AGRIFOOD 4Future

D4.2

VET Programmes for EQF 6-8

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Abstract

This document provides a comprehensive guide to the careful design and development of the Agrifood for Future Training Programme as part of Work Package 4. It outlines the rationale behind the curricula, the course structure, and the methodology employed to create a cohesive and impactful learning experience for students in the agrifood sector.

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List of abbreviation

AF4F	AGRIFOOD4FUTURE
WP4	Work Package 4
ADDIE	Analyze, Design, Develop, Implement, and Evaluate Model
EQF	European Qualifications Framework
CSR	Corporate Social Responsibility
UCSC	Università Cattolica del Sacro Cuore
FCUP	University of Porto
ECTS	European Credit Transfer and Accumulation System

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1 Introduction

1.1 Scope of WP4 "Development of innovative teaching and training programmes in smart farming and sustainable food systems"

The scope of Work Package 4 (WP4) in the AF4F project centers on the creation and implementation of innovative teaching and training programs to support smart farming and sustainable food systems in higher education. These programs will cater to different educational levels and include a focus on lifelong learning, ensuring the continuous development of skills in this evolving field. Additionally, WP4 will introduce transnational models for the recognition of qualifications and ensure quality assurance across the VET sector.

The key objectives of WP4 are:

- Developing innovative educational content for various EQF levels (EQF 3-5 and EQF 6-8), including advanced master's and PhD courses on smart farming and sustainability.
- Enhancing the professional development of advisors, teachers, and trainers through blended learning, modular curricula, and practical site visits to demonstration farms.
- Creating e-learning tools and best-practice resources for teaching agri-food topics and offering practical guidance for farmers.
- Implementing capacity-building initiatives for small and medium-sized enterprises (SMEs) and farmers to promote more efficient and sustainable agricultural practices.
- Establishing a guidance service and territorial observatory to monitor labor market trends and adjust VET programs to emerging needs in the agri-food sector.

1.2. Description of the WP4

WP4 is an important pillar of the AF4F project, designed to address the digital transition, green transition, bioeconomy, and soft upskilling needs within the European agrifood sector. This Work Package is structured into a series of tasks and actions aimed at developing 4 different curricula for each pillar to ensure the students in the Agrifood sector are equipped with the requisite digital, green, bioeconomic, and soft skills competencies.

WP4 focuses on creating a comprehensive framework for training, assessment, and ongoing learning, specifically designed to address the emerging needs of the agrifood sector. This initiative is carefully structured to encompass everything from curriculum development to the practical application of the training material, ensuring a well-rounded approach to skills development.

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The initial phase under WP4, enclosed in Tasks 4.1 and 4.2. More specifically, Task 4.2 is also related to the design and development of 4 different curricula. This includes the formulation of new competence-based courses, creation of an assessment methodology, and the production of training content, all of which are leading towards fostering a learning environment that promotes the aforementioned skills in the agrifood sector.

This task is pivotal for the curricula implementation that will be prior tested in each partner country in universities (Università Cattolica del Sacro Cuore - UCSC in Italy, University of Porto - FCUP in Portugal, - University of Applied Sciences - VIVES in Belgium and AgroParisTech in France), for piloting of EQF6-8 training, delivering the training content to its practical application of the training schemes. The milestones of WP4 serve as indicators of progress toward the deliverables, highlighting the completion of the training content development. These milestones are instrumental in ensuring that WP4 stays on course, aligning with the broader objectives of the AF4F Project.

This deliverable aims to establish the basis for designing the training content, providing a structured approach to skills development that is essential for the success of the upcoming tasks and actions in WP4.

The specific task under WP4 describes a structured and comprehensive approach to fostering a digitally and sustainably adept learning environment, aligning with the emerging skills that are needed in higher education for the agrifood sector. Overall, through collaborative efforts among the consortium members, WP4 will contribute to the development of crucial skills in the agrifood sector.

1.3 The Relationship Between EQF Levels 6-8 and Higher Education

The European Qualifications Framework (EQF) is a standardized reference framework used to compare qualifications across different education systems in Europe. It consists of eight levels, each corresponding to different levels of knowledge, skills, and competences. EQF levels 6 to 8 directly relate to higher education as follows:

1. EQF Level 6: Bachelor's Degree

Corresponds to: Bachelor's degree or equivalent in most European countries.

Knowledge and Skills: At this level, learners demonstrate advanced knowledge of a field of work or study, critical comprehension of theories and principles, and the ability to apply knowledge in solving complex and unpredictable problems. This includes the development of higher cognitive skills, critical thinking, and analytical abilities.

Competence: The ability to manage complex projects or processes and take responsibility for decision-making within professional or study contexts.

2. EQF Level 7: Master's Degree

Corresponds to: Master's degree or equivalent.

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Knowledge and Skills: EQF Level 7 is characterized by highly specialized and advanced knowledge, typically in a particular field of study. Learners are expected to be capable of independent research, analysis, and interpretation, and they demonstrate problem-solving abilities in new or unfamiliar contexts.

Competence: The ability to manage and transform complex professional activities or environments that require innovation and leadership. At this level, learners take responsibility for leading professional development or academic research.

3. EQF Level 8: Doctorate (Ph.D.)

Corresponds to: Doctoral degree or equivalent.

Knowledge and Skills: At this level, individuals have the most advanced, specialized, and frontier knowledge of a particular field. They are expected to contribute original research and lead the advancement of their discipline.

Competence: EQF Level 8 learners are expected to manage complex, unpredictable work or study situations, and be capable of creating new knowledge through original research. This level often involves leading innovation and demonstrating authority in academic or professional practice.

- ✓ EQF Level 6 typically aligns with undergraduate education (Bachelor's), where students focus on gaining foundational and advanced knowledge in their chosen field.
- ✓ EQF Level 7 aligns with graduate education (Master's), where students specialize further and develop skills for independent research and professional application.
- ✓ EQF Level 8 is the level of doctoral education (Ph.D.), where learners conduct original research and contribute to academic knowledge or professional practice.

The European Qualifications Framework (EQF) provides a standardized system to compare and align qualifications across Europe, and in the context of the Erasmus+ "Agrifood for Future" project, it serves as a key reference for curriculum development. This project, aimed at enhancing education in the agrifood sector, focuses on creating learning opportunities aligned with EQF levels 6-8, which directly correspond to higher education qualifications.

1.4 EQF Levels and Their Relation to Higher Education in AF4F Project

- **EQF Level 6: Bachelor’s Degree**

At this level, the curriculum within the AF4F program is designed to build foundational and advanced knowledge in agrifood topics. It enables undergraduate students to gain critical understanding and problem-solving abilities, addressing gaps identified by project partners.

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The six-month exchange program within the project enables students at this level to expand their learning beyond their regular courses, gaining specialized knowledge from other European institutions involved in the program.

- **EQF Level 7: Master's Degree**

At the Master's level, the AF4F program aims to provide highly specialized knowledge in areas relevant to the agrifood sector, leveraging cutting-edge topics identified in WP2. Students are encouraged to deepen their expertise and conduct advanced research or applied work that enhances their professional competencies.

By facilitating cross-border exchange, the project allows Master's students to gain insights from partner institutions not available in their home curriculum, fostering collaboration and the development of new skills.

- **EQF Level 8: Doctorate (Ph.D.)**

For doctoral candidates, the curriculum at EQF Level 8 focuses on original research and contributing to the advancement of knowledge in the agrifood sector. The AF4F project facilitates the sharing of research approaches and methodologies across institutions, giving Ph.D. students the opportunity to collaborate internationally.

These exchanges enable doctoral students to work on complex, interdisciplinary problems, aligning their research efforts with the project's objectives while contributing innovative solutions to real-world challenges in the agrifood industry.

1.5 Curriculum Development Based on EQF Levels

The AF4F project's curriculum aligns with EQF levels 6-8, ensuring that students participating in the exchange program receive education that meets the standardized learning outcomes defined across Europe. By integrating existing courses and filling gaps identified through project research, the program ensures that students at all three EQF levels gain access to advanced knowledge and training.

The use of the ERASMUS mobility program further supports student exchanges across the four partner institutions (UCSC, VIVES, FCUP, AgriParisTech), allowing for smooth credit transfer and recognition of learning outcomes, with 30 ECTS credits awarded for the six-month exchange. This structure supports the personal and academic growth of students while addressing the educational and professional needs of the agrifood sector at all higher education levels.

In summary, the EQF levels 6-8 framework provides a structured foundation for the curriculum in the AF4F project, ensuring that participating students receive relevant, high-quality education and training, contributing to both academic and sectoral advancements across Europe.

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1.6 Sustainability and Long-Term Impact of the AF4F Curriculum

The sustainability and long-term impact of the AF4F curriculum are key considerations in ensuring that the project's objectives continue to benefit both the education sector and the agrifood industry beyond the project's lifespan. The following strategies and outcomes are designed to ensure that the curriculum remains relevant, adaptable, and influential in the future:

1. Integration into Regular Curricula

A major aspect of the curriculum's sustainability lies into its being part of the regular curricula of the partner institutions involved in the project, as well as of other institutions that may join later. Finding the correspondence between the courses in the four institutions involved, UCSC, VIVES, FCUP and AgriparisTech, it is a challenging process but it will ensure the sustainability and and the long-term existence of the developed curriculum after the end of the project.

The curriculum's focus on filling identified gaps in agrifood education ensures that it addresses current sectoral needs in the four countries of the partners involved in the development of the curriculum, making it a valuable and sought-after component of academic programs. This relevance increases the likelihood that universities will continue offering the courses after the project ends, either by developing Double Degree programs or through ongoing collaboration under the ERASMUS framework.

2. Scalability

The topics design of the curriculum allows it to be scalable and adopted by other institutions, beyond the original four partners (UCSC, VIVES, FCUP, AgriParisTech). The knowledge gained from the piloting phases will enable the project to refine the curriculum and make it adaptable to the rules and the needs of the various educational and regulatory environments across the European countries involved.

The tailored learning paths created for students from various institutions ensure the curriculum's flexibility, allowing other institutions to easily adopt and adapt it to meet their unique academic or industry-specific requirements.

3. Continuous Industry Alignment

As the agrifood industry evolves, the curriculum is designed to be continuously updated with emerging trends and technological advancements. This adaptability ensures that graduates remain competitive in the job market and capable of addressing new challenges in the agrifood sector.

Collaboration with industry partners for the internship programme, mandatory in each curriculum will help maintain alignment between the curriculum and the skills demanded by employers. Feedback loops with industry partners, professional bodies, and alumni can facilitate ongoing curriculum updates that reflect the latest sector innovations.

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4. Cross-Border Academic and Professional Networks

One of the long-term benefits of the project is the creation of cross-border academic and professional networks. The exchange program, which brings together students, faculty, and industry leaders from multiple countries, fosters collaboration and knowledge-sharing that will extend beyond the project's duration.

