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An overview of higher education AgTech in Europe: general features, sustainability content, and life-long learning pathways

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Definitions and abbreviations used in the report

AgTech: Agricultural technologies. The modern definition of AgTech is the application of artificial intelligence with a focus on data-driven decision-making, and the progression from "farming" to "smart farming". The objective of AgTech is to implement smart solutions ensuring the sustainability of production in the field of agriculture within the framework of the food security strategy of the United Nations sustainable development program (Spanaki et al., 2022).

European Credit Transfer and Accumulation System (ECTS): a standard means for comparing academic credits, i.e., the "volume of learning based on the defined learning outcomes and their associated workload" for higher education across the European Union.

European Qualifications Framework (**EQF**): a translation tool to make national training and academic qualifications more comparable and understandable across Europe. The EQF aims to relate various countries' national training and academic qualifications systems to a common European reference framework. Since 2012, all new qualifications issued in Europe carry a reference to an appropriate EQF level (EUROPASS 2023).

HEI: Higher Education Institution.

LATEST: Local-focused AgTech Education for Successful Ag Transitions, an Erasmus+ project (2021-2024). LATEST has five consortium partners: University of Hohenheim, Germany; Uni LaSalle, France; BOKU, Austria; University of Udine, Italy; Harper Adam´s University, UK. Project website: http://latest-project.eu/.

LLL: Life-Long Learning

Module: a set of classes on a specific topic, e.g. within a semester at the university. To complete a module and get module credits one should complete the classes belonging to the module.

Program: a coherent set or sequence of educational activities designed and organized to achieve pre-determined learning objectives or accomplish a specific set of educational tasks over a sustained period (*Educational Programme*, 2020).

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1. Introduction

Agriculture is the economic sector that is most exposed to climate change patterns, with cascade effects on ecosystems functioning and food security (Gitz & Meybeck, 2016). At the same time, agriculture is also considered one of the major contributors to climate change (EEA 2019). Innovations are thus needed in order to adapt agricultural systems to extreme climate events, increase carbon storage, and mitigate GHG and pollutant emissions. Ensuring environmentally friendly food production is also a key part of the Farm to Fork strategy at the heart of the European Green Deal. The process of shifting from current mainstream conventional agricultural practices to more sustainable ones is known as "agricultural transition", and is also referred to as agroecological, climate-smart or energetic transitions.

A range of research, from sources such as Steenwerth et al. (2014) have underlined the role of AgTech as one of the main drivers of this transition, together with institutional innovations that enable actors in society to successfully build the agricultural transition together. In fact, AgTech is expected to contribute to reducing pollution, saving resources (water, energy, soil) and increasing productivity. AgTech includes sensors, precision agriculture technologies, artificial intelligence and robotics, but also farm management information systems as well as various technologies that enable agricultural practitioners to use novel farming systems for more environmentally-friendly products that appear along supply chains in the agri-food sector. AgTech also has the potential to positively modify the role of farmers in the decision-making process by giving them more autonomy and power in the decision-making process at the farm-level. Ultimately, AgTech enables various actors in the supply chain to monitor, manage and understand the intersection of agriculture, environment, and society in more precise ways. Several key challenges and needs have been identified in existing literature when it comes to the development of AgTech, such as the need for supply chain actors to know how to adopt and master the needed skills and knowledge to use the technology; data management and data ownership; the effective matching of research and development with end-user needs; the profitability of AgTech along the agri-food chain; the actual environmental impacts of AgTech; questions of dealership and distribution, and so forth (McBratney et al., 2005; Reganold & Wachter, 2016). To meet the challenges, there is an urgent need to assess, re-adjust and upscale AgTech training programmes, especially at the

higher education level, to address the main climate and sustainability issues faced by society, to meet the needs of the green labour market, and to bolster skilled labour in agriculture and industry.

The LATEST project aims to respond to these needs. This project is primarily aimed at bolstering AgTech within European higher educational programs to train future professionals to be able to deal with the ongoing agricultural transition toward more sustainable agriculture, with a focus on master-level programs. It also aims to support life-long learning and training in AgTech and diversify learner's profiles. Recent educational transitions in Europe have highlighted the need for a new framework for life-long learning that will include the recognition of micro-credentials (Thi Ngoc Ha et al., 2022), and the LATEST project will incorporate these credentials into its outputs. To achieve these objectives, a deep analysis on both the actual situation and the future education/skills needed to support a sustainable agricultural transition in the next years is being performed. It will highlight up-to-date academic programs to fill the identified gaps, also taking into account the most relevant EU policies as well as the existing initiatives and activities in the field of AgTech.

The objective of this report was a first step in the deep analysis referred to above, namely to gain a broad overview of AgTech higher education programs across Europe, covering EQF levels 5 to 8 plus life-long learning programs, and to characterize the programs main contents and features especially insofar as they are linked to sustainability issues. Correspondingly, this report presents an overview of the current state of AgTech higher education training in Europe with a strong climate and sustainability focus. It forms a baseline assessment for the rest of the LATEST project.

2. Methods

LATEST partners discussed and validated research aims, research parameters, and data collection methods at the project´s first transnational meeting held at the University of Hohenheim from May 9 to 10, 2022. On this occasion, it was decided to collect data in as many European countries as possible, using an online survey with built-in data protection features, and to include higher education institutions (HEIs) with traditional academic programs containing EQF levels 5-8 and/or life-long learning programs. Following the transnational meeting, data collection categories were refined and validated by all partners to include a range of information that give a detailed overview of the type of AgTech training programs being offered across Europe, their contents (especially related to climate and sustainability issues), mode of delivery, language, future climate/sustainability aims, and many more categories (Table 1). It was decided to conduct the survey in English due to the limitation of the survey software, the limits of project partners time capacities for translation, and the assumption that a professor, researcher or program manager at a European higher education institution is likely to understand basic English or can find a colleague or online translation tool to help them. Partners agreed to offer live 1:1 support to survey respondents in German, French, and Italian (languages spoken by the consortium partners) on an as-needed basis.

