Co-funded by the European Union

AI4AGRI

AI4Agri
Developing green and digital skills towards AI use in agriculture

Project Number: 2023-1-PL01-KA220-VET-000160825

Erasmus+
KA220-VET - Cooperation partnerships in vocational education and training

Exploiting AI use in agriculture & Policy recommendations

AI4Agri Policy Recommendations

Developed by
The Polish Farm Advisory and Training Centre not-for-profit Sp. z o. o.
September 2025

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.

Co-funded by the European Union

AI4AGRI

Table of Content

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Executive Summary

AI4Agri: Policy Recommendations Report

This report summarizes the key findings and recommendations of the Erasmus+ project *AI4Agri – Developing green and digital skills towards AI use in agriculture*. The project addressed the urgent need for digital and green competences in the agricultural sector, combining research, training, and policy dialogue.

Key Outcomes

- Comprehensive analysis of AI adoption and needs in four partner countries (Poland, Sweden, Cyprus, Greece).
- Development of a full AI4Agri Curriculum and seven interactive training modules for VET learners and professionals.
- Pilot training with 83 learners validating the materials and highlighting further needs.
- National and transnational policy roundtables identifying common challenges and opportunities.

Main Policy Recommendations

1. Invest in rural digital infrastructure.
2. Provide accessible financial mechanisms for AI adoption.
3. Expand modular training and capacity-building for farmers, advisors, and VET educators.
4. Promote open data frameworks and interoperability.
5. Ensure ethical and regulatory clarity, including data ownership and transparency.

AI4Agri contributes directly to the EU's twin digital and green transitions by equipping the agricultural workforce with essential competences and by shaping a coherent policy framework for the future of farming.

Introduction & Project Overview

This chapter sets the stage for the AI4Agri policy recommendations report. It introduces the motivation behind the project, the challenges facing the agricultural sector in the context of the twin green and digital transitions, and the role of Artificial Intelligence (AI) as a potential enabler of sustainable transformation. It also provides an overview of the AI4Agri project, its objectives, partnership, and alignment with key European Union strategies. The aim is to give readers a clear understanding of the project's foundations and its contribution to the broader European policy landscape.

Background and Rationale

The agricultural sector stands at the crossroads of the twin green and digital transitions. Climate change, environmental degradation, demographic shifts, and global food security challenges place unprecedented pressure on European farming systems. At the same time, technological advances, particularly Artificial Intelligence (AI), offer new opportunities to improve efficiency, sustainability, and resilience in agriculture.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Despite this potential, barriers remain. Farmers and agri-entrepreneurs often lack digital literacy and practical experience with AI applications. Rural areas face persistent infrastructure gaps, and there is a general absence of accessible training programs adapted to the specific needs of Vocational Education and Training (VET) learners. Furthermore, policy frameworks at both national and EU levels are still adapting to the implications of AI adoption in agriculture.

Against this backdrop, the Erasmus+ project AI4Agri – Developing green and digital skills towards AI use in agriculture was launched to empower the agricultural workforce with the knowledge, skills, and competences required to leverage AI for sustainable farming and business development.

Project Objectives

AI4Agri pursues four overarching objectives:

1. **Bridge the Knowledge Gap** – provide agricultural professionals with a comprehensive understanding of AI concepts and applications in farming.
2. **Cultivate Digital Proficiency** – strengthen digital literacy and the ability to work with AI-powered tools and platforms.
3. **Champion Sustainability** – promote AI-driven solutions that contribute to sustainable agriculture and environmental stewardship.
4. **Inspire Innovation and Entrepreneurship** – encourage farmers and VET learners to use AI for innovation, new business models, and green entrepreneurship.

By combining research, training, and policy dialogue, the project creates a holistic framework for integrating AI into the agricultural sector.

Project Structure and Work Packages

The project is organized into five Work Packages (WPs), each contributing specific results and collectively ensuring the achievement of the project's aims.

- **WP1 – Project Management**
  Aim: To ensure effective coordination, monitoring, and quality assurance.
  Key Results: A management plan, monitoring tools, interim and final reports, and an evaluation framework supporting efficient collaboration among partners.
- **WP2 – Connecting AI with the Agricultural Sector: Current Status and Needs Assessment**
  Aim: To map the current landscape of AI use in agriculture and identify training needs.
  Key Results: A comprehensive analysis of EU and national policies, technologies, and best practices; stakeholder surveys and roundtables in four partner countries; identification of digital skills gaps, infrastructural barriers, and opportunities for AI adoption.
- **WP3 – Development & Delivery of AI4Agri Training**
  Aim: To design and implement a comprehensive training program for VET learners and agricultural professionals.
  Key Results:

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

- **Curriculum** providing a structured framework for training aligned with project objectives.
- **Pedagogical Manual** guiding educators in using interactive, practice-oriented methodologies.
- **Seven e-learning modules** covering core topics:
  1. *Introduction to AI in Agriculture* – foundational AI knowledge and current applications.
  2. *Digital Skills for the Modern Farmer* – digital literacy and mastery of AI-powered tools.
  3. *AI for a Sustainable Future* – role of AI in advancing green practices and climate-smart farming.
  4. *Becoming an Agripreneur: AI Innovation and Business* – fostering entrepreneurship and innovation in agri-business.
  5. *Understanding AI – Concepts and Applications* – exploring key AI technologies and their agricultural relevance.
  6. *Putting AI to Work: Data and Farming* – using AI for data collection, analysis, and optimization of farming practices.
  7. *Innovate and Strategize* – developing business models and strategies that leverage AI.
- **Pilot Training Report** documenting the implementation of the modules with 83 learners in four countries. The report confirmed the relevance of the materials and suggested improvements for interactivity and learner engagement.