These networks can lead to future research collaborations, joint degrees (Double Degrees), and professional partnerships in the agrifood sector, further supporting the long-term sustainability of the curriculum.

5. Strengthening ERASMUS Partnerships

By leveraging the existing ERASMUS mobility program, the project strengthens partnerships between the participating institutions, creating a foundation for continued student exchanges and collaborative programs. The agreements made during the project will facilitate ongoing mobility, enabling students to continue benefiting from cross-cultural learning experiences and diverse academic perspectives in the agrifood field.

The sustainability and long-term impact of the AF4F curriculum are underpinned by its alignment with existing educational frameworks, adaptability to future needs, and the strong collaborative networks it fosters. Through integration into regular academic programs, continuous alignment with industry demands, and the creation of lasting cross-border partnerships, the curriculum is designed to make a lasting contribution to the education and professional development of students in the agrifood sector.

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2 Methodology for the Development of a Higher Education Semester Exchange for the Erasmus+ Project "Agrifood4 Future" (EQF 6-8)

The development of a new Semester Exchange curriculum according to the EQF thathosting organizations need for the higher education levels of EQF 6-8 within the framework of the AF4F project faces certain institutional and temporal constraints. Specifically, higher education partners decided to rely on a semester exchange as this will provide both the institutions and the learners with already available knowledge of the highest level, based on each partner's specialized expertise - what is more this knowledge is integrated into the official Curricula and validated by the national authorities which is an additional asset. Through the exchanges, the institutes will gain insights on sub-sectors that are not or are partly developed within their courses and the selected learners will be able to excel in many different topics, taking advantage of an interdisciplinary approach and studying courses that they would have probably never had access to (at least at bachelor's or master's level) should this Curriculum have not existed. Therefore, instead of capitalizing the partners' expertise on designing a completely new Curriculum, the partners decided to address this need through their currently offered courses. Such changes require formal approval from National Education Ministries, a process that exceeds the project's timeline. Therefore, the following structured methodology has been developed to ensure that the project achieves its educational objectives while adhering to these limitations.

2.1 Utilizing Established Curricula and Extensive Course Mapping

The development of the AF4F semester exchange curricula is anchored in the optimization of existing courses currently offered by the partner institutions. This approach strategically builds on the wealth of knowledge and expertise already embedded in the higher education programs at UCSC, VIVES, FCUP, and AgriParisTech. The initial step in this process involved an extensive course mapping exercise, focusing on courses taught in English across these institutions. Through the careful identification and organization of relevant subjects, this process established a strong framework, or "skeleton," for the curricula.

This foundational course structure will be further refined and expanded through a detailed gap analysis based on the thematic focus areas and the specific needs highlighted in Work Package 2 (WP2). WP2's insights into industry demands, emerging agrifood trends, and educational gaps are instrumental in ensuring that the new curricula addresses contemporary challenges in the agrifood sector, as well as the specific academic and professional needs of both partner institutions and their students.

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By enhancing the existing curricula with additional, strategically integrated topics and internship programme, the project ensures that students receive a well-rounded and forward-thinking education that not only fills current knowledge gaps but also prepares them for future advancements in the agrifood industry. This method guarantees that the curricula remains flexible, targeted, and adaptable to the evolving needs of the sector, while maintaining the integrity and quality of higher education standards across borders.

2.2 Gap Analysis and Integration of New Topics

A comprehensive gap analysis was carried out during Work Package 2 (WP2) to pinpoint critical areas where additional topics, skills, and knowledge are necessary to meet the evolving demands of the agricultural and food sectors. This in-depth analysis identified specific gaps in the existing educational frameworks, highlighting the need for supplementary content to ensure that students are fully equipped to address contemporary challenges and opportunities in the agrifood industry.

As a result, the current course structure will be strategically enhanced by incorporating these key areas, thereby broadening the curricula with cutting-edge subjects that are not yet offered at students' home institutions. This enrichment process not only introduces learners to the latest developments in the field but also ensures they acquire industry-relevant competencies and knowledge, positioning them as future leaders in the sector. By aligning the curricula with the identified needs of the agrifood industry, the program bridges the gap between academic theory and practical application, offering students a more holistic, future-oriented education that is both academically rigorous and professionally relevant.

The gap analysis conducted during WP2 (for more details see D.4.1) revealed several critical skill deficiencies in key areas crucial to the agrifood sector's development. These include:

Digital Transition: Significant gaps in digital competencies, particularly in data management and analysis, hinder the sector’s ability to leverage advanced technologies such as precision agriculture and digital communication platforms. There is also a notable lack of skills in digital product management, robotic solutions, and the ability to navigate digital bureaucratic systems and supply chains.

Green Transition: The agrifood workforce needs upskilling in resource efficiency, sustainable logistics, regenerative practices, and biodiversity management. Expertise in sustainable water and energy management, soil health, and climate adaptation is also lacking. Additionally, there is a growing demand for knowledge in environmental policies and CSR reporting to ensure compliance and enhance sustainability efforts.

Bioeconomy: Skills gaps in quality management, food safety, life cycle analysis, and waste stream analysis are impeding the sector's shift towards bioeconomic practices. Professionals need practical experience in these areas to ensure the sustainable use of biological resources and effective management of bioeconomic value chains.

Soft Skills: Deficiencies in strategic thinking, self-management, teamwork, leadership, and entrepreneurial skills are hampering the sector’s ability to adapt to change, innovate,

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and collaborate across the agrifood value chain. These soft skills are essential for navigating the sector's digital transformation and sustainability challenges.

Addressing these gaps through targeted curricula enhancements will ensure that students are well-prepared to meet the future demands of the agrifood sector.

2.3 Designing a Personalized Curriculum

To provide a richer and more dynamic learning experience, the curricula will be carefully tailored to each individual student, taking into account the specific academic goals, career aspirations, and thematic focus areas of the partner institutions. This personalized approach allows students to engage with a flexible educational path that not only addresses the unique needs of each participant but also harnesses the collective strengths and expertise of the international consortium. By tapping into the diverse offerings of the participating institutions, the curriculum becomes a bespoke educational journey, empowering students to develop a more comprehensive skill set that transcends their home curricula.

The program offers a six-month exchange period, enabling students to study abroad and immerse themselves in courses and internship programme not available at their home institutions. This cross-border experience enriches their academic journey, allowing them to gain specialized knowledge and practical skills from diverse educational environments. Upon successful completion of the program, students will be awarded 30 ECTS credits, as outlined in the project proposal, which ensures that the exchange integrates seamlessly into their existing academic trajectory.

By fostering this personalized and internationally collaborative approach, the curricula encourages students to explore innovative topics and emerging trends in the agrifood sector, equipping them with the cutting-edge competencies needed to thrive in an increasingly global and interdisciplinary field. This model not only enhances academic learning but also cultivates valuable intercultural competencies, adaptability, and a global perspective, positioning students as future leaders in the agrifood industry.

2.4 Involvement of Partners

Although AgriParisTech was not originally listed as a primary partner in the first piloting phase of the project, its early involvement was strategically prioritized to ensure the achievement of the project’s key performance indicators (KPIs). By integrating AgriParisTech from the outset, the project team was able to utilize its unique expertise in agricultural sciences and sustainable practices, ensuring a more holistic and cutting-edge approach to curricula development.

The decision to include AgriParisTech early in the process was driven by several key considerations. First, the institution's extensive experience in interdisciplinary education and research provides invaluable contributions to the curriculum's structure, particularly in addressing emerging challenges within the agrifood sector. Second, incorporating AgriParisTech from the beginning helps to overcome potential bureaucratic and administrative delays associated with inter-institutional agreements and the formal

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recognition of the exchange program by national educational authorities. Given the time-intensive nature of these processes, early engagement allows for smoother coordination across institutions, ensuring that all partners are aligned and that the curricula are approved and fully functional within the project's timeline.

Moreover, AgriParisTech's involvement enhances the overall breadth and depth of the learning experience, offering students access to specialized courses and innovative research facilities that complement the strengths of the other partner institutions—UCSC, VIVES, and FCUP. This partnership ensures that students gain exposure to a diverse range of topics, from digital transformation in agriculture to sustainable resource management, allowing them to develop cross-disciplinary competencies essential for addressing the global challenges faced by the agrifood sector.

By actively involving AgriParisTech from the outset, the project not only strengthens the interdisciplinary nature of the curriculum but also ensures that the program remains aligned with the evolving needs of both academia and industry. This proactive approach helps to solidify the long-term sustainability of the initiative and guarantees that the project will meet its milestones and impact goals on schedule.

2.5 Coordination and Stakeholder Engagement

A series of strategic meetings were organized with Centers of Vocational Excellence (COVEs) from various countries to foster collaboration and ensure effective coordination throughout the project. These meetings played a pivotal role in mapping potential candidate institutions for the second phase of piloting. Engaging with COVEs early in the process ensures that the curriculum is not only academically rigorous but also adaptable to the specific needs and standards of diverse educational systems across multiple countries. This collaborative framework is essential for facilitating future scaling, institutional adoption, and cross-border recognition of the curriculum.

Each meeting involved key stakeholders from both higher education and vocational training sectors, ensuring a wide representation of industry perspectives and educational expertise. Discussions were centered on the alignment of the curriculum with the European Qualifications Framework (EQF) levels 6-8, ensuring that the content adheres to internationally recognized standards of academic quality and skill development. This alignment is crucial for creating a curriculum that is flexible and topics oriented, making it easier for new institutions—both higher education and vocational training centers—to adopt and implement the program according to their specific contexts.

Additionally, the engagement with COVEs ensures that the program can bridge the gap between academic theory and practical, industry-relevant skills, offering students hands-on experience that aligns with the latest trends in the agrifood sector. By incorporating feedback from institutions across various regions, the curricula can be well designed to meet the needs of local industries while maintaining a broader European and global perspective. This dynamic approach enables the program to be scalable and transferable, promoting widespread adoption across different educational institutions and countries in the future.

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Furthermore, these meetings helped to establish clear criteria for selecting candidate institutions for the second piloting phase, ensuring that participating schools or universities possess the necessary infrastructure and resources to successfully implement the curricula. Involving stakeholders in these early discussions helps to create a strong network of future partners who can contribute to the ongoing development and enhancement of the curricula, promoting their sustainability and long-term impact.

The result of these coordinated efforts are curricula that are not only academically robust but also adaptable, scalable, and responsive to the evolving demands of the agrifood industry and education sectors. This collaborative effort with COVEs and other stakeholders establishes a solid foundation for future institutional partnerships, allowing the curricula to extend beyond the initial pilot institutions and engage a wider audience both across Europe and internationally.

2.6 Student Mobility and Use of ERASMUS Program

Since the project's budget does not allocate funds for student mobility, the ERASMUS program will be leveraged to support the exchange of students. ERASMUS, a well-established European Union program for education, training, and exchange, offers a reliable and structured platform to facilitate international student mobility. Agreements are currently being negotiated between the four key partner institutions—UCSC, VIVES, FCUP, and AgriParisTech— to facilitate students' smooth participation in a six-month exchange program.