After the survey parameters were set, a range of potential free or low-cost survey tools were reviewed, including Google Forms, Microsoft Forms, SurveyMonkey, EUSurvey and Questback. Questback was determined to be only tool from among these which supported a survey with recurring multiple pathways (e.g., answering a multiple-choice question with option A leads to a different path through the survey than answering with option B and so on), with GDPR-compliant data protection features, and which enabled adequate user support. Therefore, Questback was the survey tool selected. The University of Hohenheim (LATEST project partner) already had a paid subscription in place for the "Unipark" version of Questback which was made available for the purposes of the LATEST project at no cost to the project.

A draft of the survey with a range of multiple choice and open-ended questions was created in Microsoft Word as a shared document, edited by all project partners and validated. Once it was validated, a complex, multi-pathway, multi-country survey was created in Questback software. Table 1 shows the main information investigated.

Table 1. Main questions from the online Questback survey for AgTech programs in HEI

Question type	Answer option type
I. General questions about the institution	
Name of institution	Open-ended
Title, name and contact details of respondent	Open-ended
Country of institution	Multiple choice (list of European countries plus the UK)
Location (address, city)	Open ended
Type of students served	Multiple choice (traditional degree-seeking, life-long, both)
Levels of programs offered	Multiple choice (EQF level 5, 6, 7, 8, life-long learning)
II. Questions on general features of the program, repeated for each EQF level	
Name of the training program	Open-ended
Website of program	Open-ended
Taught language(s) of program	Multiple choice
Typical duration of program	Multiple choice (less than 12 months, 12, 18, 24 months, 3, 4, 5 years, more than 5 years, other)
Number of ECTS credits required to complete program	Multiple choice (30, 60, 90, 120, 180, other)
Name of the degree/diploma type	Open-ended
Is the program online, in person, or hybrid?	Multiple choice (online, in-person, hybrid)
III. Questions about climate and sustainability content, repeated for each EQF level and LLL programs	
Does a specific *track/study path* in the program focus on climate change and/or sustainability?	Multiple choice (Yes, climate change; Yes, sustainability; Yes, both climate change and sustainability; No; Optional comment box)
Examples of *tracks/study paths* within the program that deal with climate change and/or sustainability, with title of the study track and link	Open-ended
Do any of the training *modules* in the program focus on climate change and/or sustainability (i.e., the orientation of the whole module is on this topic)	Multiple choice (Yes, climate change; Yes, sustainability; Yes, both climate change and sustainability; No; Optional comment box)
Examples of *modules* within the program that deal with climate change and/or sustainability, with title of the study track and link	Open-ended
If neither of the above, does the program incorporate climate change/sustainability topics in the modules (e.g., some of the lectures, exercises, or excursions within a module deal with this topic)	Multiple choice (Yes, climate change; Yes, sustainability; Yes, both climate change and sustainability; No; Optional comment box)
If the program does not offer whole modules or study paths focuses on climate change and/or sustainability, does it want to in the future?	Multiple choice (Yes, climate change; Yes, sustainability; Yes, both climate change and sustainability; No; Not sure; Optional comment box)

How strongly would you rate the incorporation of learner-centred pedagogical approaches in the program?	Sliding scale (5 = very high level of incorporation of learner-centred approaches, 1 = very low.)

IV. Questions about broader program content, repeated for each EQF level and LLL programs	
What are the main themes the program deals with?	Multiple choice (Agricultural engineering/AgTech broadly; Artificial intelligence; Climate change <focused on local issues>/<focused on global issues>; Data analytics; Digitalization; Precision agriculture; Robotics/automated processes; Sustainability; Other)
Describe up to 3 further specializations/tracks within the program (do not have to be climate change or sustainability related)	Open ended
Can life-long learners attend modules in this program?	Multiple choice (yes, no)
If yes, can life-long learners acquire micro-credentials?	Multiple choice (Yes, a certificate; Yes, ECTS credits; Yes, both a certificate and ECTS credits; No credentials, but can attend; Other--please describe)

V. General questions about life-long learning (LLL) programs, where relevant	
Is the LLL program open to the public? In other words, anyone with the relevant prerequisites can join, regardless of their affiliation to the institution?	Multiple choice (yes, no, optional comment)
Which of the following EQF levels does the LLL program correspond to? (select all that apply)	Multiple choice (EQF Level 5, EQF Level 6, EQF Level 7, EQF Level 8, other, none)
Does the LLL program offer a diploma or certificate?	Multiple choice (yes, no)
If yes, does the LLL program offer ECTS credits?	Multiple choice (yes, no)
Which micro-credentials does the LLL program offer? (select all that apply)	Multiple choice (ECTS credits for a particular course, Qualification for a job, Qualification for entering university, Other--please describe, No micro credential)
Who is the target group of the LLL training? (select all that apply)	Multiple choice (Career changers; Employees in industry; Employees in public sector; Farmers; Independent Contractors; Researchers/professors; School teachers; Self-motivated learners; Trainees in industry; Trainees in the public sector; Other)