- **WP4 – Exploiting AI Use in Agriculture & Policy Recommendations**
  Aim: To translate research and training results into actionable policy recommendations. *Key Results:* National and transnational policy roundtables gathering farmers, educators, policymakers, and technology providers. These dialogues identified barriers such as high investment costs, lack of digital literacy, and poor infrastructure, while highlighting opportunities such as cooperative/shared service models and open data frameworks. The process informed five transnational policy pillars: infrastructure investment, financial support mechanisms, capacity building and training, open data and interoperability, and ethical/regulatory clarity.
- **WP5 – AI4Agri Outreach Activities**
  Aim: To ensure the dissemination, exploitation, and sustainability of project outcomes. *Key Results:* A project website and social media channels, communication and promotional materials, multiplier events in partner countries, and a sustainability strategy to support long-term use of AI4Agri training resources by VET providers, policymakers, and the agricultural community.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

WP	Aim	Key Results
WP1 – Management	Ensure efficient coordination, monitoring, quality assurance	Management plan, evaluation tools, reporting
WP2 – Needs Assessment	Analyse AI use in agriculture and identify skills/training gaps	Final Analysis Report; surveys; stakeholder roundtables
WP3 – Training Development	Develop curriculum, manual, and e-learning modules	Curriculum, Pedagogical Manual, 7 modules, Pilot Training Report
WP4 – Policy Recommendations	Translate findings into actionable policies	National/transnational roundtables, 5 policy pillars
WP5 – Outreach	Disseminate and sustain project outcomes	Website, events, communication materials, sustainability strategy

Consortium and Partners

The project is implemented by a transnational consortium of organisations with expertise in agriculture, sustainability, digital innovation, and vocational education:

- **The Polish Farm Advisory and Training Centre (PL)** – project coordinator, specialised in agricultural training and rural development.
- **IRIS Sustainable Development (SE)** – NGO promoting environmental sustainability and youth empowerment.
- **Strategic Omnia Research and Technology Development Ltd (CY)** – SME focused on sustainable technologies, big data, and agricultural innovation.
- **School of Foreign Languages S. Fafaliou (GR)** – experienced in VET and curriculum development.
- **YET ASTIKI MI KERDOSKOPIKI ETAIREIA (GR)** – focused on entrepreneurship, digital transformation, and innovation capacity-building.

This broad partnership ensures that project results combine **policy expertise, digital innovation, practical training, and outreach capacity** at both local and EU level.

Alignment with EU Priorities (Green Deal, CAP, Digital Decade)

The project is directly aligned with key EU strategies and frameworks:

- **European Green Deal** – supporting climate neutrality and biodiversity protection through sustainable farming.
- **Common Agricultural Policy (CAP 2023–2027)** – fostering innovation, digitalization, and sustainability in rural areas.
- **EU Digital Decade** – contributing to digital skills, digital infrastructure, and adoption of emerging technologies.
- **European Skills Agenda** – enhancing reskilling and upskilling of the agricultural workforce.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Through these links, AI4Agri contributes to **EU-wide ambitions for climate-smart, digital, and inclusive agriculture**.

Methodology of Policy Development

The policy recommendations presented in this report are the result of a structured, multi-stage methodology that combined research, training, and dialogue across four European countries. This approach ensured that the recommendations are not only evidence-based but also grounded in the perspectives of farmers, educators, policymakers, and technology providers.

Desk Research (WP2 Findings)

The starting point of the methodology was the comprehensive desk research conducted under Work Package 2. Partners analysed existing European and national policy frameworks, ongoing digitalisation strategies, and the current state of AI adoption in agriculture. The analysis identified:

- persistent infrastructure gaps in rural areas,
- limited awareness of AI opportunities among farmers and VET learners,
- insufficient integration of AI topics in vocational training systems,
- policy gaps between high-level EU strategies and national implementation measures.

This research provided a baseline understanding of both opportunities and barriers, setting the foundation for subsequent stages of the project.

Needs Assessment Surveys

Building on the desk research, AI4Agri partners conducted needs assessment surveys with farmers, advisors, and VET educators in Poland, Sweden, Cyprus, and Greece. The surveys explored attitudes towards AI, existing levels of digital competence, and expectations regarding training.

Key findings included:

- strong interest in AI applications for precision farming and resource management,
- generational divides in digital literacy, with younger participants showing greater readiness,
- demand for practical, hands-on learning opportunities, rather than purely theoretical training.

These results highlighted the skills gaps that the AI4Agri curriculum needed to address.