These agreements will cover essential aspects such as credit recognition, academic integration, and administrative support, ensuring that students' learning experiences are aligned with both their home and host institutions' curricula. The use of the ERASMUS framework provides a flexible and familiar mechanism for ensuring the smooth transfer of students, while also offering financial support for living and travel expenses. By utilizing ERASMUS, the project ensures that student mobility is not hindered by budgetary constraints, allowing participants to benefit from the international exposure, diverse academic experiences, and specialized training and internship programmes offered by the partner institutions.

Additionally, the program's reliance on ERASMUS agreements supports long-term sustainability by encouraging continued collaboration between the institutions involved, setting a precedent for future student exchanges and broader participation in international learning networks. This approach not only strengthens the curriculum's impact but also ensures that students gain valuable cross-cultural skills and practical knowledge that will enhance their employability in the global agrifood sector.

2.7 Evaluation and Refinement

Upon completion of the pilot phase, a comprehensive evaluation process will be conducted to assess the curriculum' effectiveness and impact on both students and participating institutions. Feedback will be gathered from multiple sources, including students, faculty members, industry experts, and external stakeholders such as representatives from agricultural and food sectors. This multi-dimensional feedback will

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offer valuable insights into the curriculum' strengths, areas for improvement, and their alignment with industry needs and academic objectives.

Key performance indicators (KPIs), such as student performance, learning outcomes, satisfaction levels, and industry readiness, will be used as benchmarks for evaluation. The evaluation process will also focus on the curriculum's ability to address the skill gaps identified during the gap analysis, ensuring that the new content meets the educational and professional demands of the agrifood sector.

After analyzing the feedback, necessary adjustments will be made to refine the curricula before the second piloting phase. These refinements could involve updating course materials, revising learning objectives, integrating new teaching methodologies, or expanding the practical components of the curricula. By incorporating this feedback-driven process, the curricula will not only be continuously improved but will also remain responsive to evolving industry trends and the diverse needs of the partner institutions.

This iterative approach to curricula refinement will help ensure the program is scalable and adaptable, positioning it for broader adoption by a larger network of institutions in the future. Additionally, the insights gained during the pilot evaluation will be shared with project stakeholders to facilitate transparency and collaborative improvements across the educational consortium.

2.8 Conclusion

This methodology, which emphasizes the adaptation of existing courses, the creation of personalized learning paths, and fostering international collaboration, ensures that the AF4F curricula are both academically rigorous and aligned with the project's broader objectives. By strategically building upon the established course offerings of partner institutions—UCSC, VIVES, FCUP, and AgriParisTech—the program utilizes existing strengths while addressing emerging needs within the agrifood sector.

A key feature of this approach is the use of personalized learning paths, tailored to the specific academic backgrounds, professional interests, and future career goals of students from different institutions. By allowing students to choose from a wide array of topics and specializations, the curricula remains highly adaptable, empowering them to engage with content that is most relevant to their individual trajectories. This ensures that students from diverse educational settings can benefit from a cohesive and customized learning experience, fostering their personal and professional growth.

Additionally, the program is designed to facilitate international collaboration through a structured six-month exchange, supported by the ERASMUS program. This mobility framework provides students with the opportunity to study at one of the partner institutions, gaining access to expertise, resources, and courses not available at their home universities. The seamless integration of ERASMUS funding allows for smooth student exchanges without financial strain on the project's budget, ensuring that the exchange period is both accessible and impactful.

The inclusion of new topics, based on WP2's comprehensive gap analysis, adds value by addressing critical skill shortages in areas such as digitalization, sustainability, and

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the bioeconomy. These topics are not only forward-looking but also highly relevant to the ongoing transformation of the agrifood industry, equipping students with cutting-edge knowledge and skills that are crucial for future employability.

Moreover, this methodology ensures that the curriculum remains practical and feasible within the regulatory frameworks of higher education. By aligning the program with the European Qualifications Framework (EQF) levels 6-8, the curriculum guarantees academic recognition and credit transfer across participating institutions. This structured yet flexible design allows the program to operate efficiently within the constraints of varying national higher education systems, while still providing a dynamic and cross-disciplinary educational experience.

In summary, the combination of course adaptation, personalized learning paths, international collaboration, and the incorporation of new content driven by industry needs makes the AF4F curriculum a pioneering model. It offers students a transformative learning experience that not only meets academic and professional standards but also prepares them to lead the future of the agrifood sector.

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3 Analysis and Rationale of Curricula for the EQF Level 6-8

3.1 A Structured Approach Using the ADDIE Model in the AF4F Project

As outlined in D.4.1, the development of the "Agrifood for Future" (AF4F) curricula follows the ADDIE model, a structured instructional design framework consisting of five key phases: (1) Analyze, (2) Design, (3) Develop, (4) Implement, and (5) Evaluate. This approach ensures that the curriculum is methodically developed to address the educational needs of learners across the EQF Level 6-8 spectrum, while also aligning with the objectives of the project and the requirements of the international consortium.

Analysis Phase

The Analysis phase forms the foundation of the ADDIE model, where the primary goal is to identify and understand the educational challenges that the AF4F curriculum aims to address. The following key inquiries drive this phase:

1. Who are the learners?

The target group consists of students from partner institutions at EQF Levels 6-8, with diverse backgrounds in agricultural sciences, food systems, and sustainability. For EQF 6, bachelor's degree students from institutions like UCSC and VIVES are considered, as both provide courses in English languages for this level. For EQF 7, the curriculum is tailored to master's students, particularly at UCSC, FCUP, and AgroParisTech. VIVES doesn't have master degrees. The EQF 8 level focuses on Ph.D. students, primarily from AgroParisTech, FCUP and UCSC, the only partners with PhD programs.

2. What are their learning styles?

Considering the diverse geographical and institutional contexts, the curricula integrates a blend of theoretical learning and practical, hands-on experiences. Internship and training courses, as well as master thesis projects, are incorporated into the design to cater to different learning preferences. The ERASMUS mobility framework also provides students with the opportunity to study topics unavailable in their home curricula, thereby enhancing cross-border educational experiences.

3. What is the knowledge problem?

The gap analysis conducted in WP2 identified significant gaps in current agricultural and food systems curricula, particularly concerning sustainability and innovative agricultural practices. These gaps inform the design of the AF4F curricula, which focuses on new and emerging topics tailored to the evolving needs of the agri-food sector. For EQF 6-8, the curricula are structured to address these gaps, ensuring that students gain knowledge and skills relevant to the future of the agrifood industry.

4. What are the learning objectives?

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The overarching learning objectives are to equip students with the interdisciplinary knowledge and practical skills required to tackle modern challenges in agriculture and food systems. For EQF 6 students, the focus is on foundational knowledge and cross-disciplinary skills. At the EQF 7 level, the curriculum aims to deepen their expertise in specialized areas, with consideration for internships, research, and master thesis projects. For EQF 8, the goal is to foster high-level research capabilities and cross-institutional collaboration.

5. What should be the learning content?

The content of the AF4F curricula are designed to reflect both the identified gaps from WP2 and the specific needs of partner institutions. For EQF 6, a specific curriculum is developed between UCSC and VIVES, with bachelor's programs also considered to expand student participation. EQF 7 curricula, developed by UCSC, FCUP, and AgroParisTech, focus on advanced topics, and internships and skill-building modules are emphasized. EQF 8 curriculum, developed by FCUP will be made available for the PhD students of UCSC and AgroParisTech and specific agreements between the three institutions will be made in order to ensure the availability of the program and the participation of the students.

6. What is the overall goal of this training programme?

The goal of the AF4F curriculum is to create a flexible, interdisciplinary educational framework that enables students to gain comprehensive knowledge and skills in sustainable agriculture and food systems. Through personalized learning paths, cross-institutional mobility, and a strong emphasis on international collaboration, the curricula ensure that students are well-prepared for the challenges of the global agrifood sector.

The ADDIE model continues to guide the design, development, and refinement of the curricula. The personalized learning paths allow students to tailor their academic journeys based on their specific needs and the unique strengths of the participating institutions. VIVES, while primarily offering EQF 5 programs, plays a crucial role in developing EQF 6 bachelor-level curricula alongside UCSC. This broadens the potential student base by including bachelor's degrees in the exchange program. At the master's level (EQF 7), FCUP , UCSC, and AgroParisTech collaborate to develop new curricula, ensuring the integration of practical training, internships, and research components, while EQF 8 curriculum, developed by FCUP will be made available for the PhD students of UCSC and AgroParisTech.

Given the constraints posed by a low number of student enrollments and tight timelines for agreements, the project has postponed the task ending date to M45. This extension accommodates a 3-semester mobility plan, facilitating exchanges in Fall 2025, Spring 2026, and Fall 2026, thus increasing the probability of student participation. The use of the ERASMUS program ensures that students can seamlessly engage in a six-month exchange period, earning 30 ECTS credits upon successful completion.

The ongoing involvement of all key partners, including AgroParisTech, which has been integrated early into the process to meet the project's key performance indicators (KPIs), ensures the timely development and successful implementation of the curriculum.

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Through this collaborative approach and adherence to the ADDIE model, the AF4F curricula are designed to meet the project's objectives while navigating the regulatory and institutional constraints of the European higher education system.

3.2 Special Needs for the Learning Environment

To create an effective and inclusive learning environment for the AF4F project, it is essential to address various special needs that cater to diverse learners. This encompasses language adaptations, technical requirements, support services, inclusivity initiatives, and additional resources. Here's a breakdown of these components:

Language Adaptations:

- **Multilingual Resources**: Course materials will be available in English language but the curricula description is available in five languages, EN, IT, FR, NL and PT. This ensures that non-native speakers can engage with the content of the curricula. However, the students will be taught just in English.
- **Bilingual Instruction**: Instructors may consider providing instructions and explanations in both the primary language of instruction and the students' native languages, fostering better understanding and participation.
- **Language Support Services**: Language workshops or tutoring sessions can be offered to assist students in improving their academic language skills in English, enhancing their overall learning experience.

Technical Requirements:

- **Accessible Platforms**: The online learning management system (LMS) and all digital resources must comply with accessibility standards, ensuring compatibility with assistive technologies like screen readers and voice recognition software. The students will be enrolled as Exchange students in the hosting institutions and the online learning platforms of the hosting institutions will be available for all the enrolled students.
- **Device Compatibility**: Course materials should be accessible across various devices (laptops, tablets, smartphones) to accommodate students' personal preferences and circumstances.
- **Technical Support**: Ongoing technical assistance will be provided to help students navigate digital platforms, troubleshoot issues, and effectively use any required software.

Support Services:

- **Academic Counseling**: Students will have access to academic advisors who will help them navigate their educational paths and address any challenges they may face.
- **Tutoring and Mentorship**: Tutoring programs and mentorship initiatives will provide additional support to students who may require extra help in their studies.