What is the typical duration of the LLL training?	Multiple choice (Short duration, high-intensity workload (1 week to 8 weeks, 14 hours+ per week); Short duration, low-intensity workload (1 to 7 weeks, < 14 hours per week); Medium duration, high-intensity workload (9 to 26 weeks, >= 14 hours+ per week); Medium duration, low-intensity workload (9 to 26 weeks, < 14 hours per week); Long duration, high-intensity workload (>= 26+ weeks, >= 14 hours per week); Long duration, low-intensity workload (>= 26 weeks, < 14 hours per week); Other;
Is the LLL training online, in person, or hybrid?	Multiple choice (online in-person, hybrid)
Who primarily delivers the LLL training?	Multiple choice (Farmers; Public servants; Researchers/research assistants; School teachers; Skilled representatives of manufacturers/industry; Special consultants; University professors; Other)
Taught language(s) of program	Multiple choice
Website of LLL program	Open-ended

The online survey was tested separately by two individuals from the project, feedback was collected, and errors were corrected. As a first step in data collection, the survey was distributed by the University of Hohenheim to all project partners, so information from their institutions could be included in the results and in order to allow for a final opportunity for the partners to identify issues with the survey and correct them before distributing the survey wider. At the same time, project partners formed a survey distribution plan, namely a plan for how to identify relevant contacts within the project countries and in wider Europe for further survey distribution, to capture as wide and accurate a picture as possible. A two-part approach was agreed upon: 1) a systematic approach to using national databases to identify relevant higher education institutions within the project countries (Germany, Italy, and France); and 2) a snowball approach toward Austria, the UK, and other countries in Europe, due to lack of capacities within the project to take a systematic approach in those contexts. A snowball approach refers to using key informants (in this case, individuals from the project partners) to use their own social networks to find participants to participate in a study, and ideally for those participants to find others in their own network, and so on (Parker et al., 2019).

The LATEST partners in France, Germany and Italy carried out a systematic approach in their own countries, using national databases[1] to identify higher education programs in the AgTech. In each of those countries, the sample size was supplemented with personal contacts of each partner. Project partners in the UK and Austria found no national level databases that were appropriate for this task, and rather than going forward with the systematic approach, provided a list of personal contacts to initiate the snowball approach.

A written invitation to the survey was prepared in English, French and German for external contacts. Other languages were not possible due to limited capacity. Support with live translation of the English language survey was offered to respondents in English, French, German, and Italian on an as-needed basis. It was decided to personalize each survey request, by addressing a particular person at the institution by name in the email, to increase the chances of engagement by that person. The email invitation also offered to help the respondent with any questions or issues they may have. The survey and invitation to it was then distributed by the University of Hohenheim in January and February 2023 by email, according to the contacts found, and all results were collected on March 31, 2023.

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[1] France: http://www.monmaster.gouv.fr; Germany: http://www.hochschulkompass.de;
Italy: http://www.universitaly.it

3. Results

Based on a combination of the systematic and snowball approaches, personalized survey requests were sent to 84 higher education institutions in 11 countries between January and February 2023, plus to LATEST´s own five partners in September 2022, for a total of 89 survey requests sent. Including project partners, a total of 24 fully completed surveys were submitted by March 31, 2023. Based on the information from the survey software, we could see that an additional 39 surveys were either opened and not started or started and not completed, and thus cannot be counted towards the results analysis. 24 surveys were not started. The results of the survey from the University of Hohenheim were later added manually, therefore, they are not included in the output of the survey software. At the very end a total of 25 fully completed surveys was available. This shows a 71% response rate, and a 28% completion rate, which is nearly in line with the average response rate of research surveys (Fincham, 2008). Respondents answered the survey in variable time between 15 minutes and 90 minutes, 30 minutes being the average. The 25 surveys completed have generated data on a total of 70 programs at the EQF levels 5-8 plus 13 LLL programs.

3.1 General features of AgTech programs

As of March 31, 2023, 25 fully completed surveys were collected from HEIs in 10 countries, with the following distribution: Austria 2, Czech Republic 1, France 2, Germany 6, Italy 6, Poland 2, Slovakia 1, Spain 1, Switzerland 1, UK (England and Northern Ireland) 3. In total, data on 70 programs at EQF level 5-8 plus 13 LLL programs were analysed (Table 2). In this survey, the Level 8 programs addressed are only *taught PhD* programs (i.e., PhD programs in which coursework is required in addition to research). The list of the HEIs which fully completed the survey is included in Annex 1. Further information regarding the geographical distribution of the HEIs surveyed can be retrieved via the mapping section on the LATEST project website[2].

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[2] link to the LATEST mapping: http://latest-project.eu/mapping-of-agtech-trainings

Table 2. Overview of AgTech program offer in Europe. SOURCE: LATEST PR1 SURVEY

| Country | EQF levels | | | | | LLL programs | Total |
	5	6	7	8	Total 5-8		
Austria	1	1	1	1	4	2	6
Czech Republic	-	1	1	1	3	1	4
France	-	1	2	1	4	2	6
Germany	-	5	5	2	12	1	13
Italy	-	5	6	4	15	3	18
Poland	-	2	2	2	6	1	7
Slovakia	-	1	1	1	3	-	3
Spain	-	1	1	1	3	1	4
Switzerland	-	-	-	-	1	1	2
UK	1	3	2	-	6	1	7
Total	2	20	21	13	56	13	69

Concerning the mode of training (in person/online), all programs are delivered at least partially in person and no program is delivered solely online. Online training components characterize nearly one third of the programs both at EQF 5-8 levels (25 out of 70, 36%) and at LLL level (6 out of 20, 30%).