Reflection Roundtables (National Level)

To deepen the understanding of survey findings, reflection roundtables were organised in each partner country. These national dialogues brought together stakeholders such as farmers, cooperatives, advisors, educators, and local policymakers.

The roundtables served three purposes:

1. validating survey results with real-world experiences,
2. identifying contextual challenges (e.g. rural internet connectivity in Cyprus and Greece, cost barriers in Poland, ethical concerns in Sweden),

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

3. collecting suggestions for policy measures to support AI uptake.

The interactive nature of the roundtables ensured that diverse voices were represented, including those often under-represented in digital policy discussions.

Pilot Training and Stakeholder Feedback (WP3.4)

Work Package 3 included the piloting of the AI4Agri training programme with 83 learners across the four countries. Participants included farmers, agricultural students, and VET trainers. The pilot tested the relevance, accessibility, and effectiveness of the seven e-learning modules.

Feedback from the pilot highlighted that:

- the modular structure was well-suited for different learner groups,
- case studies and practical exercises were especially valued,
- some participants requested more interactive features and real-life demonstrations,
- training should be complemented by advisory services and local demonstration sites.

The pilot results provided critical evidence that shaped both the refinement of training materials and the policy recommendations, particularly those related to capacity building and education.

Transnational Policy Dialogues (WP4)

The final stage of the methodology was the organisation of policy roundtables at both national and transnational levels under Work Package 4. Roundtables in Poland, Sweden, Cyprus, and Greece brought together policymakers, farmers, VET providers, researchers, and technology companies.

At the transnational level, findings were synthesised to identify shared challenges and common ground across countries. Five recurring themes emerged:

1. high upfront costs of AI technologies,
2. lack of rural digital infrastructure,
3. low awareness of funding mechanisms under the Common Agricultural Policy (CAP),
4. need for targeted, modular training programs,
5. concerns about ethics, data ownership, and transparency.

These insights were consolidated into the five policy pillars presented in this report. The iterative and participatory process ensured that the recommendations are not only aligned with EU strategies but also reflect the realities of farmers and educators in partner countries.

Case Studies and Best Practices

The AI4Agri project generated a rich body of evidence on how AI can support agriculture across different European contexts. This chapter presents four illustrative case studies and best practices identified through research, surveys, pilot training, and national policy roundtables. They highlight both opportunities and challenges in the uptake of AI, offering inspiration for policymakers and practitioners.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Precision Agriculture in Poland

In Poland, precision agriculture has begun to gain traction, particularly among medium and large farms. Farmers increasingly adopt AI-powered drones and satellite imaging systems to monitor crop health, detect early signs of disease, and optimise irrigation and fertilisation.

One best practice example emerged from a farm advisory centre where AI tools were integrated into training sessions for local farmers. By analysing real-time field data, farmers learned to make informed decisions about input use, reducing costs and environmental impacts.

Key lessons

- Practical demonstrations significantly increase trust in AI technologies.
- Precision agriculture aligns well with the European Green Deal by supporting resource efficiency and emission reduction.
- Smaller farms require cooperative models or leasing schemes to overcome high investment costs.

Digital Experimentation Policies in Sweden

Sweden stands out for its supportive regulatory environment for innovation. National policies encourage digital experimentation through so-called *regulatory sandboxes*. These controlled environments allow farmers, technology providers, and researchers to test AI solutions under real-world conditions without facing immediate regulatory hurdles.

One example involved the trial of AI-based livestock monitoring systems. Farmers could test facial recognition and behaviour analysis technologies to detect early signs of disease in dairy herds. The sandbox approach enabled rapid learning, adaptation, and policy feedback.

Key lessons

- Regulatory flexibility accelerates innovation and trust-building.
- Experimentation in a safe environment reduces perceived risks for farmers.
- Public–private partnerships are essential for scaling successful solutions beyond pilot projects.

Cooperative AI Service Models in Greece

Greek roundtables revealed strong interest in cooperative or shared-service approaches to AI adoption. Given the prevalence of smallholder farms, many stakeholders argued that individual investment in AI technologies is unrealistic. Instead, cooperatives and producer organisations could pool resources to purchase and operate AI tools, such as drones, smart sensors, or AI-enabled farm management software.

One promising practice discussed was the development of cooperative service hubs where farmers collectively access AI-based soil monitoring and crop management systems. Such models reduce individual costs, enhance knowledge-sharing, and foster collective ownership of digital innovation.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Key lessons

- Cooperative models make AI adoption more inclusive for smallholders.
- Shared services strengthen farmer networks and knowledge exchange.
- Policy support is needed to embed cooperative AI models in national rural development programs.

Challenges of Traditional vs. Smart Farming in Cyprus

In Cyprus, the introduction of AI in agriculture is hampered by significant digital infrastructure gaps and limited awareness of new technologies. Traditional farming methods remain dominant, particularly in rural areas with poor internet connectivity.

During project roundtables, farmers expressed scepticism about AI, often confusing it with general digital tools. However, pilot demonstrations of AI dashboards for irrigation scheduling showed that younger farmers were eager to experiment with smart solutions, provided that costs were manageable.

