USAGE-NG

Up-skilling Agricultural Engineering Next Generation

Report on dissemination activities

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Contents

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1 Conference and event participations (Italy, Germany, Spain, USA, Canada, Japan)

Dissemination of USAGE-NG results was carried out through a series of targeted conference participations, seminars, international meetings, and structured networking events across Europe and selected non-European countries. These activities addressed academic, vocational, and professional audiences involved in agricultural engineering, smart farming, green skills, and lifelong learning.

1.1 Europe (Germany, Italy, Spain)

In Germany, dissemination activities included:

Participation in national academic and applied education contexts, combining university-based dissemination with outreach to vocational and professional training providers.

The Multiplier Event at the Technical University of Munich (21 June 2023), which, in addition to its multiplier function, also served as a dissemination forum toward trainers, lecturers, and students, with demonstrative content on ISOBUS, CAN bus data logging, digital platforms, and smart farming workflows.

Contributions to European engineering and education-oriented conferences, including dissemination aligned with SEFI-related activities (presentation delivered in September 2023), where USAGE-NG was presented in the context of innovation in engineering and agricultural education.

In Italy, dissemination was conducted through Conference and professional event participation focusing on agricultural education, smart farming technologies, and skills development.

Networking-oriented dissemination with higher education and applied research audiences, supporting visibility of USAGE-NG training concepts and educational outcomes within Italian academic and professional communities.

In Spain, dissemination was closely linked to European lifelong learning and continuing education platforms:

Participation in the EUCEN Autumn Seminar 2024 (Barcelona) with the contribution "Empowering agricultural professionals with green skills through Micro-credentials: Innovative Educational pathways in the USAGE.NG".

Participation in the EUCEN Autumn Seminar 2025 (Barcelona) with the contribution "Building an AI Tutor: Advantages, Design process and applications in specialised training".

These participations positioned USAGE-NG within European discussions on micro-credentials, digital learning, and flexible upskilling pathways.

1.2 North America (USA, Canada)

In Canada, project dissemination was explicitly realised through:

Participation in the ASABE Annual International Meeting 2025 (Toronto), including a peer-reviewed conference contribution and presentation and a podcast interview about USAGE-NG. This event reached an international audience of agricultural engineers, researchers, and educators and enabled dissemination of USAGE-NG approaches to smart farming education and training.

In the United States, dissemination included:

Participation in professional and academic events in June 2025, including presentation activities and structured engagement formats with universities, research institutions, and industry stakeholders.

An organised US study and networking tour (June 2025), combining dissemination meetings, institutional visits, and exchange with academic and industry partners. These activities supported awareness of USAGE-NG results and facilitated transatlantic dialogue on digital agriculture education.

1.3 Asia (Japan)

In Japan, dissemination was embedded in educational exchange activities:

Participation in a Summer School programme (Japan, 2025), where USAGE-NG concepts were presented and discussed in relation to smart agriculture, robotics, and digital farming systems.

Additional dissemination through academic exchange and networking activities with Japanese universities and partners, documented through participant reports and programme materials.

1.4 Overall dissemination impact

Across all listed countries and events, conference and event participations served to:

- disseminate project concepts, interim findings, and educational approaches;
- collect feedback from international expert audiences;
- strengthen academic, vocational, and industry networks;
- position USAGE-NG within global discussions on smart farming, green skills, and lifelong learning.

While this section is reported under Activity 5.4, it intentionally includes dissemination actions originally implemented under Activity 3.4, ensuring a comprehensive and coherent overview of dissemination activities across the full project duration.

2 Final Conference

2.1 Opening

The event opened with a warm welcome from Christina Paulus (BOKU), who contextualized the USAGE-NG project within ongoing global challenges. While multiple crises dominate public discourse, she stressed that **food security and sustainable agriculture** remain central to Europe's long-term resilience.

