heat stress in livestock
- AI technology and data analytics for CSA
- Infrastructure around sustainable energy is still lacking (batteries not a real solution)
- CO2 goals are measured per quantity product and not per hectare. What is best for development?
- Hemp production for insulation material
- High temperature CSA
- Hybrid seeds with improved drought and heat resistance, is a business case
- Combination of training with sales of solutions (for example hybrid seeds with training about use of it). Sales person can offer a training course as a package deal.
- CSA is an old term and will gradually being replaced by the new focus of "Nature positive Foodsystems".
- Early warning systems improvement is needed. For example, weather reporting and combination or connection with advice for farmers (sowing, drilling, fertilizing, harvesting, and certainly irrigation start).
- Herb rich meadows.

Practices/topics

The most influencing practices are listed below:

- Weed robot
- Focus on soil is working
- Energy generation on farm level

- ecological approach (soil focused, soil health management
- Robust crops
- Regenerative agriculture
- De spots payer, project KPI Flevoland, regenerative agriculture McCain, Farm of the future.

Needs

There was not a great deal of gaps or missing links but there were a few that need considering:

- Skills in technological, agronomical and scientific solutions
- Data interpretation and data driven practice
- Digital skills - computer systems programming, IT skills - ability to identify technological needs and responses, using digital technologies in a creative way.
- Skills in sustainable agriculture/ agroecology
- Innovation speed is not in pace with exchange of knowledge about it in education. Even definition of CSA is not very clear in education. This slows development.

Conclusion

The speed of innovation does not keep pace with the speed of exchange of knowledge about these innovations within education. The definition of CSA is now very broad and unclear, is now a repository of definitions that do not match each other. This inhibits the focus on the road to solutions for sustainability.

Preliminary research shows it might be interesting to make vulnerable area's visible in maps concerning drought and flood risk.

Continuation of cooperation among all partners is essential to address, respond to and solve current and future issues around Climate Smart Agriculture.

Consortium

Coordinator

Partners

EVECSA

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