Key lessons

- Rural infrastructure is a prerequisite for digital transformation in agriculture.
- Awareness-raising and basic digital literacy training must precede advanced AI training.
- Demonstration sites and peer-to-peer learning are effective entry points for building farmer confidence.

Stakeholder Perspectives

The AI4Agri project placed strong emphasis on engaging a wide range of stakeholders, including farmers, agricultural advisors, VET educators, policymakers, researchers, and technology providers. Their perspectives were collected through surveys, national reflection roundtables, pilot training activities, and transnational policy dialogues. These voices illustrate both the enthusiasm and the concerns surrounding the adoption of AI in agriculture.

Key Insights from Stakeholders

- **Farmers** expressed interest in AI applications that directly reduce costs, save time, and increase yields, such as precision irrigation, pest detection, and yield prediction. At the same time, they highlighted barriers including high investment costs, unclear return on investment, and limited access to training.
- **Advisors and extension services** saw AI as an opportunity to modernise advisory practices and provide data-driven recommendations to farmers. However, they also recognised their own need for upskilling in digital and AI tools to effectively support end-users.
- **Educators and VET providers** underlined the importance of embedding AI in agricultural training curricula. They stressed that learning must be practical, modular, and easily adaptable to learners with diverse levels of digital literacy.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

- **Policymakers** acknowledged the potential of AI for achieving the European Green Deal and CAP objectives. Yet, they recognised gaps in awareness, funding mechanisms, and regulatory clarity, particularly concerning data ownership and interoperability.

Voices from the Field

"AI could help us predict yields and reduce waste, but many farmers don't know how to start. We need practical, affordable tools." – Farmer, Greece

"Digital infrastructure in rural areas is a prerequisite. Without fast internet, AI training and tools remain inaccessible." – Advisor, Poland

"Our students are curious and open to AI, but they need real-life examples, not just theory." – VET Educator, Cyprus

"AI can support climate-smart agriculture, but we must ensure trust, transparency, and clear ethical guidelines." – Policy Expert, Sweden

Generational and Educational Divides

The project also revealed clear generational and educational divides in the uptake of AI in agriculture:

- **Younger farmers and students** demonstrated higher levels of digital literacy, openness to experimentation, and interest in entrepreneurship opportunities linked to AI.
- **Older farmers** were often more sceptical, perceiving AI as complex, costly, or unnecessary for their daily work. They emphasised the need for visible, tangible evidence of AI's benefits before considering adoption.
- **Educators** highlighted the need to bridge these divides by tailoring training content to different levels of digital readiness. Introductory modules and peer-to-peer learning were seen as effective strategies to build confidence and gradually introduce more advanced AI concepts.

Policy Context

The successful adoption of AI in agriculture cannot be understood without considering the wider policy environment in which the sector operates. This chapter outlines the relevance of the European Green Deal, the Common Agricultural Policy (CAP), and the EU's digitalisation agenda to the agricultural sector. It highlights the opportunities AI can create for sustainable farming and climate action, while also emphasising the critical role of vocational education and training (VET) in equipping farmers and rural communities with the necessary skills to embrace innovation. By situating AI4Agri within these frameworks, the chapter demonstrates how the project contributes to ongoing European priorities.

EU Policy Priority	AI4Agri Contribution
European Green Deal	Promotes AI-driven sustainable farming practices, resource optimization, and climate-smart agriculture

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

EU Policy Priority	AI4Agri Contribution
CAP Reform	Integrates AI adoption into eco-schemes, training, and advisory support for farmers
Digital Education Action Plan	Provides innovative e-learning modules, digital skills training, and VET-targeted resources
EU AI Act	Raises awareness of ethical AI, transparency, and data ownership in agricultural applications

Agriculture in the European Green Deal

The European Green Deal establishes agriculture as a central pillar of Europe's climate and biodiversity strategy. With the sector responsible for around 10% of EU greenhouse gas emissions, adopting innovative approaches is essential. AI-powered solutions can reduce environmental footprints by optimising input use, monitoring soil health, forecasting weather, and supporting circular practices.

Role of AI in Sustainable Agriculture and Climate Action

Artificial Intelligence provides the tools for a shift from conventional, resource-intensive farming to **precision and climate-smart agriculture**. It enables:

- Smart irrigation and fertilisation systems reducing resource waste.
- Early detection of pests and diseases through image recognition.
- Predictive models improving resilience to climate extremes.
- Real-time monitoring of biodiversity and ecosystem services.

By integrating these technologies, the sector can address food security, sustainability, and competitiveness simultaneously.

Relevance to Vocational Education and Training (VET)

A crucial enabler of this transition is **skills development**. Many farmers, especially smallholders and older workers, lack the digital competences required to adopt AI effectively. AI4Agri addresses this gap by:

- Developing tailored VET training on AI in agriculture.
- Providing accessible and flexible learning opportunities.
- Building awareness of AI as a driver of both **green and digital skills**.

This approach contributes directly to the **EU's Skills Agenda** and enhances the resilience of rural labour markets.