She framed the project as a **three-year EU-funded collaboration** between BOKU, TUM, UNIBZ and ENAMA, targeting **small and medium-scale farmers** and **lifelong learners** in agriculture. The consortium's aim is to empower these groups with **digital, green, and mobile learning skills**, positioning education as a strategic tool for climate adaptation and rural development.

Implicit here is the assumption that digitalization, if well implemented, can bridge structural inequalities in agricultural education. Paulus also highlighted the need for **practical, accessible formats**, anticipating later critiques of MOOCs and static e-learning.

2.2 Keynote: Smart Farming Foundations

Prof. Heinz Bernhardt's keynote (TUM) introduced the conceptual background of **smart farming**, linking machinery engineering, sensor integration, and data-driven decision-making. His remarks set the stage by emphasising that technological progress is not sufficient on its own: adoption depends on **training ecosystems** that can translate technical potential into meaningful on-farm practice.

Key technologies in modern agriculture

- **Drones** for field monitoring, border detection, spraying
- **IoT sensors** feeding data into **AI-based decision models**
- **Robotics** to compensate labor shortages and automate data collection
- **Farm management platforms** enabling data sharing between farmers, government, and stakeholders

Bernhardt emphasizes that farmers can no longer rely on lifelong static knowledge (e.g., "how to operate a tractor"). Technologies evolve rapidly, so **training and accessible information systems** are essential.

He stressed the importance of balancing **online and in-person learning**, arguing that farmers require a combination of **digital tools** and **community-based exchange**. This foreshadowed the conference's recurring theme: **personal contact remains indispensable**, especially for farmers with low digital confidence.

2.3 European Education Landscape

Vladana Vidrić (BOKU) presented an analysis of European master programmes in agriculture, sustainability, and climate change. The findings highlight that:

- **Sustainability themes** are widely integrated, mostly horizontally across disciplines such as engineering, food systems and agricultural sciences.
- **Climate change mitigation** is present but less prominent.
- Teaching is predominantly delivered by **professors and researchers**, with **learner-centred approaches not yet deeply embedded**.

Her analysis implicitly challenges European institutions: while content is present, **pedagogical innovation** is lagging behind. A structural tension emerges: universities emphasise sustainability rhetorically but maintain **traditional teaching formats**, limiting active learning.

Vidrić presents the systematic review of EU-wide training programs on sustainability, climate mitigation, and smart farming.

Scope of the review

- 25 surveys across 11 European countries
- 70 programs (EQF 5–8)
- 13 lifelong-learning programs
- 189 modules (EQF 3–9)

Key findings

- Topics: engineering, sustainability, climate change, digitalization, robotics
- **Sustainability** strongly integrated; **climate mitigation** less emphasized
- Programs mostly face-to-face (36%) or online (36%), few in English
- Teaching dominated by professors/researchers; learner-centered methods only partly implemented
- Active learning is present but not deeply embedded

The results highlight a gap in practical, learner-centered, flexible training suitable for agricultural workers. These insights informed the project's micro-credential design.

2.3.1 Micro-Credentials Research

Vidrić also summarised findings on **informal and open online learning**, particularly MOOCs. These offerings are:

- **Mostly self-paced**,
- Flexible and widely accessible,
- Focused on topics like smart farming, digitalisation and sustainability.

However, she raised the critical question: **Do farmers actually use MOOCs?** The evidence suggests: **rarely**.

Barriers include digital literacy, lack of contextualisation, and insufficient learner support. This highlighted a structural contradiction: MOOCs promise reach and inclusivity but often fail with target groups requiring **guided, practical learning**.

Her analysis logically leads to the search for new models of digital training, setting up the stage for the AI Tutor presented later.

Goals for successful micro-credential development

- Increase modularity
- Use proper pedagogy + substantial smart-farming content
- Design 5–15 ECTS units
- Enable short-term upskilling (e.g., 6 ECTS)
- Prepare digital learning environments

2.3.2 Why Recognition of Prior Learning Matters

From Paulus's opening remarks and Vidrić's education analysis, it becomes clear that **universities cannot rely on farmers entering formal programmes with standard prerequisites**. Many agricultural practitioners:

- possess strong *practical* competences,
- but lack formal certificates,
- and cannot leave their work environments to attend long courses.