Turning to training language, the English language is adopted at least partially in nearly three fourths of the programs at EQF 5-8 levels (47 out of 70), while local language was also prominent in nearly all programs (60 cases); the remaining ten programs, delivered entirely in English language as foreign language, are in Germany (1 at EQF level 6, 7 at EQF level 7), and in Italy (EQF levels 7 and 8). For LLL programs, modules are largely taught in the local language, with only one exception, while English is available in nearly half of the cases (6 out of 13, 46%), even if it does not always cover all the contents.

Regarding the presence of climate change and sustainability study tracks within the programs, it was found that a focus on climate change alone is absent. When climate change is taken up as a study track, it is always accompanied by other sustainability issues. Overall, a focus on sustainability alone as a broader study track is present in 17 programs (24% of the total), while climate change plus other sustainability issues is specifically addressed in 8

programs (11% of the total). For LLL programs, similar tendencies were found. A number of respondents observed that a focus on climate and sustainability is not offered as stand-alone study tracks, but are mostly integrated in wider subject areas (e.g., *production systems, fruit and landscape, food industry engineering*) within a range of topics like *diversification, individualized livestock production, healthy food, waste management, biomaterials, energy* and *water*, etc.

Although sustainability and climate change cannot be considered the main focus of most academic offers, they are treated as important themes by 71% and 49% of the programs, respectively (Fig.1). The prevailing themes treated in EQF programs are engineering-AgTech (including mechanical engineering and precision agriculture) and sustainability followed by digitalization/robotics (including automation and artificial intelligence), climate change, other themes (e.g., food science and agricultural business management) and data analytics. LLL program themes follow a similar behaviour.

In relation to the teaching category, scholars clearly emerged the main content delivers, followed by industry representatives and consultants (Fig. 2). A minor role is played by other categories (farmers, school teachers, and public servants). On average, the number of teacher categories involved in delivering content is between 2 and 3. In LLL programs, the presence of academics (researchers, professors) is less pronounced whereas school teachers and farmers are slightly more numerous than compared with standard EQF levels 5-8.
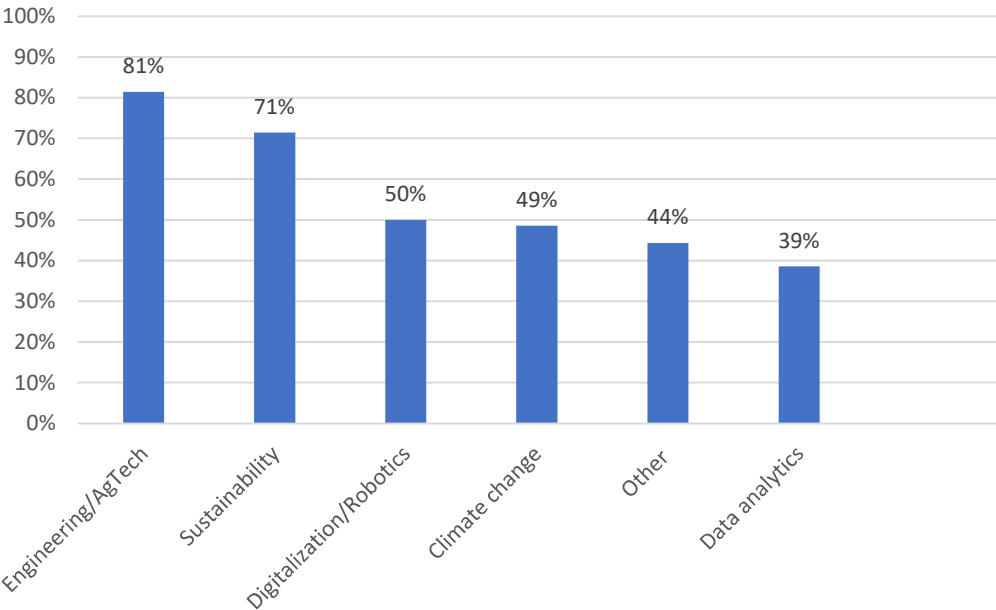

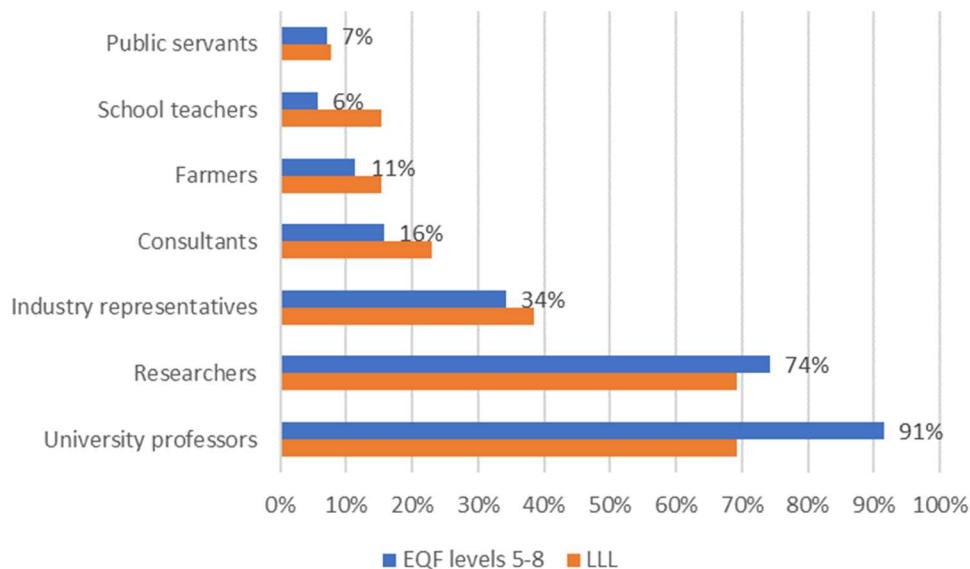FIGURE 1. MAIN THEMES OF EQF 5-8 PROGRAMS. SOURCE: LATEST PR1 SURVEY

The strength of application of learner-centred pedagogy was partially assessed as part of the survey. Such an approach places student at the centre of the teaching-learning process and involves exchanges and negotiations between teacher and learner (examples include providing students with choices, designing lessons for multiple intelligences, place-based learning, project-based learning, etc). On average, respondents rated their programs incorporation of learner-centred pedagogies as moderate/slightly above average. (3 on a scale of 1 to 5); no relevant variation was found across the EQF levels.