Barriers and Regulatory Gaps

The transformative potential of Artificial Intelligence in agriculture is unquestionable, yet its uptake across Europe remains fragmented and uneven. The barriers impeding AI adoption go far beyond

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

individual farms or technologies; they reflect deeper structural inequalities, regulatory ambiguities, and gaps in strategic alignment at the EU level. Unless these obstacles are addressed in a systemic manner, there is a risk that AI will exacerbate existing divides—between large and small farms, technologically advanced and lagging regions, and well-capitalised and resource-constrained actors. This chapter provides a critical assessment of the barriers that must be overcome to unlock AI's role as an enabler of sustainable, inclusive, and competitive European agriculture.

Infrastructure Deficit and Digital Divide

Digital connectivity is the backbone of Agriculture 4.0. Yet, broadband and 5G deployment remain insufficient in many rural regions, leaving farmers unable to access AI-driven platforms, cloud-based analytics, or real-time advisory systems. This digital lag perpetuates a two-speed agricultural Europe: technologically advanced clusters in well-connected regions, and digitally isolated smallholders elsewhere. Addressing this gap is not only a technical necessity but a political imperative for territorial cohesion.

High Costs and Limited Financial Support

AI technologies demand significant upfront investments—ranging from precision sensors and autonomous machinery to data management platforms. For small and medium-sized farms, the cost-benefit balance remains unfavourable without targeted subsidies or financing mechanisms. Current CAP instruments provide fragmented support but fall short of enabling systemic affordability. The absence of inclusive financial models risks concentrating innovation among large agribusinesses, widening structural inequalities.

Low Digital Literacy and Skills Gap

Low levels of digital literacy, particularly among aging farmers, represent one of the most persistent bottlenecks. Beyond technical skills, there are cultural barriers: reluctance to experiment with disruptive technologies, fear of replacing traditional knowledge, and limited exposure to innovation ecosystems. The skills gap is therefore not only a matter of competence but also of trust, mindset, and cultural readiness. Overcoming it requires a rethinking of vocational training and lifelong learning strategies.

Fragmented Data Governance

AI depends on data—yet agricultural datasets remain fragmented, inconsistent, and siloed across public, private, and research domains. The absence of a harmonised governance framework for agricultural data undermines interoperability and reduces the reliability of AI applications. Moreover, the lack of clear rules on data sharing reinforces asymmetries, allowing larger actors to monopolise valuable information while excluding smaller players. Without a European-level "Green Deal Data Space for Agriculture," AI adoption will remain sub-optimal.

Ethical and Legal Uncertainty

The rapid deployment of AI in agriculture is outpacing the development of appropriate ethical and legal safeguards. Questions remain unresolved regarding liability for AI-driven decisions, transparency of algorithms, and the protection of farmers' autonomy and data rights. The absence of tailored guidance for agriculture within the broader EU AI Act creates uncertainty, which in turn hinders

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

investment and adoption. Building trust in AI will require robust ethical frameworks and clear legal standards that recognise the specificities of agricultural contexts.

Opportunities for AI in Agriculture

At the same time as barriers persist, AI represents a once-in-a-generation opportunity to reimagine European agriculture in line with the twin green and digital transitions. When strategically deployed, AI can shift the sector from a productivity-driven model to one that is sustainable, resilient, and knowledge-based. Far from being merely a technological tool, AI should be understood as a catalyst for systemic transformation—enabling farmers to align food production with climate goals, biodiversity protection, and rural revitalisation. This chapter outlines the most promising domains where AI can deliver long-term value for Europe's agricultural sector and policy agenda.

AI for Sustainable Food Systems (Farm to Fork)

AI technologies enable precision farming practices that optimise the use of fertilisers, pesticides, and water. Machine learning models can anticipate crop stress, detect diseases early, and recommend targeted interventions, thus reducing environmental impacts while enhancing productivity. Beyond the farm gate, AI supports supply chain optimisation, helping to reduce food loss, improve traceability, and enhance consumer trust. In this way, AI becomes a core enabler of the EU's Farm to Fork Strategy, bridging sustainability goals with food security imperatives.

AI for Energy and Climate Action

Agriculture is both a contributor to and a victim of climate change. AI applications—ranging from predictive climate modelling to optimization of renewable energy integration on farms—can play a decisive role in mitigating emissions and enhancing resilience. By enabling smarter irrigation, energy-efficient greenhouse management, and predictive maintenance of renewable installations, AI directly contributes to the EU's climate neutrality target under the European Climate Law. It positions agriculture not as a problem, but as a strategic partner in Europe's energy transition.

AI for Circular Economy and Resource Efficiency

AI has the capacity to transform linear agricultural models into circular ones. Through advanced analytics, farmers can recycle nutrients, optimise input use, and reduce waste at every stage of production. Smart waste-sorting systems, AI-powered recycling technologies, and material flow analysis can extend beyond agriculture into the broader agri-food chain. These innovations directly support the EU Circular Economy Action Plan, making agriculture a driver of resource efficiency and environmental stewardship.