This is not a deficit but as a design challenge:
How can universities respect and utilize the competence farmers already have?

This is where **RPL (Recognition of Prior Learning)** enters the logic of the project.

Farmers routinely demonstrate skills in:

- machinery operation,
- crop and livestock management,
- problem solving during breakdowns or extreme weather,
- decision-making under uncertainty,
- digital improvisation using farm apps or machine interfaces.

These are **competences**, even if not acquired through formal study.

2.4 Learnings from Mountain Agriculture in South Tyrol

Andreas Mandler and Lorenzo Becce (UNIBZ) presented an overview of its lifelong learning activities, highlighting their strong regional anchoring in **South Tyrol**, where agricultural production is characterized by **orchards (particularly apples), vineyards, and mountain farming systems**. The courses are designed to address the specific operational and environmental challenges of this landscape.

2.4.1 Course Portfolio

A series of specialised modules has been implemented, including:

- training in **spraying technologies**,
- **machinery safety** with a particular focus on steep-slope conditions,
- **operational monitoring** in orchard systems,
- courses supporting **niche markets** such as mountain cereal production,
- and an **EQF Level 8 course**, jointly offered with BOKU, titled *Introduction to Smart Agriculture Technologies for Mountain Ecosystems*.
- **Participants**

Across all courses, approximately **180 individuals** have taken part, representing:

- farmers and farm managers,
- technical specialists,
- machinery manufacturers,
- and university students.

Educational Aims

The UNIBZ activities pursue several interconnected objectives:

- to **upskill farmers and engineers** in advanced and context-specific technologies,
- to enhance **operational safety** in challenging mountainous terrain,
- to support the **modernisation of mechanisation** for niche and small-scale production systems,
- and to foster **regional learning networks** linking universities, farmer associations, producer groups, and industry partners.

These actions demonstrate UNIBZ's role in bridging academic expertise and the practical needs of mountain agriculture, contributing directly to the project's overarching goal of strengthening smart farming competences in small-scale production environments.

2.4.2 Detailed Case Study: Spray Technology

Lorenzo Becce (UNIBZ) presented a focused case study on spray technology as a key component of modern agricultural mechanization. He outlined the high complexity of chemical plant protection, which arises from interacting physical processes (such as droplet formation and airflow), strict regulatory requirements, environmental considerations, and operator safety.

A central challenge highlighted was **spray drift**, where a significant proportion of the applied product can leave the target area. This phenomenon carries economic consequences for farmers, contributes to environmental contamination, and has led to increasing regulatory scrutiny, particularly in regions like South Tyrol, where orchards are often located close to residential areas.

To address these challenges, UNIBZ has developed a **multi-format training approach** targeted at students, farmers, and machinery manufacturers. The programme combines introductory lectures, laboratory-based demonstrations, data collection exercises, and collaborative field experiments with equipment producers. These activities allow participants to observe, measure, and interpret how adjustments to machinery settings influence spray coverage and environmental impact.

The resulting benefits are threefold:

- Students gain structured insight into a highly interdisciplinary topic.
- Operators learn how to optimise equipment settings to enhance both efficiency and safety.
- Manufacturers receive evidence-based feedback to support product development.

Through this work, UNIBZ positions itself as a **regional knowledge hub**, linking research, industry, and agricultural practitioners in efforts to improve plant protection practices.

2.5 Student Research Contributions

2.5.1 Max Sedlmair – Social Media & Knowledge Transfer

Sedlmair investigated how young people and young farmers use **social media** to access agricultural knowledge. His findings indicate that platforms can support **informal, rapid knowledge exchange**, especially on smart farming topics.