Inclusivity Initiatives:

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- **Diverse Teaching Strategies**: A variety of teaching methods to accommodate different learning styles, such as visual aids, group discussions, and hands-on activities will be applied.
- **Culturally Relevant Curriculum**: The curricula will reflect diverse perspectives and be inclusive of various cultural backgrounds, ensuring that all students see themselves represented in their learning materials.
- **Feedback Mechanisms**: Creating avenues for students to provide feedback on inclusivity and accessibility issues allows for continuous improvement in the learning environment.

Additional Resources:

- **Supplemental Learning Materials**: A range of supplementary resources, such as online modules, video tutorials, and interactive tools will be available.
- **Resource Centers**: The enrolled Exchange students will have access to specialized materials, technology, and study spaces available in the hosting Universities.
- **Workshops and Training**: The enrolled Exchange students will take part to workshops focused on skill development, including study techniques, time management, and stress reduction, organized by the hosting Universities.

By addressing these special needs within the learning environment, the AF4F project can ensure a supportive and equitable educational experience for all students, fostering engagement, success, and personal growth.

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4 Design Phase

Considering the skill gaps identified by WP2 outputs and available English courses in the involved universities, different curricula have been implemented. Each university offer the following 30ECTS curricula:

4.1 Business sustainability and valorisation of resources (VIVES)

Curriculum Title	**Business sustainability and valorisation of resources**
Curriculum Description (aim & objectives)	The "Business sustainability and valorisation of resources " curriculum takes into consideration 6 courses: Global Sustainability and Engagement, Strong Sustainability, Project Entrepreneurship, Emerging Technologies, Product Development (Spring) or Food Microbiology (Fall) and Work Field Exploration for a total of 24 ECTS. An internship of 6 ECTS will complete the program. The internship will provide students with a rewarding experience, giving them the opportunity to deepen their knowledge while contributing to the dynamic evolution of the agro-food industry. Agro-food firms in West Flanders are industry leaders known for the world-class production and processing of meat, fish, vegetables, potatoes and grain. The province is home to Europe's greatest concentration of frozen food companies.
EQF Level	6
Learning Objectives	
1. To have thorough insights in the challenges that the (agro-food) industry faces in terms of sustainable entrepreneurship. **2.** To include new perspectives bound to climate change and to a more efficient use of natural resources for food production and processing. **3.** To acquire fundamental knowledge about food production, preservation and processing. **4.** To provide the future Bachelor graduates with the skills, knowledge and capacities to perform within the competitive agro-food sector and to improve the quality, sustainability and market performance of agro-food firms. **5.** To provide students with the fundamental scientific, technical and operational knowledge related to food treatment, preservation and processing. **6.** To give an overview on the fundamentals in applied agronomy to students hoping to build their knowledge and skills in the topics that are most needed for sustainable management of agroecosystems.	
Course schedule	Global sustainability and engagement
	Strong Sustainability
	Project Entrepreneurship
	Emerging Technologies
	Product Development
	Food Microbiology
	Work Field Exploration
	Internship
Learning Parts	Theoretical/Practical
Curriculum length	6 months Semester Exchange (February-July)

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4.2 European Master in Biological and Chemical Engineering for a Sustainable Bioeconomy (AgroParisTech)

Curriculum Title	Biological and Chemical Engineering for a Sustainable Bioeconomy
Curriculum Description (aim & objectives)	Bioceb addresses the needs of the growing bio-based industry sector in scientists being aware of the markets and socio-economic contexts. It aims at training future research and innovation managers to tackle the challenges related to the deployment of the bioeconomy across the world. Bioceb vision of the bioeconomy is based on the sustainable use of biological resources, preserving biodiversity and favoring circular economy systems. It offers students with backgrounds in biology-related disciplines the opportunity to specialize in one field of biotechnologies while developing the ability to implement systemic value chain approaches.
EQF Level	7
Learning Objectives	
1. Comprehending specificities of lignocelluloses and the different levers of their quality. **2.** Comprehending the complex agricultural systems leading to biomass production within territories. **3.** Facing up the complexity of science-based decision-making, understanding the process of innovation and being able to develop a new business model. **4.** Acquiring economic tools to address issues related to environmental, ecological and climatic issues. **5.** Raising students' awareness of complementary approaches applicable to the management of ecosystems and of bio-based value-chains in general.	
Course schedule	Introduction
	From paper industry to lignocellulose biorefinery: towards a multicriteria approach of quality
	Energetic crops and biomass
	Lignocelluloses and fibers
	Visit of R&D centers (IFPEN Biotechnologies division, FRD center)
	Visit of production unit (Greenfield paper recycling unit)
	Visit of research laboratory (INRA unit in plant sciences)
	Lecture on resources production
	Lecture on required fluxes for biomass production
	Lecture on actors networks
	Practical work
	Field trip
	Tutored collective work
	Decision aiding
	Operation research
	Introduction to Sciences of Innovation
	Fundamentals of Microeconomic Analysis
	Bio-economy
	Economic calculus
	Optimal use of renewable resources
	Economics of risk and innovation
	Growth and the environment
	Principles of environmental management

	Introduction to methodological frameworks
	Application to the bio-economy
	Group work
Learning Parts	Theoretical/Practical
Curriculum length	6 months Semester Exchange (January - June)

4.3 Climate, Land-Use and Ecosystem Services (Fall) (AgroParisTech)

Curriculum Title	**Climate, Land-Use and Ecosystem Services**
Curriculum Description (aim & objectives)	Climate, Land-Use and Ecosystem Services (acronym: CLUES) is a Master of Sciences programme offered by AgroParisTech, as part of the Paris-Saclay Univiersity in France. Its overarching objective is to provide students with the scientific knowledge, know-how and skills necessary to understand the functioning of terrestrial ecosystems in response to major drivers such as climate change, land-use change patterns and ecosystem management technologies. Courses will promote integrated approaches through a multi-disciplinary curriculum combining natural sciences (climatology, bioclimatology, soil science, ecology), social and economic sciences and advanced courses in data management, analysis and modelling. The capacities of students to synthesize and integrate information from a range of sources and knowledge from these different disciplines will be fostered through the development of projects related to climate and ecosystems in case-study areas, based on state-of-the-art methodologies to involve local stakeholders and proponents. Students will need to choose courses from the list, totaling 24 ECTS, in agreement with the program directors. An intership of 6 ECTS will complete the program.
EQF Level	7
Learning Objectives	
1.	To provide students with the scientific knowledge, know-how and skills necessary to understand the functioning of terrestrial ecosystems in response to major drivers such as climate change, land-use change patterns and ecosystem management options.
2.	To equip students with a detailed knowledge of biosphere-climate interactions, with methods to assess ecosystem services and environmental impacts, and raise their awareness of the panel of technological options available in terms of land-use management and planning to promote sustainable development in rural and urban areas.
Course schedule	Biosphere-climate interactions at local to global scales
	Global agronomy, land-use planning and modelling
	The assessment of ecosystem services
	Internship in research lab or experimental farm (6 ects)
Learning Parts	Theoretical/Practical
Curriculum length	6 months Semester exchange (September - February)

4.4 New sustainable practices in horticulture (Spring) (FCUP)

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Curriculum Title	New sustainable practices in horticulture
Curriculum Description (aim & objectives)	The "New sustainable practices in horticulture" curriculum includes 4 courses: Precision Agriculture, Grape and Wine Production, Vegetable and Fruit Production and Risks to the Environment and Human Health - corresponding to a total of 24 ECTS. An intership of 6 ECTS will complete the program. The intership will provide the students with a hands-on experience, giving them the opportunity to deepen the knowledge obtained in the courses, supported by new technologies and scientific knowledge that promotes production with increased resource use efficiency and higher product quality. In strict collaboration with Faculty of Sciences of University of Porto (FCUP) & GreenUPorto - Sustainable Agrifood Production Research Centre, the students will have the opportunity to perform their internship within R&D ongoing projects and/or with horticultural stakeholders, learning different laboratorial techniques and field practices. Additionally, students will gain insight on risk assessment, for instance on the predictive risk assessment process aplied on the registration of new chemical susbtances as pesticides.
EQF Level	7
Learning Objectives	
1. Design culture systems tailored to Precision Agriculture, considering diverse objectives and constraints defined by agronomic, economic, environmental, and social contexts. **2.** Comprehend the pros and cons of protected cultivation systems, including vertical farming/plant factories; iii) Select the most adequate greenhouse type(s) according to the needs and geographical region; iv) perform simple risk calculations to human health and the ecosystems.	
Course schedule	Precision Agriculture
	Grape and Wine Production
	Vegetables and Fruit Production
	Risks to the environment and human health
	Intership in horticultural and environmental sciences
Learning Parts	Theoretical/Practical
Curriculum length	6 months Semester exchange (February - July)

4.5 New sustainable practices – Viticulture (Fall) (UCSC)

Curriculum Title	New sustainable practices in - Viticulture
Curriculum Description (aim & objectives)	The "New sustainable practices – Viticulture " curriculum for the Fall semester takes into consideration 3 courses: Advances in Enology, Environment and Biota and Vineyard Variability: Traditional and Precision Approaches for a total of 24 ECTS. An intership of 6 ECTS will complete the program. The intership will provide students with a rewarding experience, giving them the opportunity to deepen their knowledge while contributing to the dynamic evolution of the wine making industry. Italy is now the largest wine producer in the world and boasts the greatest variability in terms of cultivars.The pecularities of Italian viticulture and chances to maintain a leading role are today bound to the ability to introduce sustainable innovation without losing its well-known appeal.The internship in a vineyard or a winery is intended to allow the student to have a direct experience of grapevine cultivation, grape production, harvest, wine making, wine stabilisation. The student participates in the different operations working manually but also being

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	part of the decision processes, verifying the criteria of decision in relation to the type of wine to be produced.
EQF Level	6-7
Learning Objectives	
1. To face deepen knowledge related to enology in order to understand the principles, the technical and practical issues in the winery. **2.** To include new perspectives bound to climate change and to a more efficient use of adjuvant and additives. **3.** To provide an understanding of the main microorganisms and metabolic processes involved in the production of wines. **4.** To give insights about the concepts of soil fertility and vine nutrition. **5.** To give insights about the main techniques of integrated management systems, vineyard zoning and precision technologies.	
Course schedule	Advances in Enology
	Environment and Biota
	Vineyard Variability: Traditional and Precision Approaches
	Intership in vineyard farm and/or cellar
Learning Parts	Theoretical/Practical
Curriculum length	6 months Semester exchange (September - February)

