

1. Appendix A

This section outlines the questions included in each section of the survey. It is important to note that not all questions have been analysed in the scope of this study.

1. *General information*, collecting foundational and demographic details about the respondent and their agricultural enterprises.
 - a. Does your farm belong to any of the following organisations or networks? (single choice)
 - Cooperative
 - Consortium
 - Producer organisation
 - Other (please specify)
 - None of the above
 - b. In which province is your farm located? (single choice)
 - (list of Italian provinces)
 - c. What is the main crop cultivated on your farm? (single choice)
 - (list of primary crop productions)
 - d. How much, in hectares, is your cultivated area (UAA)? (free text with numeric input)
 - e. What is your farm's annual turnover? (single choice)
 - Less than €50,000
 - Between €50,000 and €250,000
 - Between €250,000 and €500,000
 - Between €500,000 and €1,000,000
 - Over €1,000,000
 - f. How many employees work in your enterprise? For this question, please do not include seasonal workers or tractor operators/technicians. (free text with numeric input)
 - g. Age of the farm manager (this may differ from the owner and refers to the person primarily responsible for decision-making in the farm's management. If there is more than one farm manager, please indicate the age of the youngest one) (single choice)
 - 18 - 30
 - 31 - 40
 - 41 - 50
 - 51 - 65
 - Over 65
 - h. Education level of the farm manager (referring to the manager with the highest level of education) (single choice)
 - Primary school
 - Secondary school
 - Bachelor's degree (first level)
 - Master's degree (second level)
 - Postgraduate level: PhD, Master's program
 - i. Does your company adhere to any voluntary quality certifications? (multiple choice)

- Organic Certification (BIO)
 - ISO Certification
 - GlobalG.A.P. Certification
 - BRC Certification
 - IFS Certification
 - If applicable, specify the certification (e.g., ISO 9001 or 14001)
 - The company does not adhere to any voluntary quality certification
2. *A4.0 awareness and implementation*, assessing the level of familiarity and the extent of adoption of the proposed set of A4.0 solutions.
- a. What is the level of knowledge and use of the following digital solutions in your company? To assess their use, please consider both those you use directly and those used by others (e.g., contractors, technicians, etc.) (Matrix with the listed solutions below crossed with the following options: In use; Used in the past, not anymore, Known, Unknown)
- Decision Support System (DSS)
 - Monitoring systems
 - Mapping solutions
 - Variable Rate Technologies (VRT)
 - Connected vehicles
 - Telemetry systems and solutions for vehicle and equipment monitoring
 - Drones
 - Robotics
- b. On how many hectares of your cultivated land is at least one of the previously indicated Agriculture 4.0 solutions used? (free text with numeric input)
- c. In which operational phases are the previously indicated solutions implemented? (multiple choice)
- Planning
 - Soil preparation and sowing/planting
 - Irrigation
 - Fertilization
 - Crop protection and weeding
 - Other crop operations (e.g., tillage, pruning, etc.)
 - Crop monitoring
 - Harvesting
 - Logistics (storage, handling, etc.)
 - Administrative activities
3. *Needs, benefits, and challenges*, exploring the specific needs driving the adoption of A4.0 solutions, the benefits achieved, and the challenges encountered during their implementation.
- a. Considering the Agriculture 4.0 solutions you have adopted, which of the following needs have you aimed to address? (multiple choice - selection limited to 5 options)
- Enhance forecasting capabilities
 - Improve farm control and management processes
 - Reduce losses due to diseases, pests, and infestations
 - Optimize the planning and scheduling of activities
 - Increase awareness on farm activities and operations
 - Optimize the use of technical inputs
 - Enhance the efficiency of machinery and equipment

- Streamline and optimize workforce processes
 - Maximize water-usage efficiency
 - Improve the quality of the final agricultural product
 - Make physical labor less demanding and more manageable
 - Improve the company's risk management strategies
 - Minimize damage caused by adverse weather events
 - Monitor soil parameters for improved management
 - Strengthen product traceability throughout the supply chain
 - Assess the environmental impact of crop production
 - Enhance logistics and distribution processes for agricultural products
 - Reduce the time required to comply with regulatory obligations
 - Promote the product effectively to end consumers
 - Other (specify)
- b. Based on the previously indicated needs, what level of benefit have you experienced from using Agriculture 4.0 solutions? (Matrix matching the needs identified in the previous question with the following response options: None; Below expectations; In line with the expectations; Above the expectations)
- c. What challenges has your company faced in using the previously mentioned digital solutions? (multiple choice)
- Limited or non-existent interoperability
 - Lack of appropriate skills and expertise
 - Inadequate return on investment
 - Insufficient or unreliable technical assistance
 - Operational challenges
 - Inadequate or unavailable connectivity
 - No issues detected or identified
 - Other
4. *Data management capabilities*, evaluating the farms' ability to collect, store, analyse, and utilize data effectively to inform decision-making processes.
- a. In your farm, are there individuals specifically responsible for managing the data generated by the previously mentioned Agriculture 4.0 solutions? (single choice)
- Yes
 - No, but we plan to hire them in the coming years
 - No, and we do not plan to hire any
- b. How do you collect data related to your field activities? (single choice)
- Manually
 - Through external providers
 - Using digital devices
 - I do not collect data
- c. How do you store the collected data? (single choice)
- On physical media – paper documents
 - On local devices – computers and hard drives
 - Through Cloud storage
 - I do not store data