3.2 Programs at EQF Level 5

Only two observations are available regarding programs EQF level 5, which refers to high school programs. At this level, *engineering-AgTech* and *sustainability* are the main themes covered. Table 3 shows specific study tracks at EQF level 5 dealing with climate change and sustainability issues.

TABLE 3. STUDY TRACKS AT EQF LEVEL 5. SOURCE: LATEST PR1 SURVEY

Country – HEI	Tracks (link)
Austria - HBLFA Raumberg Gumpenstein	*Agricultural Production* (http://raumberg-gumpenstein.at/schule/bildungsangebot/landwirtschaft/landwirtschaft.html)[1]
	Environmental Management and Resource Management (http://raumberg-gumpenstein.at/schule/bildungsangebot/umwelt-und-ressourcenmanagement/umwelt-und-ressourcenmanagement.html)

[1]Note: link to the track not available, program link was reported.

3.3 Programs at EQF Level 6

EQF level 6 concerns bachelor degrees. The prevailing themes of programs at this level are *engineering-AgTech* (75%) and *sustainability* (63%), followed by *digitalization/robotics* (50%), *other* (including further aspects of agriculture, environmental issues and machine design), *climate change*, and *data analytics* (Fig. 3). Table 4 reports study tracks dealing with climate change and sustainability.
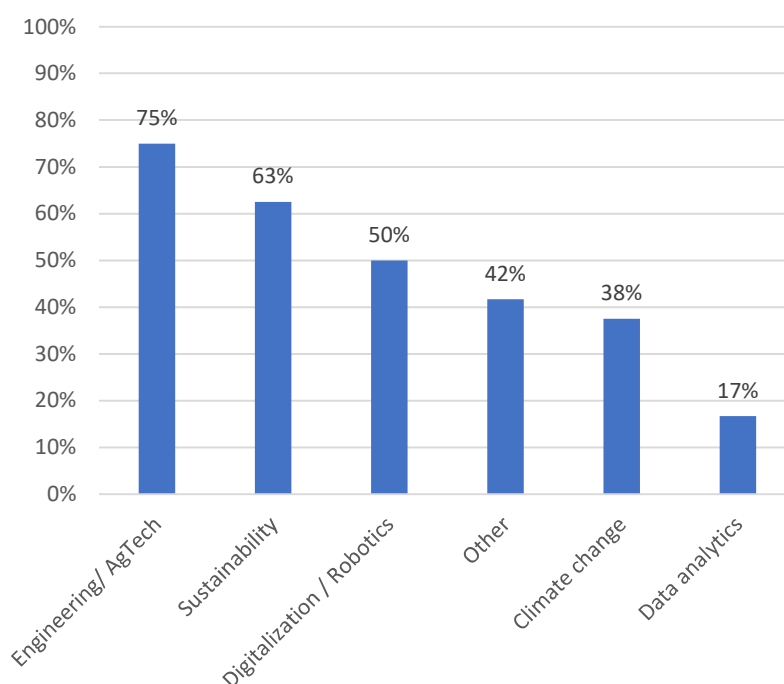

FIGURE 3. MAIN THEMES OF EQF LEVEL 6 PROGRAMS. SOURCE: LATEST PR1 SURVEY

TABLE 4. STUDY TRACKS DEALING WITH CLIMATE CHANGE AND SUSTAINABILITY IN EQF LEVEL 6 PROGRAMS. SOURCE: LATEST PR1 SURVEY

Country - HEI	Tracks (link)
Austria - BOKU University of natural resources and life sciences	*Smart Crop Farming* (https://smartcrop.boku.ac.at/)
Germany - Technische Universität Braunschweig	*Sustainable Engineering of Products and Processes (https://www.tu-braunschweig.de/fmb/studium/bachelor/sustainable-engineering-of-products-and-processes)*
Germany - University of Hohenheim	*Biobased Products and Bioenergy (https://www.uni-hohenheim.de/en/biobased-products-and-bioenergy-bachelors)* *Agricultural Sciences (https://www.uni-hohenheim.de/en/agricultural-sciences-bachelors)* *Agricultural Biology (https://www.uni-hohenheim.de/en/agricultural-biology-bachelor)* *Sustainability and Change (https://www.uni-hohenheim.de/sustainability-and-change-bachelor-studium)*
UK (England) - Harper Adams University	*Agricultural Systems and Field Engineering (https://www.harper-adams.ac.uk/courses/undergraduate/201013/2023/agricultural-engineering)*
	Engineering and the Future Environment (https://www.harper-adams.ac.uk/courses/undergraduate/201013/2023/agricultural-engineering)
	Ethics and Sustainability (https://www.harper-adams.ac.uk/courses/undergraduate/201013/2023/agricultural-engineering)