AI for Biodiversity and Environmental Monitoring

AI-powered tools for satellite imagery, drones, and sensor-based monitoring allow unprecedented insight into ecosystems. Farmers, policymakers, and scientists can detect deforestation, monitor soil degradation, track wildlife populations, and assess biodiversity in near real time. These tools not only safeguard ecosystems but also provide the evidence base for more effective policy interventions. In this sense, AI is not just a farming technology—it is a cornerstone of Europe's ambition to reverse biodiversity loss by 2030.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Policy Recommendations

The success of AI in European agriculture will depend not only on technological innovation but on bold, coherent, and future-oriented policy frameworks. To ensure that AI becomes a driver of sustainability and inclusiveness, European and national institutions must embed it within the architecture of the Common Agricultural Policy (CAP), the European Green Deal, and the Digital Decade agenda. This chapter presents policy recommendations that address systemic barriers while maximising opportunities. Each recommendation is directly linked to EU priorities, ensuring relevance for decision-makers at national and European levels.

Integrate AI-for-Sustainability Measures into the CAP

Barrier addressed: Limited mainstreaming of AI in agricultural policy instruments. **Recommendation:** Establish CAP eco-schemes and rural development measures explicitly funding AI tools that contribute to emission reduction, biodiversity protection, and input efficiency. **Applicability:** Ensures AI uptake is directly tied to the CAP's green architecture, creating synergies between digitalisation and sustainability.

Establish Rural Digital Innovation Hubs

Barrier addressed: Digital divide and lack of hands-on support. **Recommendation:** Expand EU Digital Innovation Hubs into rural regions, with demonstration farms, on-site training, and shared digital infrastructure. **Applicability:** Contributes to the EU Digital Decade targets, while fostering territorial cohesion and supporting national rural development strategies.

Develop EU-Wide Agricultural Data Governance Framework

Barrier addressed: Fragmented, inconsistent data systems. **Recommendation:** Create a "Green Deal Data Space for Agriculture" to ensure open, ethical, and interoperable access to agricultural data across Member States. **Applicability:** Aligns with the European Data Strategy and GAIA-X initiative, fostering trust and enabling cross-border innovation.

Introduce "Green AI by Design" Standards

Barrier addressed: Ethical and environmental uncertainty around AI. **Recommendation:** Establish EU-wide standards for energy-efficient, transparent, and environmentally responsible AI models in agriculture. **Applicability:** Builds on the EU AI Act and Sustainable Products policies, ensuring that digitalisation advances sustainability rather than undermining it.

Create AI-Specific Microgrants and Innovation Funding

Barrier addressed: Financial exclusion of small and medium-sized farms. **Recommendation:** Provide microgrants and targeted subsidies for smallholders and cooperatives to adopt AI tools, alongside access to advisory services. **Applicability:** Can be rolled out within CAP innovation instruments and national recovery and resilience plans.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Promote Multi-Level Policy Coherence

Barrier addressed: Fragmentation between EU and national measures. **Recommendation:** Align national CAP Strategic Plans with EU-level digital and green priorities, ensuring consistency across Member States. **Applicability:** Strengthens policy coherence and avoids fragmentation in AI uptake across Europe.

Barrier	Policy Recommendation	Applicability at EU / National Level
Infrastructure deficit and rural digital divide	Establish **Rural Digital Innovation Hubs** offering connectivity, training, and demonstration sites.	EU: Expand Digital Europe Programme and CEF2 into rural areas. National: Integrate hubs into CAP Strategic Plans and rural broadband programmes.
High costs and limited financial support	Introduce **AI-specific microgrants and innovation subsidies** for smallholders and cooperatives.	EU: EAFRD and Horizon Europe pilots. National: CAP eco-schemes and Recovery & Resilience Facility.
Low digital literacy and skills gap	Mainstream **AI-focused VET training modules** within Erasmus+, CAP knowledge transfer, and lifelong learning.	EU: Erasmus+ KA2 and Pact for Skills. National: VET providers and agricultural extension services.
Fragmented data governance	Develop an **EU "Green Deal Data Space for Agriculture"** ensuring open, ethical, and interoperable data.	EU: Align with European Data Strategy and GAIA-X. National: Adapt national data platforms to EU-wide standards.
Ethical and legal uncertainty	Introduce **"Green AI by Design" standards** for transparency, energy-efficiency, and farmer data rights.	EU: Integrate into AI Act and Digital Decade targets. National: Tailor implementation through ministries of agriculture/digitalisation.
Policy fragmentation	Ensure **multi-level policy coherence** by aligning CAP Strategic Plans with EU digital and green priorities.	EU: Monitor coherence through DG AGRI & DG CONNECT. National: Cross-ministerial coordination and policy alignment.

Multi-Stakeholder Engagement

AI adoption in agriculture is not a purely technological challenge—it is a societal transformation. Its success depends on the active participation of multiple stakeholders across different levels of governance and sectors. Farmers, technology developers, policymakers, educators, and civil society must co-create solutions that are inclusive, ethical, and tailored to local contexts. This chapter

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

highlights the roles and responsibilities of key actors, emphasising the importance of collaborative governance for embedding AI in European agriculture.

Farmers' Associations and Cooperatives

Farmers' organisations are central to building trust, disseminating knowledge, and scaling innovations. By pooling resources and creating cooperative models for AI use, they can reduce costs and democratise access to technology.