4.6 New sustainable practices – Viticulture (Spring) (UCSC)

Curriculum Title	**New sustainable practices in horticulture**
Curriculum Description (aim & objectives)	The "New sustainable practices – Viticulture " curriculum for the Spring semester takes into consideration 3 courses: Applied Grapevine Eco-physiology, Disease and Pest Management towards sustainable viticulture and Grape and Wine Biotechnology for a total of 24 ECTS. An intership of 6 ECTS will complete the program. The intership will provide students with a rewarding experience, giving them the opportunity to deepen their knowledge while contributing to the dynamic evolution of the wine making industry. Italy is now the largest wine producer in the world and boasts the greatest variability in terms of cultivars.The pecularities of Italian viticulture and chances to maintain a leading role are today bound to the ability to introduce sustainable innovation without losing its well-known appeal.The internship in a vineyard or a winery is intended to allow the student to have a direct experience of grapevine cultivation, grape production, harvest, wine making, wine stabilisation. The student participates in the different operations working manually but also being part of the decision processes, verifying the criteria of decision in relation to the type of wine to be produced.
EQF Level	7
Learning Objectives	
1. To face basic knowledge related to enology in order to understand the principles, the technical and practical issues in the winery. **2.** To include new perspectives bound to climate change and to a more efficient use of adjuvant and additives. **3.** To provide knowledge about morphology, anatomy, and bionomics of the main grape pests, related damages, plant symptoms, and integrated pest management strategies. **4.** To give insights on biotechnologies and genomics with a special focus on grape and on wine production.	
Course schedule	Applied Grapevine Eco-physiology

	Disease and Pest Management towards sustainable viticulture
	Grape and Wine Biotechnology
	Intership in vineyard farm and/or cellar
Learning Parts	Theoretical/Practical
Curriculum length	6 months Semester exchange (February - July)

4.7 New sustainable practices – Viticulture (Spring) (UCSC)

Curriculum Title	**New sustainable practices in horticulture**
Curriculum Description (aim & objectives)	The "New sustainable practices – Viticulture " curriculum for the Spring semester takes into consideration 4 courses: Applied Enology, Applied Viticulture, Integrated vineyard protection and Applied Agronomy and Horticulture for a total of 24 ECTS. An intership of 6 ECTS will complete the program. The intership will provide students with a rewarding experience, giving them the opportunity to deepen their knowledge while contributing to the dynamic evolution of the wine making industry. Italy is now the largest wine producer in the world and boasts the greatest variability in terms of cultivars.The pecularities of Italian viticulture and chances to maintain a leading role are today bound to the ability to introduce sustainable innovation without losing its well-known appeal.The internship in a vineyard or a winery is intended to allow the student to have a direct experience of grapevine cultivation, grape production, harvest, wine making, wine stabilisation. The student participates in the different operations working manually but also being part of the decision processes, verifying the criteria of decision in relation to the type of wine to be produced.
EQF Level	6
Learning Objectives	
1.	To face basic knowledge related to enology in order to understand the principles, the technical and practical issues in the winery.
2.	To include new perspectives bound to climate change and to a more efficient use of adjuvant and additives.
3.	To acquire fundamental knowledge about general viticulture (current diffusion, vine anatomy and physiology).
4.	To face the basics on vineyard design and management by considering an array of genotypes and environmental conditions.
5.	To provide the future Bachelor graduates with the skills, knowledge and capacities to maintain and improve vineyard's and grapevine production's quality, sustainability and market performance.
6.	To acquire fundamental knowledge about plant organs and fruit tree products intended for human nutrition.
7.	To provide students with the fundamental scientific, technical and operational knowledge related to the establishment and management of fruit tree orchards.
8.	To give an overview on the fundamentals in applied agronomy to students hoping to build their knowledge and skills in the topics that are most needed for sustainable management of agroecosystems.
9.	To illustrate the main principles of soil agricultural science, regenerative agriculture and how these principles can be applied to modern farming systems.
Course schedule	Applied Agronomy and Horticulture
	Applied Enology

	Applied Viticulture
	Integrated vineyard protection
	Intership in vineyard farm and/or cellar
Learning Parts	Theoretical/Practical
Curriculum length	6 months Semester exchange (February - July)

4.8 Learning Outcomes

The AF4F project, as in the case for the curricula for the EQF level 3-5, endeavors to shape the Curricula utilizing the Learning Outcomes approach. As outlined by CEDEFOP, "*the "learning outcomes" approach shifts the emphasis from the duration of learning and the institution where it takes place, to the actual learning and the knowledge, skills and competences that have been or should be acquired through the learning process*"[1]. This approach is essential for developing unified curricula across different countries, as it acts as a universal framework that integrates various vocational education and training (VET) tools, such as the European Qualifications Framework (EQF), and the European Credit Transfer and Accumulation System (ECTS). One ECTS credit corresponds to the workload and defined learning outcomes associated with 25 to 30 hours of study.

The methodology implemented guarantees the establishment of appropriate assessment methods and procedures to evaluate the attainment of learning outcomes. This alignment among learning outcomes, teaching, learning, and assessment aims to create a more coherent, transparent, and meaningful learning experience for both learners and all stakeholders involved. Learning outcomes are closely linked to assessment, clearly outlining what and how to evaluate. This synchronization in assessing learner performance influences the teaching and learning process through the assessment itself.

The primary objectives of incorporating learning outcomes into Curriculum Design are as follows:

- To clarify the expectations associated with each learning activity.
- To assist trainers in the teaching process and their selection of methods.
- To inform learners about what they are expected to know or accomplish after completing the learning activity.

To summarize, learning outcomes clarify what learners are expected to know and be able to do upon finishing the training program. They articulate the learning process and define the expectations for assessment. By establishing well-defined learning outcomes, both educators and learners gain a clear understanding of the desired outcomes for courses or units throughout the teaching, learning, and assessment processes.

[1] CEDEFOP (2013) USING LEARNING OUTCOMES European Qualifications Framework Series: Note 4, p.3
https://www.cedefop.europa.eu/files/Using_learning_outcomes.pdf

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4.8.1 Bloom's Taxonomy and Higher Education

Educational researcher Benjamin Bloom, along with his colleagues, developed the original taxonomy to categorize learning into three domains: Cognitive (related to thinking and knowledge), Affective (concerning emotions and feelings), and Psychomotor (pertaining to physical or manual skills). In higher education, while all three domains are considered, the cognitive domain typically receives the most emphasis.

A subsequent revision of the cognitive domain by Anderson and Krathwohl shifted the focus towards what learners actively do during the learning process. This revision explored how learners move through stages of remembering, understanding, applying, analyzing, evaluating, and creating. The updated approach, which highlights learner actions, coincided with a growing emphasis in higher education on formulating clear learning objectives and outcomes, particularly within these six cognitive categories.

Higher education educators must understand how to use the taxonomy categories to clearly communicate with various stakeholders, including students, administrators, and accreditors—most importantly, themselves—about what students will learn throughout a course or an entire program of study. When creating outcomes, educators can refer to programmatic goals within the major or general education and apply their disciplinary knowledge to determine what students need to know and do.

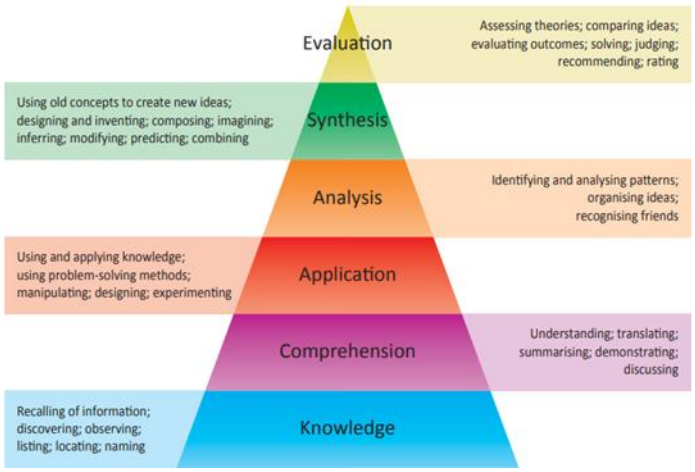

Figure 1: Adapted from Alford, G., Herbert, P. and Frangenheim, E. (2006), 'Bloom's taxonomy overview', Innovative teachers companion 2006, ITC Publications, pp. 176-224.

The taxonomy is often accompanied by suggested action verbs, which can aid in crafting learning objectives (what students are expected to do) and outcomes (what students should have accomplished by the end of the program). A typical learning outcome statement might follow this structure:

In this X (course or program) students will be able to do X (some aspect of learning, such as defining or analyzing or computing), through X (give some detail here on how this happens, such as activities or major assignments) for X reason (sometimes, not always, added to explain the why, the purpose).

In designing the Agrifood for Future curriculum for higher education, we integrate Bloom's Taxonomy to ensure that learning outcomes are both clear and measurable, aligning with the overarching educational goals of the project. The taxonomy allows educators to articulate what students will achieve at various stages of the curriculum, focusing on higher-order thinking and application skills across the EQF 6-8 levels.

For example, in the context of the Agrifood4Future program, course outcomes might include:

Application: "Through this course, students will be able to apply agricultural economic models to analyze and draw conclusions about the sustainability of farming practices in various EU regions."

Identification: "Students will be able to identify critical environmental issues affecting European agrifood supply chains, using case studies to diagnose challenges and propose actionable solutions, fostering analytical and problem-solving skills."

Analysis: "Participants will analyze key elements of agrifood policy reforms and assess their potential impact on food security, through integration of knowledge from rural development and environmental economics."

By utilizing Bloom's revised cognitive framework, this curriculum not only focuses on theoretical knowledge but also encourages students to engage in critical thinking, practical application, and cross-disciplinary analysis, fostering a holistic learning experience. This approach ensures that students not only understand the content but are also prepared to apply it in professional contexts, reflecting the international and collaborative ethos of the AF4F program.