3.4 Programs at EQF Level 7

EQF level 7 refers to master degrees. As for previous EQF levels, *engineering – AgTech* (83%) and *sustainability* (77%) are the prevailing themes. *Climate change* is studied in 60*%* of the programs at EQF level 7*,* followed by *data analytics, other (*including livestock pig production, pest control, soil and water management) *and digitalization/robotics* (Fig 4). Table 5 reports study tracks dealing with climate change and sustainability.
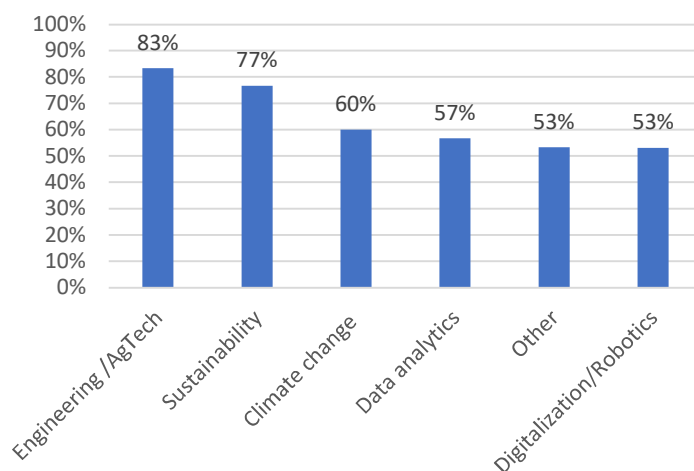
FIGURE 4. MAIN THEMES OF EQF LEVEL 7 PROGRAMS. SOURCE: LATEST PR1 SURVEY

TABLE 5. STUDY TRACKS DEALING AT EQF LEVEL 7 PROGRAMS. SOURCE: LATEST PR1 SURVEY

Country - HEI	Tracks (link)
Austria - Boku University of natural resources and life sciences	*Organic Agricultural Systems and Agroecology (Agro-Eci-Organic) and Organic Agricultural Systems and Agroecology (https://boku.ac.at/studienservices/studien/master-en/uh066500?selectedTypes=group)*
	Material and Energy Use of Renewable Resources (https://boku.ac.at/studienservices/studien/master-int/uh066471?selectedTypes=group)
	Environmental and Bioresource Management (https://boku.ac.at/studienservices/studien/master/uh066427?selectedTypes=group)
France - Institut Polytechnique UniLaSalle	*Farming for the future (https://www.unilasalle.fr/parcours-farming-future)*
	Management of natural resources (https://www.unilasalle.fr/parcours-gestion-des-ressources-naturelles-dans-les-agroecosystemes)
Germany - Technische Universität Braunschweig	*Sustainable Energy Engineering (https://www.tu-braunschweig.de/en/fmb/students/masters-degree-programmes/sustainable-energy-engineering)*
Germany - University of Hohenheim	*Biobased products and Bioenergy (https://www.uni-hohenheim.de/en/biobased-products-and-bioenergy-masters)* *Agricultural Sciences (https://www.uni-hohenheim.de/en/agricultural-sciences-masters)* *Bioeconomy (https://www.uni-hohenheim.de/en/bioeconomy-masters)* *Environmental protection and agricultural food production*

	(https://www.uni-hohenheim.de/en/environmental-protection-and-agricultural-food-production-masters)
	Landscape Ecology (https://www.uni-hohenheim.de/landscape-ecology-master-studium)
	Earth and Climate System Science
	(https://www.uni-hohenheim.de/earth-and-climate-system-science-master-studium)
	Agricultural Science in the tropics and subtropics
	(https://www.uni-hohenheim.de/agricultural-sciences-in-the-tropics-and-subtropics-master-studium)
	Environmental Science Soil, Water and Biodiversity
	(https://www.uni-hohenheim.de/environmental-science-soil-water-and-biodiversity-master-studium)
	Organic agriculture and Food Systems
	(https://www.uni-hohenheim.de/organic-agriculture-and-food-systems-master-studium)
Italy - Free University of Bozen-Bolzano	Environmental Management of Mountain Areas (https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/master-environmental-management-mountain-areas/)[1]
	Horticultural Science (IMaHS) (https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/master-horticultural-science/)[1]
	Food Sciences for Innovation and Authenticity (https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/master-food-sciences-innovation-authenticity/)[1]
Italy - University of Teramo	Management of spatial and temporal variability (https://www.unite.it/UniTE/Didattica/Master_e_corsi_di_formazione_2022_2023/Agricoltura_di_precisione_1)[1]
	Modeling & Decision Support System (https://www.unite.it/UniTE/Didattica/Master_e_corsi_di_formazione_2022_2023/Agricoltura_di_precisione_1)[1]
	Agriculture Data and digital precision technology (https://www.unite.it/UniTE/Didattica/Master_e_corsi_di_formazione_2022_2023/Agricoltura_di_precisione_1)[1]
Italy - University of Tuscia	Digital management of forest and water resources (https://unitusorienta.unitus.it/course/gestione-digitale-dellagricoltura-e-del-territorio-montano/)[1]
	Energy supplies (https://unitusorienta.unitus.it/course/gestione-digitale-dellagricoltura-e-del-territorio-montano/)[1]
	Environmental quality monitoring (https://unitusorienta.unitus.it/course/gestione-digitale-dellagricoltura-e-del-territorio-montano/)[1]
Italy - University of Bari	Fruit tree eco-physiology and strategies to cope with climate change (https://www.uniba.it/it/ricerca/dipartimenti/disspa/english/courses/clm-ideas)[1]

	Sustainable field cropping systems for bio-based sectors and bioenergy (https://www.uniba.it/it/ricerca/dipartimenti/disspa/english/courses/clm-ideas)[1]	
	Innovation in biomass and wastes management in agrifood systems (https://www.uniba.it/it/ricerca/dipartimenti/disspa/english/courses/clm-ideas)[1]	
Spain - University of Lleida	*Master degree Integrated Pest Management (https://ipm.udl.cat/en/)[1]*	
	Master degree Wildland Fire. Science and Integrative Management (https://masterfuegoforestal.udl.cat/en/)⁻	
UK - Harper Adams University	*Agricultural Systems and Field Engineering (https://www.harper-adams.ac.uk/courses/undergraduate/201012/2023/agricultural-engineering)*	
	Ethics and Sustainability (https://www.harper-adams.ac.uk/courses/undergraduate/201012/2023/agricultural-engineering)	
	Engineering the Future Environment (https://www.harper-adams.ac.uk/courses/undergraduate/201012/2023/agricultural-engineering)	

[1]Note: link to the track not available, program link was reported.