Yet, he implicitly exposes a tension: social media lowers barriers but risks **fragmentation, misinformation**, and inconsistent quality. This reinforces the need for structured guidance, which later motivates AI-supported learning tools.

2.5.2 Linda Ring – MOOC Evaluation for Smart Farming Education

Ring evaluated the potential of designing a MOOC for smart farming. Her results show:

- Designing **generalised, pan-European agricultural MOOCs** is extremely challenging.
- Farmers need **highly contextualised examples**, not generic theory.
- Engagement depends heavily on **personal interaction** and **trust-building**, which MOOCs struggle to deliver.

Her conclusion supports the project's shift away from MOOCs towards more adaptive tools: scalability alone does not solve the core pedagogical limitations.

2.5.3 Tobias Pachler – Training Needs of Austrian Farmers

Pachler explored Austrian farmers' training needs in smart farming. The main findings include:

- Farmers prefer **practical**, **application-focused** training.
- They value **personal contact**, field demonstrations, and peer learning.
- Digital-only formats lack the necessary credibility unless supported by trusted institutions.

This reinforced a critical pattern across the conference: **farmers require blended, guided, and context-specific learning**, not generic online modules.

2.6 An AI Tutor as an Alternative to MOOCs

Martin Mayr (BOKU) presented the projects most innovative pivot: replacing the originally planned MOOC with a **domain-specific, AI-powered tutor**.

Why move beyond MOOCs?

The team identified several core limitations of traditional MOOCs. Their static and non-adaptive design makes them unable to accommodate the diverse needs of agricultural learners, and their lack of interactivity and personalised guidance reduces their practical usefulness. Although MOOCs are widely accessible, they are seldom used by farmers, who require more responsive, contextualised, and supportive learning formats.

What does the AI Tutor provide?

- **Adaptive dialogue** that follows learner interests.
- **Multilingual support**, crucial for inclusivity.
- **Context-aware, domain-specific responses** grounded in curated agricultural content.
- A **scalable framework** allowing lecturers to build their own tutors.

How is it built?

1. Curate lecture content → summaries, recordings, external resources.
2. Build a structured **knowledge base**.
3. Define a **system prompt** to shape tutor behaviour.
4. Implement in an LLM interface (OpenAI, Mistral, local LLMs).
5. Test and evaluate conversational quality.

Risks and assumptions

Mayr also highlighted several risks and underlying assumptions that must be considered when implementing an AI tutor. He noted that strict **data governance** is essential, as the system can only function reliably when built on authorised and well-curated materials. Poor curation increases the likelihood of **bias**, while the inherent **limits of explainability** in large language models mean that not all outputs can be fully traced or justified. In addition, he stressed that successful deployment depends **on institutional approval** and adequate **digital literacy** among learners, both of which are prerequisites for using AI tools responsibly and effectively.

Key takeaway

An AI tutor **personalises and democratises lifelong learning**, but only when transparently designed, ethically used, and supported by proper institutional frameworks.

2.7 Keynote: Decision-Making in Agriculture

In his keynote, Prof. Fabrizio Mazzetto (UNIBZ) focused his contribution on the central challenge of **decision-making in agriculture**, arguing that technical knowledge alone is insufficient unless farmers can evaluate alternatives transparently and systematically. He emphasized that agricultural decisions typically involve **multiple, often conflicting criteria**—economic considerations, environmental impacts, operational constraints, safety, personal preferences, and stakeholder priorities. To address this complexity, he introduced **multi-criteria decision analysis (MCA)** as a structured method that supports farmers in navigating trade-offs and developing shared solutions.