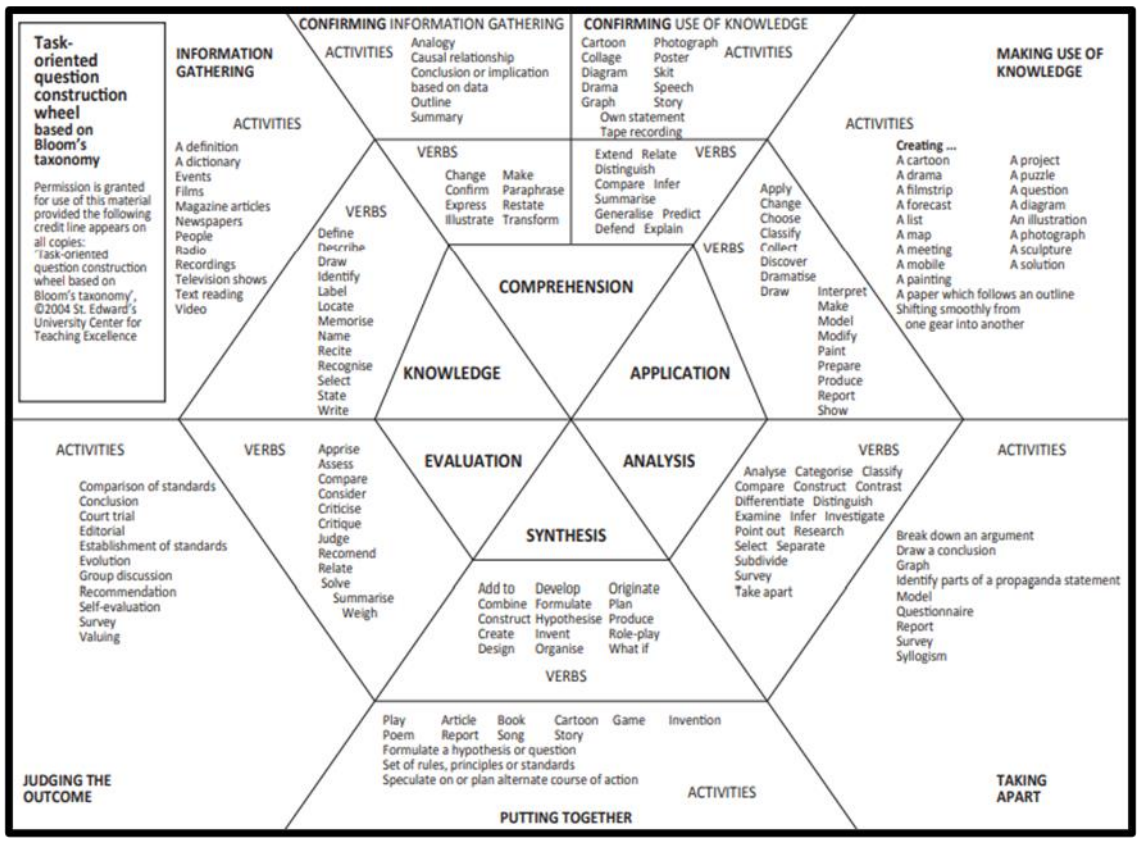

Figure 2: Bloom's Verbs And Matching Assessment Types
(Source: Adapted from St. Edward's University Center of Teaching Excellence, 2004)

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4.9 European Qualifications Framework Level Descriptors for Higher Education

4.9.1 Higher Education

Table 1: EQF level descriptors

EQF level	Knowledge	Skills	Responsibility and autonomy
Level 6	Advanced knowledge of a field of work or study involving a critical understanding of theories and principles.	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialized field of work or study.	Manage complex technicalor professional activities or projects, taking responsibility for decision making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups.
Level 7	Highly specialized knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research. Critical awareness of knowledge issues in a field and at the interface between different fields.	Specialized problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields.	Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.
Level 8	Knowledge at the most advanced frontier of a field of work or study and at the interface between fields.	The most advanced and specialized skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice.	Demonstrate substantial authority, innovation, autonomy,scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts, including research.

(Source: EASO Guide to writing learning outcomes, 2018)

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4.10 Curriculum Overview and Description

4.10.1 "Business sustainability & valorisation of resources"

COURSE DESCRIPTION	
Course Title	Global sustainability and engagement
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1**: Gain understanding and acquire knowledge about a wide variety of global issues. **LOut2**: Develop and apply 21st century skills (sustainability, international and intercultural competences, creativity and innovation, dealing with diversity, world citizenship etc.) in different contexts **LOut3**: Encourage active global engagement **LOut4**: Work together in interdisciplinary and intercultural groups
Topic(s)	21st century competences
Learners' profile	Undergraduate students from UCSC
Duration	6 months Semester exchange (Spring: February-July of Fall: September - December)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	Written exam and assignments
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Strong Sustainability
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1**: Explain typical concepts and representations linked to sustainability. **LOut2**: Indicate the motives for integrating sustainability. **LOut3**: Clarify the importance of sustainability. **LOut4**: Strategically implement sustainability in practice (in daily life or in an organization). **LOut5**: Indicate applications where sustainability plays a crucial part.
Topic(s)	Sustainability
Learners' profile	Undergraduate students from UCSC
Duration	6 months Semester exchange (Spring: February-July of Fall: September - December)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	Written exam and assignments
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Project Entrepreneurship
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1**: Gain understanding and acquire knowledge about corporate social responsibility. **LOut2**: Get acquainted with design thinking. **LOut3**: Write down a 'lean canvas' in preparation of preparing a business plan. **LOut4**: Develop a prototype and present it to a professional jury. **LOut5**: Pitch an idea.
Topic(s)	1. Innovation 2. Entrepreneurship
Learners' profile	Undergraduate students from UCSC
Duration	6 months Semester exchange (Spring: February-July of Fall: September - December)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	Written exam and assignments
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Emerging Technologies
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1**: Know different technological innovations. **LOut2**: Acquire an insight in possibilities, opportunities and threats of the technologies in scope and this in relation to himself, the future working environment and the broader society. **LOut3**: Learn how to implement the different technologies.
Topic(s)	Emerging Technologies
Learners' profile	Undergraduate students from UCSC
Duration	6 months Semester exchange (Spring: February-July of Fall: September - December)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	Written exam and assignments
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Product Development
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Develop a product using a project. **LOut2**: Come up with innovative solutions to problems that arise during the work or internship. **LOut3**: Have sufficient coping capacity and cope with skills to either maintain professional conduct or seek appropriate support.
Topic(s)	Product Development
Learners' profile	Undergraduate students from UCSC
Duration	6 months Semester exchange (Spring: February-July of Fall: September - December)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	The evaluation will consist of written exams, assignments, reports from practical courses and continuous evaluation following a growth plan during the internship.
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Food Microbiology
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Be familiar with the major groups of microorganisms that are used in food processing (dairy, bakery, brewing, …). **LOut2**: Be familiar with pre- and probiotics. **LOut3**: Be familiar with the major groups of pathogenic microorganisms in the food industry. **LOut4**: Be familiar with preservation techniques for different food groups. **LOut5**: Be familiar with quality control systems in the food industry.
Topic(s)	Food Microbiology
Learners' profile	Undergraduate students from UCSC
Duration	6 months Semester exchange (Spring: February-July of Fall: September - December)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	The evaluation will consist of written exams, assignments, reports from practical courses and continuous evaluation following a growth plan during the internship.
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Work Field Exploration
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Communicate correctly and clearly about subject-related topics. **LOut2**: Relate newly acquired information to personal experiences/ prior knowledge. **LOut3**: Synthesize the newly acquired information into a logical and correct knowledge base. **LOut4**: Be open to alternative ideas and opinions, explore them and weigh the value of these perspectives.
Topic(s)	Work Field Exploration
Learners' profile	Undergraduate students from UCSC
Duration	6 months Semester exchange (Spring: February-July of Fall: September - December)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	The evaluation will consist of written exams, assignments, reports from practical courses and continuous evaluation following a growth plan during the internship.
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Internship
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Function in a professional work environment. **LOut2**: Turn theoretical knowledge into practice. **LOut3**: Adapt its attitude from scholar to professional. **LOut4**: Gain new insights and realizes the value and need of lifelong learning and personal development. **LOut5**: Relate newly acquired information to personal experiences/ prior knowledge. **LOut6**: Synthesize the newly acquired information into a logical and correct knowledge base. **LOut7**: Be open to alternative ideas and opinions, explores them and weighs the value of these perspectives.
Topic(s)	Internship
Learners' profile	Undergraduate students from UCSC
Duration	6 months Semester exchange (Spring: February-July of Fall: September - December)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	The evaluation will consist of written exams, assignments, reports from practical courses and continuous evaluation following a growth plan during the internship.
Delivery mode	Face to Face

Co-funded by the European Union

4.10.2 "Biological and Chemical Engineering for a Sustainable Bioeconomy (Bioceb)"

COURSE DESCRIPTION	
Course Title	Bioenergies and lignocelluloses
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1**: Develop knowledge on the composition and structure of lignocellulose and explore the main conversion routes in materials, molecules, and energy; understand the factors governing their quality; recognize the current challenges associated with lignocellulose biorefinery and identify different possible technological levers; comprehend research and innovation strategies related to lignocellulose. **LOut2**: Gain knowledge on how certain agricultural biomasses are produced, analyze the fluxes required for biomass production, and examine the structure of the agricultural system involved; understand the role of stakeholders in biomass production. **LOut3**: Acquire knowledge on decision aiding, understand its history, key theories, and applications; study operations research, its history, major theories, and applications; grasp the sciences for innovation. **LOut4**: Learn the basics of microeconomics; understand the notion of risk in economics and its application to climate change; grasp the concept of the bio-economy; apply discounting calculus; analyze the challenges of renewable resource management; contextualize knowledge in relation to the trade-off between economic growth and limited resources. **LOut5**: Understand the principles of environmental management and assessment in the context of the bio-economy; master the main steps of environmental assessment methods.
Topic(s)	1. Introduction 2. From paper industry to lignocellulose biorefinery: towards a multicriteria approach of quality 3. Energetic crops and biomass 4. Lignocelluloses and fibers 5. Visit of R&D centers (IFPEN Biotechnologies division, FRD center) 6. Visit of production unit (Greenfield paper recycling unit) 7. Visit of research laboratory (INRA unit in plant sciences)
Learners' profile	Graduate students from FCUP and UCSC
Duration	6 months Semester exchange (January- June)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	Bioenergies and lignocelluloses: Individual synthetic report on the visits, including the comparison of the different structures and their research and innovation approaches. Biomass Resources and Territories: Individual written exam on the lectures content (25% of the grade). Individual short report on the on field trip (10% of the grade). Collective (maximum of 3 students) work (10 pages report) and oral presentation (30 minutes) on a biomass production issue (65% of the grade). Decision Aiding, Operation Research and Sciences for innovation: Coaching exercises and group work. Economic tools for environmental analysis: To be defined. Environmental Assessment for a sustainable bio-economy: Report and oral defense of group work on the assessment of a bio-based project.
Delivery Mode	Face to Face

COURSE DESCRIPTION	
Course Title	Biomass Resources and Territories
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Know how some biomasses from agriculture are produced. **LOut2**: Know which fluxes are usually required for biomass production. **LOut3**: Comprehend the structure of the agricultural system involved in biomass production. **LOut4**: Comprehend the role of some stakeholders involved in biomass production.
Topic(s)	1. Lecture on resources production 2. Lecture on required fluxes for biomass production 3. Lecture on actors networks 4. Practical work 5. Field trip 6. Tutored collective work
Learners' profile	Graduated students from FCUP and UCSC
Duration	6 months Semester exchange (January- June)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	Bioenergies and lignocelluloses: Individual synthetic report on the visits, including the comparison of the different structures and their research and innovation approaches. Biomass Resources and Territories: Individual written exam on the lectures content (25% of the grade). Individual short report on the on field trip (10% of the grade). Collective (maximum of 3 students) work (10 pages report) and oral presentation (30 minutes) on a biomass production issue (65% of the grade). Decision Aiding, Operation Research and Sciences for innovation: Coaching exercises and group work. Economic tools for environmental analysis: To be defined. Environmental Assessment for a sustainable bio-economy: Report and oral defense of group work on the assessment of a bio-based project.
Delivery Mode	Face to Face