3.5 Programs at EQF Level 8

EQF level 8 concerns taught PhD degrees (i.e., where completion of the PhD requires coursework in addition to research). In contrast to the other EQF levels, *sustainability* (79%) is here the main theme, followed by *engineering/AgTech* (71%) and *digitalization/robotics* (57%)*.* Half of the programs at this EQF level deal with *climate change* issues (Fig 5). Tracks are reported in Table 6.
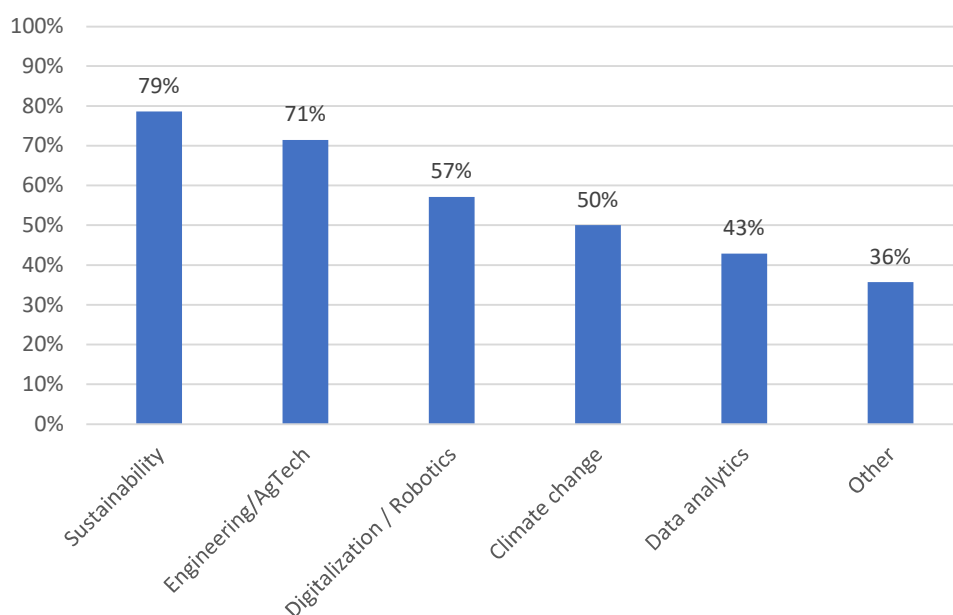
FIGURE 5. MAIN THEMES OF EQF LEVEL 8 PROGRAMS. SOURCE: LATEST PR1 SURVEY

TABLE 6. STUDY TRACKS DEALING WITH CLIMATE CHANGE AND SUSTAINABILITY IN EQF LEVEL 8 PROGRAMS. SOURCE: LATEST PR1 SURVEY

Country - HEI	Tracks (link)
Germany - Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB)	*Bioeconomy (https://www.atb-potsdam.de/en/career/offers-for-phd-students)*
Germany – University of Hohenheim	*Agricultural Sciences (https://www.uni-hohenheim.de/en/agricultural-science-doctoral-degree-program)*
Italy - University of Tuscia	*Energy and engineering systems (https://www.unitus.it/it/dipartimento/deim-ingegneria/corsi-di-dottorato-ing/articolo/presentazione-offf-ing-deim-dott)*
	Biosystems and environment (https://www.unitus.it/it/dipartimento/deim-ingegneria/corsi-di-dottorato-ing/articolo/presentazione-offf-ing-deim-dott)

3.6 LLL programs

Turning to LLL programs, 13 out of the 25 institutions surveyed offered life-long learning programs in AgTech in addition to programs for traditional degree-seeking students. However, none of these institutions offered LLL programs exclusively. Nearly half of the programs up to EQF 7 are also accessible to LL learners, while this figure is reduced to closer to 30% for taught PhD programs at EQF 8 (Fig. 6). The prevailing themes of LLL programs are

engineering-AgTech and sustainability followed by digitalization/ robotics, climate change and data analytics.

Turning to teacher types, scholars are the main content delivers of LLL programs, followed by industry representatives and consultants (Fig. 2).

Regarding credentials delivered, half of the HEIs (7 out of 13) offer ECTS credits upon completion of the LLL program; the majority of them (9 out of 13) offer either a certificate (5), a diploma (1), or both (3).
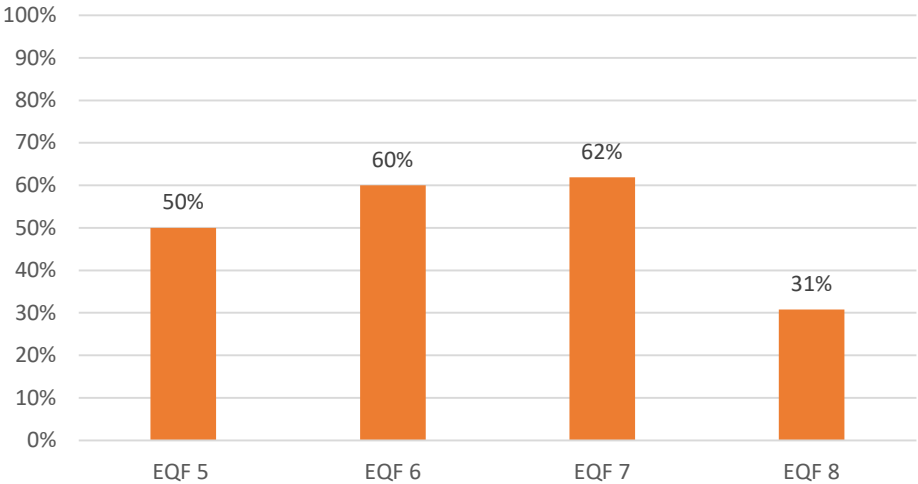