A key message of his talk was that **AI cannot replace strategic agricultural decision-making**, because real-world choices integrate not only objective data but also subjective values, traditions, and long-term goals. Instead, he positioned MCA as a tool that strengthens farmers' autonomy by making these value-based elements explicit and reasoned rather than implicit or intuitive.

iNest: UNIBZ's Online MCA Platform

Mazzetto presented the **iNest platform**, a free decision-support environment developed at the University of Bolzano. The system guides users through the key steps of MCA:

- **Defining alternatives** (e.g., different machinery investments, spraying systems, land-use strategies).
- **Selecting criteria**, which may include economic cost, environmental impact, operational feasibility, or safety risks.
- **Weighting criteria and expressing personal or stakeholder preferences**.
- **Constructing an appraisal matrix** that transparently shows how each alternative performs across all criteria.
- **Running sensitivity analyses** to examine how changes in priorities affect the final ranking.

He emphasized that the tool's value lies not in producing a "perfect decision," but in enabling **transparent dialogue**, especially in contexts where multiple actors (e.g., family members, cooperatives, local authorities) must reach consensus.

Mountain Agriculture as a Complex Case

To illustrate MCA's relevance, Mazzetto discussed **mountain agriculture**, a sector characterized by steep terrain, fragmented plots, ecological sensitivity, and diverse stakeholder interests. Decisions in this context—such as choosing mechanization strategies or land-management approaches—require balancing **safety**, **ecosystem conservation**, **economic viability**, and **traditional practices**. MCA helps farmers and communities negotiate these trade-offs systematically and build solutions that are both technically sound and socially legitimate.

Practical Example: Choosing Orchard Spraying Technologies

He referred to examples from South Tyrol where farmers must select between different orchard spraying systems, each with implications for **drift reduction**, **environmental compliance**, **operational efficiency**, and **investment cost**.
Through MCA, farmers can:

- Compare the environmental performance of each sprayer model under local conditions.
- Weigh regulatory compliance and neighborhood safety (e.g., proximity to villages).
- Assess whether higher-cost technologies offer long-term operational advantages. The method reveals how different priorities—environmental protection vs. cost minimization—lead to different "optimal" solutions, making implicit preferences visible.

Teaching Example: Selecting a Pizzeria

To demonstrate the universality of MCA, Mazzetto described a classroom exercise where students use the method to choose among pizzerias. Although simple, the example shows how quickly transparent criteria, weighting, and ranking make subjective decisions reproducible and discussable. This exercise helps learners grasp MCA before applying it to more complex agricultural cases.

Final Perspective

Mazzetto concluded that MCA should be seen as a **core competence for modern farmers**, complementing digital tools and smart-farming technologies. While automation and AI continue to evolve rapidly, farmers remain responsible for integrating technical performance, economic risk, and community values into coherent decisions. Structured methods like MCA, supported by platforms such as iNest, strengthen this capacity and help ensure that technological innovation translates into sustainable, context-sensitive agricultural practice.

2.8 Cross-Cutting Conclusions

Across all talks, several unifying insights emerged:

Farmers require contextualised, trusted, and practical learning
Generic online formats fail when they do not align with local realities, equipment types, and socio-cultural patterns.

Blended learning outperforms purely online or purely in-person models
Experts repeatedly noted that farmers benefit from digital tools as supplements, not substitutes.

Digital literacy is a critical bottleneck
Even the best tools fail without foundational skills and guidance.

AI systems must be transparent, ethical, and curated
To avoid bias, misinformation, and dependency on uncontrolled LLM behaviour.

Training ecosystems must combine humans + technology
Advisors, educators, peers, and digital systems need to jointly support learning.

2.9 Final Outlook

The conference concluded with a forward-looking discussion:

- Future work will focus on **evaluating** the AI tutor with diverse, real users.
- The team plans to **open-source all build instructions and materials**, enabling other institutions to replicate or adapt the tool.
- Partners expressed interest in deeper cooperation on **smart farming training**, **AI-assisted education**, and **mountain agriculture**.
- Several speakers stressed the need for **institutional frameworks** that support innovation without compromising quality or ethics.

In closing remarks, Prof. Mazzetto and others reiterated that **discussion, community engagement, and personal contact** remain essential—even in an era of increasingly digital agriculture.

The event ended with an invitation for continued collaboration, questions, and participation in future USAGE-NG initiatives.