COURSE DESCRIPTION	
Course Title	Decision Aiding, Operation Research and Sciences for innovation
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Acquire knowledge on decision aiding, study its history, explore great theories, and analyze its applications. **LOut2:** Learn about operations research, investigate its history, understand key theories, and examine its applications. **LOut3:** Explore the sciences for innovation, with a focus on developing and understanding new business models.
Topic(s)	1. Decision aiding 2. Operation research 3. Introduction to Sciences of Innovation
Learners' profile	Graduated students from FCUP and UCSC
Duration	6 months Semester exchange (January- June)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	Bioenergies and lignocelluloses: Individual synthetic report on the visits, including the comparison of the different structures and their research and innovation approaches. Biomass Resources and Territories: Individual written exam on the

	lectures content (25% of the grade). Individual short report on the on field trip (10% of the grade). Collective (maximum of 3 students) work (10 pages report) and oral presentation (30 minutes) on a biomass production issue (65% of the grade). Decision Aiding, Operation Research and Sciences for innovation: Coaching exercises and group work. Economic tools for environmental analysis: To be defined. Environmental Assessment for a sustainable bio-economy: Report and oral defense of group work on the assessment of a bio-based project.
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Economic tools for environmental analysis
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Study decision aiding, explore its history, understand great theories, and analyze its applications. **LOut2:** Investigate operations research, review its history, grasp key theories, and evaluate its applications. **LOut3:** Examine the sciences for innovation, particularly by exploring new business models.
Topic(s)	1. Fundamentals of Microeconomic Analysis 2. Bio-economy 3. Economic calculus 4. Optimal use of renewable resources 5. Economics of risk and innovation 6. Growth and the environment
Learners' profile	Graduated students from FCUP and UCSC
Duration	6 months Semester exchange (January- June)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	Bioenergies and lignocelluloses: Individual synthetic report on the visits, including the comparison of the different structures and their research and innovation approaches. Biomass Resources and Territories: Individual written exam on the lectures content (25% of the grade). Individual short report on the on field trip (10% of the grade). Collective (maximum of 3 students) work (10 pages report) and oral presentation (30 minutes) on a biomass production issue (65% of the grade). Decision Aiding, Operation Research and Sciences for innovation: Coaching exercises and group work. Economic tools for environmental analysis: To be defined. Environmental Assessment for a sustainable bio-economy: Report and oral defense of group work on the assessment of a bio-based project.
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Environmental Assessment for a sustainable bio-economy
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Know the principles of environmental management and assessment in the context of the bio-economy. **LOut2**: Be familiar with the main steps of environmental assessment methods. **LOut3**: Diagnose the main environmental issues associated with bio-based processes and propose methods to address them. **LOut4**: Apply life-cycle assessment to bio-based value-chains.
Topic(s)	1. Principles of environmental management 2. Introduction to methodological frameworks 3. Application to the bio-economy

	4. Group work
Learners' profile	Graduated students from FCUP and UCSC
Duration	6 months Semester exchange (January- June)
Participation prerequisites	- Bachelor in life sciences - Knowledge in biochemistry - Basic notions of mathematics - Basic knowledge of bio-economy processes (feedstock production, conversion pathways for biomaterials, bioenergy or bio-molecules purposes)
Assessment Method	Bioenergies and lignocelluloses: Individual synthetic report on the visits, including the comparison of the different structures and their research and innovation approaches. Biomass Resources and Territories: Individual written exam on the lectures content (25% of the grade). Individual short report on the on field trip (10% of the grade). Collective (maximum of 3 students) work (10 pages report) and oral presentation (30 minutes) on a biomass production issue (65% of the grade). Decision Aiding, Operation Research and Sciences for innovation: Coaching exercises and group work. Economic tools for environmental analysis: To be defined. Environmental Assessment for a sustainable bio-economy: Report and oral defense of group work on the assessment of a bio-based project.
Delivery mode	Face to Face

The course "Biological and Chemical Engineering for a Sustainable Bioeconomy" offered by AgroParisTech will implement a variety of assessment methods to evaluate students' understanding and application of the course material. Students will be required to submit an individual synthetic report on site visits, comparing different structures and their research and innovation approaches. A written exam on the lecture content will account for 25% of the final grade, while a short individual report on the field trip will contribute 10%. A significant portion of the assessment, 65% of the grade, will come from collective work (with a maximum of 3 students per group) that includes a 10-page report and a 30-minute oral presentation focused on a biomass production issue. Additional exercises and group work will be assigned at the beginning of the course to further enhance learning outcomes and engagement with the course content.

4.10.3 "Climate, Land-Use and Ecosystem Services (Fall)"

COURSE DESCRIPTION	
Course Title	Biosphere-climate interactions at local to global scales
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Acquire basic knowledge of atmospheric dynamics and energetics. **LOut2:** Advance students' knowledge and understanding of the fundamentals of biosphere-atmosphere interactions and biophysical mechanisms. **LOut3:** Develop fundamental skills in biometeorology. **LOut4:** Gain thorough know-how in modeling, monitoring, and data processing within this domain. **LOut5:** Build fundamental skills in understanding biosphere-atmosphere interactions on a global scale.
Topic(s)	1. Climatic system- Introduction to atmospheric 2. Biosphere-Atmosphere interactions at local scale 3. Biogeochemical cycles and surface-atmosphere 4. Group work
Learners' profile	Graduated students from FCUP and UCSC

Co-funded by the European Union

Duration	6 months Semester exchange (September - February)
Participation prerequisites	- Bachelor degree with background in physics, ecology, agronomy, modelling, mathematics/applied mathematics, chemistry, biology, earth sciences. - B2 proficiency in English
Assessment Method	Exams, reports, presentations
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Global agronomy, land-use planning and modelling
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Use open global databases to analyze global issues related to agricultural production. **LOut2**: Analyze yield time series. **LOut3**: Collect data on different crops to describe their production, uses, and past and projected trends at a global scale. **LOut4**: Build a critical perspective on the discourse of "doubling food production by 2050." **LOut5**: Gain basic knowledge of soil functioning and its response to climatic and management drivers. **LOut6**: Become conversant with land-use modeling principles and approaches at a global scale. **LOut7**: Design and assess land-use and management scenarios from local to global scales. **LOut8**: Apply ecological engineering principles to solve water quality issues. **LOut9**: Gain basic knowledge of environmental economics. **LOut10**: Learn how to evaluate public policies aimed at reducing GHG emissions. **LOut11**: Understand how productive ecosystem management adapts to climate change. **LOut12**: Acquire basic knowledge of urban ecosystems.
Topic(s)	1. Agronomy for global issues 2. Land-use engineering for the provision of climate and environmental services 3. Public policy for climate and environmental regulation
Learners' profile	Graduated students from FCUP and UCSC
Duration	6 months Semester exchange (September - February)
Participation prerequisites	- Bachelor degree with background in physics, ecology, agronomy, modelling, mathematics/applied mathematics, chemistry, biology, earth sciences. - B2 proficiency in English
Assessment Method	Exams, reports, presentations
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	The assessment of ecosystem services
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Acquire a basic understanding of ecology. **LOut2:** Comprehend the complexity of climate change effects on ecosystem structure and functioning, along with the associated issues. **LOut3:** Learn how to construct a clear, well-structured, problematized oral presentation on a given subject. **LOut4:** Gain advanced knowledge of planetary boundaries science and basic knowledge of scientific concepts contributing to food and nutrition security and poverty alleviation.

	LOut5: Understand key interactions between natural resources and food and nutrition security. **LOut6:** Develop basic knowledge of negotiation games to address complex ecosystem-production issues. **LOut7:** Comprehend current trends in ecological intensification and climate-smart agriculture. **LOut8:** Learn the principles of environmental management and apply them to various decision-making contexts (industry, agriculture, public policies). **LOut9:** Perform a life-cycle assessment (LCA) of a complex product system. **LOut10:** Comprehend the relationships between LCA and other assessment methods, including the evaluation of ecosystem services.
Topic(s)	1. Ecology under climate change 2. Everyone eating well within environmental limits 3. Integrated assessment of ecosystem services and sustainability
Learners' profile	Graduated students from FCUP and UCSC
Duration	6 months Semester exchange (September - February)
Participation prerequisites	- Bachelor degree with background in physics, ecology, agronomy, modelling, mathematics/applied mathematics, chemistry, biology, earth sciences. - B2 proficiency in English
Assessment Method	Exams, reports, presentations
Delivery mode	Face to Face

The course "Climate, Land-Use and Ecosystem Services" offered by AgroParisTech will include a diverse set of assessment methods tailored to specific topics. Students will complete individual reports based on data analysis of plant-atmosphere interactions and fluxes, with attendance and participation considered in the final grading. One or two executive summaries will address questions posed during the course. Group work, involving 3 to 5 students, will be required for the presentation of agronomical issues, as well as an oral presentation on the analysis of scientific papers or ecological engineering case studies. Additionally, a synthesis report will be submitted, and attendance and participation will again be part of the grading criteria. Other assessments include group presentations on ecological issues, contributions to a final debate, and a written report on environmental management workshops and ecosystem services. A database report on industrial ecology will also be required. Each component will emphasize active engagement and the application of course content to real-world environmental challenges.

4.10.4 "New sustainable practices – Viticulture"

COURSE DESCRIPTION	
Course Title	Advances in Enology
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Own fundamental knowledge about enology, effects and constraints related to winemaking management and wine composition. **LOut2**: Be familiar with applied techniques related to key practices such as stabilization and bottling. **LOut3**: Apply the learned principles and techniques to recognize limiting factors affecting each winemaking type in order to provide suitable solutions **LOut4**: Successfully deliver, in both oral and written forms, a correct diagnosis and discussion of the different winemaking practices using proper technical language.