- d. Which of the following tools do you use to analyse data? (single choice)
- Agricultural software (FMIS, DSS, etc.)
 - Spreadsheets (Excel, etc.)
 - External consulting services
 - I do not analyze data
- e. Do the collected data have a concrete influence on your business decisions? (single choice)
- Yes, often
 - Yes, rarely
 - Never
5. *Digital skills*, assessing the competences and level of expertise of farm operators in relation to A4.0 solutions.
- a. How many employees use the digital solutions adopted in your farm? (free text with numeric input)
- b. What is the level of digital skills among your company's staff in using digital solutions? (single choice)
- Very low – it is not possible to adopt any digital tools due to lack of skills
 - Low – there is only basic knowledge of software and tools, and little confidence in using more advanced digital technologies
 - Good – with training and support, digital tools can be adopted within a reasonable timeframe
 - High – staff have higher competence than similar companies
 - Very high – staff have a high level of expertise and specialization
 - I don't know
- c. What is your company's average annual expenditure on training activities? (EUR) (free text with numeric input or option "I don't know")
- d. How many people with digital skills have you hired in recent years? (free text with numeric input or option "I don't know")
- e. How many people with digital skills do you plan to hire in the coming years? (free text with numeric input or option "I don't know")
6. *Investments*, reviewing past investments, current expenditures, and anticipated future investments in A4.0 solutions.
- a. In what year did you make your first investment in Agriculture 4.0 solutions (including precision farming technologies)? (dropdown menu with years in descending order)
- b. What is the total amount you have spent so far on Agriculture 4.0 solutions and services? (EUR) Please include both investments made to purchase or rent the solution and spending on Agriculture 4.0 services. (single choice)
- Less than €5,000
 - Between €5,000 and €15,000
 - Between €15,000 and €30,000
 - Between €30,000 and €50,000
 - Between €50,000 and €75,000
 - Between €75,000 and €100,000

- More than €100,000
- c. How much did you spend on Agriculture 4.0 solutions and services in the year 2023? (EUR) (free text with numeric input)
- d. Who are the main promoters of digital innovation in your farm? (multiple choice - selection limited to 5 options)
 - An external consultant
 - A technology provider
 - The entrepreneur
 - A project innovation manager
 - Other (please specify)
 - I don't know
- e. What are the main information channels you use to find out about digital innovation in agriculture? (multiple choice - selection limited to 3 options)
 - General media
 - Specialized media
 - Forums, blogs, and social networks
 - Trade fairs
 - Supplier of technical equipment
 - Agronomist
 - Contractor
 - Other farmers
 - Farmers' association
 - Public institution
 - Smart AgriFood Observatory
 - Educational institution or university
 - Call for proposals
- f. Which of the following support tools for digitalization investments in agriculture have you used? (multiple choice)
 - Sabatini Law
 - Rural Development Program (PSR)
 - INAIL Agriculture Call
 - Agriculture 4.0 Plan (Transition 4.0 – 4.0 tax credit)
 - Digital Voucher 4.0 (Chamber of Commerce)
 - AGRI platform by Cassa Depositi e Prestiti
 - Southern Italy Credit
 - Other (please specify)
 - None of these incentives
- g. Do you think the availability of incentives influenced your investment decisions? (single choice)
 - No, I would have invested anyway
 - Yes, I anticipated the investment
 - Yes, I chose to invest in a more expensive solution
 - Yes, I chose to invest in multiple solutions
 - Other (please specify)
- h. Are you planning to adopt additional Agriculture 4.0 solutions in the future? If yes, which ones? (multiple choice)

- Decision Support System (DSS)
- Monitoring systems
- Mapping solutions
- Variable Rate Technologies (VRT)
- Connected vehicles
- Telemetry systems and solutions for vehicle and equipment monitoring
- Drones
- Robotics
- I do not intend to adopt any Agriculture 4.0 solutions in the future

i. How much do you expect to spend on these solutions in the future? (single choice)

- Less than €5,000
- Between €5,000 and €15,000
- Between €15,000 and €30,000
- Between €30,000 and €50,000
- Between €50,000 and €75,000
- Between €75,000 and €100,000
- Over €100,000
- I don't know

7. *Inhibiting factors*, identifying the barriers and constraints preventing or limiting the adoption of A4.0 solutions.

a. To what extent do you agree with the following statements? (matrix crossing the statements reported below with the following options: Disagree; Neither agree nor disagree; Agree)

- Company size deemed too small to justify the investment
- Low expected utilization of the solution
- Existing tools considered adequate to meet current needs
- Benefits perceived as insufficient to justify the investment
- Challenges in evaluating the potential investment benefits
- Investment viability relies on spreading costs over time
- Investment viability relies on cost-sharing across enterprises
- Incentives hindered by requirements or bureaucracy
- Solutions not applicable to specific production activities
- Insufficient skills among operators to implement 4.0 solutions
- Insufficient technical or operational expertise
- Lack of clarity on where to obtain the necessary information
- Limited access to credit lines
- Inability to utilize the solution due to connectivity challenges
- Concerns about data privacy and cybersecurity of 4.0 solutions