Agri-Tech Companies and AI Developers

The private sector must ensure that AI solutions are affordable, scalable, and environmentally responsible. Developers should work closely with farmers to design user-friendly tools that respect data sovereignty and align with EU sustainability objectives.

Vocational Education Providers and Research Institutions

VET providers play a crucial role in equipping the agricultural workforce with the skills necessary for the digital transition. Universities and research institutes contribute evidence-based insights, shaping both training content and policy design. Together, they ensure that knowledge transfer is practical, innovative, and future-oriented.

NGOs and Civil Society Organisations

Civil society brings the perspectives of rural communities, environmental advocates, and consumers into the debate. Their involvement is vital for ensuring that AI adoption does not undermine social equity, biodiversity, or ethical standards.

EU Institutions and National Policymakers

EU institutions set the strategic framework, while national ministries of agriculture, education, and digitalisation adapt and implement measures within their territories. Close cooperation between both levels is essential to harmonise regulation, funding, and support structures.

Financial Institutions (EIB, Banks, Funds)

Access to finance will be decisive for AI adoption. The European Investment Bank (EIB) and other financial actors should integrate AI-for-agriculture into their green financing portfolios, ensuring that innovative farmers and rural entrepreneurs can access affordable capital.

AI in agriculture will only fulfil its transformative potential if it is developed as a **shared European project**. The collaborative effort of stakeholders—from farmers in rural regions to policymakers in Brussels—will determine whether AI becomes a tool for sustainability and resilience, or a driver of inequality and exclusion. By fostering inclusive dialogue, building trust, and aligning incentives, Europe can lead the way in demonstrating how AI can be deployed not just for profit, but for the public good.

Monitoring and Evaluation

The long-term impact of AI in agriculture will depend not only on the design of innovative policies but also on the robustness of mechanisms to **monitor progress, evaluate outcomes, and ensure sustainability beyond project funding cycles**. This chapter outlines how the AI4Agri project proposes

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

to embed monitoring and evaluation (M&E) into its strategy, ensuring accountability, scalability, and alignment with EU objectives.

Adoption Metrics and Impact Indicators

A structured framework of indicators is required to capture both the quantitative uptake of AI solutions and the qualitative changes they bring to rural communities. Suggested indicators include:

- Number of farmers and VET learners completing AI training modules.
- Uptake of AI-enabled practices across farm types (smallholders, cooperatives, large farms).
- Reduction in resource inputs (water, fertilisers, pesticides) linked to AI adoption.
- Contribution to climate and biodiversity targets measured through precision data.

These metrics should feed into **EU monitoring systems** such as the CAP's Performance Monitoring and Evaluation Framework (PMEF), ensuring coherence with established reporting mechanisms.

Regional and Sectoral Uptake

AI adoption must be assessed not only at aggregate EU level but across regions and sectors. Monitoring should account for disparities in digital readiness between Member States, highlighting both best practices and lagging areas. This approach allows for the **scaling of successful pilots** and the targeted support of underperforming regions, thus reinforcing EU cohesion policy.

Evaluation for Policy Learning

Beyond compliance, evaluation must serve as a **policy learning tool**. AI4Agri proposes a feedback loop between research, training outcomes, and policy recommendations, ensuring that findings are systematically fed into CAP Strategic Plans and EU digitalisation strategies. By embedding evaluation into decision-making, the project strengthens the evidence base for future reforms.

Long-term Impact and Sustainability

Ensuring that the results of AI4Agri extend beyond the lifetime of the project has been a central priority. The project's outcomes are designed not only as immediate deliverables but also as resources, models, and practices that can be sustained, scaled, and transferred across Europe.

Embedding AI4Agri Curriculum in VET Institutions

A key legacy of AI4Agri is the development of a comprehensive training curriculum, pedagogical manual, and seven modular e-learning units. These resources were designed to be openly accessible and adaptable for integration into VET programmes. Partner institutions have already committed to embedding the curriculum in their own training activities, and outreach efforts are underway to engage additional VET providers across Europe.

By offering modular content, AI4Agri ensures flexibility: educators can select specific units according to learner needs, while institutions can adopt the full programme as part of their digital and green skills provision. This flexibility increases the likelihood of long-term use and continuous updating.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

Policy Uptake of Recommendations at National and EU Levels

The policy recommendations developed under Work Package 4 provide practical guidance for addressing infrastructural, financial, educational, and regulatory barriers to AI adoption in agriculture. National and transnational policy roundtables have already initiated dialogue between farmers, advisors, educators, and policymakers.

The recommendations align closely with EU strategies such as the European Green Deal, the Common Agricultural Policy (CAP), and the Digital Education Action Plan. This alignment increases their potential for uptake at both national and EU levels. By translating project findings into clear policy pillars, AI4Agri contributes evidence that can support reforms and funding decisions in the coming years.