FIGURE 6. PROGRAMS AT EQF LEVEL 5 TO 8 ACCESSIBLE TO LL LEARNERS

4. Concluding remarks

The aim of this report was to gain a detailed overview of European higher education and life-long learning programs dealing with AgTech, with particular attention to the programs´ climate change and sustainability contents. In order to assess this, LATEST project partners distributed detailed surveys to 89 higher education institutions in the EU, UK, and Switzerland. A total of 25 fully completed surveys were submitted, through which data on a total of 70 programs at the EQF levels 5-8 plus 13 LLL programs was retrieved.

In terms of program content, while an exclusive focus on climate change is absent, climate change is often treated as part of a wider curriculum on sustainability. The prevailing themes treated within European academic AgTech programs are engineering/AgTech (including mechanical engineering and precision agriculture) and sustainability, half of the programs deal with digitalization/robotics (including automation and artificial intelligence). Nearly half of the programs deal with climate change, data analytics and others. Within this last category, general issues within food science and agricultural business management such as livestock management, pest control, soil management, and water management are summarized. EQF level 8 programs were the exception insofar as sustainability is the most addressed theme.

Concerning the method of program delivery, it was found that all programs are delivered at least partially in person, with one third of the programs also delivered online. Most of the programs at EQF levels 5-8 are offered in both local and English languages, while at the LLL level, nearly all modules are taught in the local language. Survey participants rated their programs´ application of learner-centred pedagogical approaches as moderately strong (3 on a scale of 1 to 5), without any significant difference across EQF and LLL levels. In contrast to programs at EQF levels 5-8, school teachers and farmers are slightly more numerous in LLL programs compared with university staff.

This research is characterized by a number of limits. Apart from the selection of survey participants which was limited by national education program databases and the professional contacts of LATEST project partners, we believe the sample size represented by the completed surveys is limited when compared with the current number of AgTech programs offered of

European HEIs. Furthermore, it must be considered that non-academic LLL programs are offered by different types of organizations such as companies, agencies, professional associations, etc, which we did not have capacity to reach.

As far as the authors know, this report is the very first fresh view into AgTech higher education offers across Europe. It provides a solid basis for exploring further analyses and actions related to questions regarding AgTech education in Europe and its intersection with climate and sustainability issues. In particular, it provides the data needed to support the next steps and aims of the LATEST project, namely to strengthen European AgTech higher education to train future professionals to be able to deal with the ongoing transition toward more sustainable and climate-friendly agriculture, with a focus on master-level programs, and to support life-long learning and training in AgTech and diversify learner's profiles. Ultimately, the results of the LATEST project, including this deliverable, reflect a response to the main climate and sustainability issues faced by society, and contribute to meeting the needs of the green labour market and bolstering skilled labour in agriculture and industry.

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Annex I

PR1 surveyed institutions of the LATEST project. Source: PR1 survey of the LATEST project.

Country, HEI	EQF levels				LLL programs
	5	6	7	8	
Austria	**1**	**1**	**1**	**1**	**2**
HBLFA Raumberg Gumpenstein	1	-	-	-	1
University of natural resources and life sciences	-	1	1	1	1
Czech Republic	**-**	**1**	**1**	**1**	**1**
Mendel University in Brno	-	1	1	1	1
France	**-**	**1**	**2**	**1**	**2**
Institut Agro	-	-	1	1	1
Institut Polytechnique UniLaSalle	-	1	1		1
Germany	**-**	**6**	**6**	**3**	**1**
Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB)	-	1	1	1	-
Technical University of Munich	-	1	1	-	1
Technische Hochschule Köln University of Applied Sciences	-	1	1	-	-
Technische Universität Berlin	-	1	1	-	-
Technische Universität Braunschweig	-	1	1	1	-
University of Hohenheim*		1	1	1-	-
Italy	**-**	**5**	**6**	**4**	**3**
Free University of Bozen-Bolzano	-	1	1	1	1
University of Molise	-	1	1	1	-
University of Teramo	-	1	1	1	1
University of Tuscia	-	-	1	1	1
University of Udine	-	1	1		-
University of Bari	-	1	1	-	-
Poland	**-**	**2**	**2**	**2**	**1**
University of Life Sciences in Lublin	-	1	1	1	-
Warsaw University of Life Sciences	-	1	1	1	1
Slovakia	**-**	**1**	**1**	**1**	**-**
Slovak University of Agriculture in Nitra	-	1	1	1	-
Spain	**-**	**1**	**1**	**1**	**1**
University of Lleida	-	1	1	1	1
Switzerland	**-**	**-**	**-**	**-**	**1**
Agroscope	-	-	-	-	1
UK	**1**	**3**	**2**	**-**	**1**
Harper Adams University	-	1	1	-	-
Queen's University Belfast	-	1	1	-	-
University Centre Myerscough	1	1	-	-	1