Networks and Partnerships Beyond the Project Lifecycle

AI4Agri fostered strong cooperation among agricultural stakeholders, VET institutions, technology providers, and policymakers. These networks are expected to continue beyond the project lifecycle through:

- national advisory networks engaged during the needs assessment and policy roundtables,
- cooperative links between VET providers who piloted the training modules,
- partnerships with technology providers interested in scaling AI solutions in agriculture.

Maintaining these connections will be crucial for sustaining project momentum and encouraging further innovation in the agricultural sector.

Transferability of Results to Other EU Countries

Although AI4Agri was piloted in four countries—Poland, Sweden, Cyprus, and Greece—the project was designed for European-wide relevance. The curriculum is available in multiple languages and is adaptable to diverse agricultural contexts. Similarly, the policy recommendations address common barriers across the EU, such as infrastructure gaps, financing needs, and digital literacy challenges.

This transferability ensures that AI4Agri's results can inform training and policy development in other Member States. The project thus contributes to building a more coherent and inclusive European strategy for AI in agriculture, supporting the twin green and digital transitions across the continent.

Conclusion

Final Reflections

The AI4Agri project has demonstrated the transformative potential of Artificial Intelligence in agriculture, while also highlighting the barriers that continue to hinder widespread adoption. Through research, training development, pilot testing, and policy dialogues, the project has provided a comprehensive evidence base for building digital and green skills in the agricultural sector.

Three key reflections emerge from the project experience:

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

- **AI is not a distant future but an immediate opportunity.** Farmers, advisors, and educators recognise the benefits of AI for sustainability, productivity, and competitiveness, provided that technologies are accessible and affordable.
- **Skills and infrastructure are the decisive enablers.** Without investment in digital literacy, training programmes, and rural broadband, AI adoption will remain uneven and limited to a small group of early adopters.
- **Policy coherence is critical.** AI adoption must be supported by clear, farmer-friendly policies at both EU and national levels, ensuring trust, fairness, and alignment with broader strategies such as the Green Deal and the CAP.

AI4Agri has created a strong foundation of knowledge, skills, and policy insights that can now guide the next steps in Europe's agricultural transformation.

Next Steps for Policymakers, Educators, and Stakeholders

For Policymakers

- Integrate AI-specific measures into CAP eco-schemes and rural development programmes.
- Provide financial incentives, such as grants, leasing schemes, and cooperative ownership models.
- Establish national guidelines on ethical AI use in agriculture, covering transparency, accountability, and data ownership.

For Educators and VET Providers

- Embed the AI4Agri curriculum and training modules in existing programs.
- Develop blended learning approaches combining theory, case studies, and hands-on demonstrations.
- Foster peer-to-peer learning and intergenerational exchange to bridge the digital divide among farmers.

For Farmers and Advisors

- Engage in training opportunities to build digital and AI competences.
- Explore cooperative models to access AI technologies cost-effectively.
- Actively participate in policy dialogues to ensure that farmer perspectives shape future AI frameworks.

For Technology Providers

- Collaborate with farmers, advisors, and educators to co-design user-friendly AI solutions.
- Develop affordable service models tailored to smallholder farms.
- Support open data platforms and interoperability standards to build trust and scalability.

Summary

The AI4Agri project has shown that Artificial Intelligence can be a decisive enabler of Europe's green and digital transition in agriculture. By combining research, training, and policy dialogue, the project

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

built a bridge between innovation and practice, creating resources that are both forward-looking and grounded in real needs.

Its legacy is threefold:

- **Knowledge and Skills** – a curriculum, manual, and seven modular e-learning units that can be embedded in VET systems across Europe.
- **Policy Evidence** – recommendations shaped through surveys, roundtables, and pilot training, addressing infrastructure, finance, skills, data, and ethics.
- **Networks and Cooperation** – partnerships that connect farmers, educators, policymakers, and technology providers in a shared vision of sustainable agriculture.

The findings make clear that AI in agriculture is not a luxury for the few, but a necessity for the many. It must be accessible, affordable, and trustworthy. For this to happen, policies must reduce infrastructure gaps, lower entry costs, and support lifelong learning, while ensuring ethical safeguards and farmer-centred governance.

The risks of inaction are evident: deepening rural divides, missed opportunities for sustainability, and loss of competitiveness in global markets. Conversely, the opportunities are transformative: more resilient food systems, empowered rural communities, and a Europe that leads in sustainable agricultural innovation.

AI4Agri has laid the groundwork. The next step belongs to policymakers, educators, farmers, and innovators to ensure that AI is not only adopted, but adopted wisely – in the service of people, planet, and prosperity.

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.
Project Number: 2023-1-PL01-KA220-VET-000160825.

Co-funded by the European Union

AI4Agri Developing green and digital skills towards AI use in agriculture
Project Number: 2023-1-PL01-KA220-VET-000160825

Co-funded by the European Union

AI4AGRI

AI4Agri Project website: https://www.ai-4-agri.eu/

AI4Agri Project e-Learning Platform: https://ai4agri-elearning.eu/

Funded by the European Union. The views and opinions expressed are solely those of the author(s) only and do not necessarily reflect those of the European Union or Foundation for the Development of the Education System. Neither the European Union nor the Foundation for the Development of the Education System can be held responsible for them.

Co-funded by the European Union