Topic(s)	1. Wine stabilization 2. Managing wine making factors 3. Plants and design optimization in winemaking 4. Wine bottling 5. Practical experience
Learners' profile	Graduated students from FCUP and AgriParisTech; Undergraduate students of University of Applied Sciences (VIVES)
Duration	6 months Semester exchange (September – February)
Participation prerequisites	- Background in microbiology and enology, geomatics, sensors and automation principles, agronomy and fruit tree crops. - Attend outdoor class, visits and seminars as well as the topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Advances in Enology: Written test. The test will last two hours and will be based on thirty choice questions. The overcoming of the final test, within one year, will exempt the student from preparing the corresponding part of the program for the final examination. This will be oral and will result in the assignment of a score that, out of thirty, will be averaged with the marks obtained in the written test; Environment and Biota – A. Wine Microbiology: Oral assessment. The evaluation criteria will be based on the levels of topics knowledge, comprehension and ability to make conceptual links between the different topics. The student must also demonstrate to be able to correctly use the technical language of the discipline; Environment and Biota – B. Soil fertility and vine nutrition: Oral assessment. Students will have to prepare a presentation on an argument related to the course. The student must choose one among a list of topics defined by the teacher and discuss it in depth within a maximum time of 30 minutes. If necessary, questions will be asked about the topics covered in the course during the discussion. The final assessment will be based on the quality of the presentation (in-depth knowledge, scientific rigor, analytical and organizational skills displayed in the work) and by the critical and in-depth skills demonstrated during the presentation; Vineyard Variability: Traditional and Precision Approaches: Oral assessment. Students will receive three general questions aiming to verify knowledge and links between subjects. Each question will be valued a maximum score of 10/30 each. Final score will be the sum of the three different question scores and will be expressed on a 0–30 scale.
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Environment and Biota - A. Wine Microbiology
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Comprehend the identity, distribution and activities of yeasts, lactic acid bacteria, acetic acid bacteria and molds in winemaking. **LOut2**: Explain the main biochemical pathways involved in wine fermentations. **LOut3**: Know the main desired traits for yeasts and LAB starter cultures. **LOut4**: Demonstrate an understanding of the main microbiological and molecular techniques used to study wine microorganisms. **LOut5**: Manage alcoholic and malolactic fermentations and to control undesired microorganisms. **LOut6**: Use the correct technical terminology in the field of wine microbiology.
Topic(s)	1. Cytology, taxonomy and ecology of vineyard, grape and wine yeasts 2. Lactic acid bacteria 3. Methods in wine microbiology 4. Genetic improvement of microorganisms of oenological interest 5. Tutorial
Learners' profile	Graduated students from FCUP and AgriParisTech; Undergraduate students of University of Applied Sciences (VIVES)
Duration	6 months Semester exchange (September – February)

Participation prerequisites	- Background in microbiology and enology, geomatics, sensors and automation principles, agronomy and fruit tree crops. - Attend outdoor class, visits and seminars as well as the topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Advances in Enology: Written test. The test will last two hours and will be based on thirty choice questions. The overcoming of the final test, within one year, will exempt the student from preparing the corresponding part of the program for the final examination. This will be oral and will result in the assignment of a score that, out of thirty, will be averaged with the marks obtained in the written test; Environment and Biota – A. Wine Microbiology: Oral assessment. The evaluation criteria will be based on the levels of topics knowledge, comprehension and ability to make conceptual links between the different topics. The student must also demonstrate to be able to correctly use the technical language of the discipline; Environment and Biota – B. Soil fertility and vine nutrition: Oral assessment. Students will have to prepare a presentation on an argument related to the course. The student must choose one among a list of topics defined by the teacher and discuss it in depth within a maximum time of 30 minutes. If necessary, questions will be asked about the topics covered in the course during the discussion. The final assessment will be based on the quality of the presentation (in-depth knowledge, scientific rigor, analytical and organizational skills displayed in the work) and by the critical and in-depth skills demonstrated during the presentation; Vineyard Variability: Traditional and Precision Approaches: Oral assessment. Students will receive three general questions aiming to verify knowledge and links between subjects. Each question will be valued a maximum score of 10/30 each. Final score will be the sum of the three different question scores and will be expressed on a 0–30 scale.
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Environment and Biota - A. Soil fertility and vine nutrition
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Own fundamental knowledge about soil fertility management, fertilizers, soil amendments and plant biostimulants, vine nutrition and selection criteria, application methods, timing of application to preserve vine health. **LOut2**: Apply the learned concepts to recognize limiting factors affecting soil fertility and vine health and providing suitable solutions. **LOut3**: Provide autonomous analysis and thinking inspired by the acquired knowledge rather than based on popular “rule of thumbs” applications. **LOut4**: Successfully deliver, in both oral and written forms, a correct diagnosis and discussion of the different problems related to soil fertility and vine nutrition, using suitable and proper technical language. **LOut5**: Hold learning capacities suitable to either lead her/him to higher study courses or to successfully tackle a job appointment.
Topic(s)	1. Soil fertility 2. Plant nutrients 3. Fertilizers, Compost and Plant biostimulants 4. Grapevine nutrition 5. Practical activities
Learners’ profile	Graduated students from FCUP and AgriParisTech; Undergraduate students of University of Applied Sciences (VIVES)
Duration	6 months Semester exchange (September - February)
Participation prerequisites	- Background in microbiology and enology, geomatics, sensors and automation principles, agronomy and fruit tree crops. - Attend outdoor class, visits and seminars as well as the topics covered during these sessions have to be considered part of the teaching program.

Assessment Method	Advances in Enology: Written test. The test will last two hours and will be based on thirty choice questions. The passing of the final test, within one year, will exempt the student from preparing the corresponding part of the program for the final examination. This will be oral and will result in the assignment of a score that, out of thirty, will be averaged with the marks obtained in the written test; Environment and Biota - A. Wine Microbiology: Oral assessment. The evaluation criteria will be based on the levels of topics knowledge, comprehension and ability to make conceptual links between the different topics. The student must also demonstrate to be able to correctly use the technical language of the discipline; Environment and Biota - B. Soil fertility and vine nutrition: Oral assessment. Students will have to prepare a presentation on an argument related to the course. The student must choose one among a list of topics defined by the teacher and discuss it in depth within a maximum time of 30 minutes. If necessary, questions will be asked about the topics covered in the course during the discussion. The final assessment will be based on the quality of the presentation (in-depth knowledge, scientific rigor, analytical and organizational skills displayed in the work) and by the critical and in-depth skills demonstrated during the presentation; Vineyard Variability: Traditional and Precision Approaches: Oral assessment. Students will receive three general questions aiming to verify knowledge and links between subjects. Each question will be valued a maximum score of 10/30 each. Final score will be the sum of the three different question scores and will be expressed on a 0–30 scale.
Delivery mode	Face to Face

COURSE DESCRIPTION	
Course Title	Vineyard Variability: Traditional and Precision Approaches
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Own fundamental knowledge about soil fertility management, fertilizers, soil amendments and plant biostimulants, vine nutrition and selection criteria, application methods, timing of application to preserve vine health. **LOut2**: Apply the learned concepts to recognize limiting factors affecting soil fertility and vine health and providing suitable solutions. **LOut3**: Provide autonomous analysis and thinking inspired by the acquired knowledge rather than based on popular “rule of thumbs” applications. **LOut4**: Successfully deliver, in both oral and written forms, a correct diagnosis and discussion of the different problems related to soil fertility and vine nutrition, using suitable and proper technical language. **LOut5**: Hold learning capacities suitable to either lead her/him to higher study courses or to successfully tackle a job appointment.
Topic(s)	1. Factors affecting vine growth, yield and fruit quality 2. Traditional approaches to vineyard variability 3. Precision farming as a new approach to vineyard variability 4. Monitoring variability 5. Prescription maps and target management within vineyards 6. Tutorials
Learners’ profile	Graduated students from FCUP and AgriParisTech; Undergraduate students of University of Applied Sciences (VIVES)
Duration	6 months Semester exchange (September - February)
Participation prerequisites	- Background in microbiology and enology, geomatics, sensors and automation principles, agronomy and fruit tree crops. - Attend outdoor class, visits and seminars as well as the topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Advances in Enology: Written test. The test will last two hours and will be based on thirty choice questions. The overcoming of the final test, within one year, will exempt the student from preparing the corresponding part of the program for the final examination. This will be oral and will result in the assignment of a score that,

	out of thirty, will be averaged with the marks obtained in the written test; Environment and Biota - A. Wine Microbiology: Oral assessment. The evaluation criteria will be based on the levels of topics knowledge, comprehension and ability to make conceptual links between the different topics. The student must also demonstrate to be able to correctly use the technical language of the discipline; Environment and Biota - B. Soil fertility and vine nutrition: Oral assessment. Students will have to prepare a presentation on an argument related to the course. The student must choose one among a list of topics defined by the teacher and discuss it in depth within a maximum time of 30 minutes. If necessary, questions will be asked about the topics covered in the course during the discussion. The final assessment will be based on the quality of the presentation (in-depth knowledge, scientific rigor, analytical and organizational skills displayed in the work) and by the critical and in-depth skills demonstrated during the presentation; Vineyard Variability: Traditional and Precision Approaches: Oral assessment. Students will receive three general questions aiming to verify knowledge and links between subjects. Each question will be valued a maximum score of 10/30 each. Final score will be the sum of the three different question scores and will be expressed on a 0–30 scale.
Delivery Mode	Face to face

The course "New Sustainable Practices – Viticulture" offered by UCSC will assess students through a combination of written and oral evaluations designed to measure their understanding of course content and ability to apply concepts in practical contexts. For attending students, a two-hour written test with thirty multiple-choice questions will be administered at the end of the course, and successful completion will exempt them from preparing the corresponding part of the program for the final examination. This final exam will be oral, and the score from the oral component will be averaged with the written test score. Students who choose not to use their written test marks can take the full oral exam, as required for non-attending students. The oral examination will consist of three general questions, each worth up to 10 points, aimed at verifying knowledge and the ability to link topics. In addition, students will prepare a 30-minute presentation on a topic chosen from a list provided by the instructor, demonstrating in-depth knowledge, scientific rigor, and analytical skills. The evaluation will also consider language clarity, the ability to make conceptual connections, and the student's expertise in precision agriculture applied to perennial tree crops, particularly in enhancing the economic and environmental sustainability of orchard and vineyard management. The final score will be expressed on a 0–30 scale, based on the quality of responses and presentations.

4.10.5 "New sustainable practices – Viticulture (Spring)"

COURSE DESCRIPTION	
Course Title	Applied Grapevine Eco-physiology
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Own fundamental knowledge about grapevine ecology, environmental effects and constraints related to vine efficiency and grape composition and applied physiology related to key vineyard practices such as summer and winter pruning. **LOut2**: Apply the learned physiological principles to recognize limiting factors affecting a given vineyard scenario and providing suitable solutions.

	LOut3: Provide autonomous analysis and thinking inspired to the acquired knowledge rather than based on popular "rule of thumb" applications **LOut4**: Successfully deliver, in both oral and written forms, a correct diagnosis and discussion of the different viticultural items, using suitable and proper technical language. **LOut5**: Hold learning capacities suitable to either lead him/her to higher study courses or to successfully tackle a job appointment.
Topic(s)	1. Bases of environmental physiology 2. Environmental physiology and climate 3. Environmental constraints and grape physiology 4. Climate change and impact on viticulture 5. Physiology of pruning and canopy management 6. Training systems and physiology of training systems
Learners' profile	Graduated students from FCUP and AgriParisTech
Duration	6 months Semester exchange (February - July)
Participation prerequisites	- Basic knowledge of plant biology and physiology, horticulture and viticulture, plant pathology and on grape diseases caused by oomycetes, fungi, bacteria, phytoplasmas and viruses, genetics. - Attend outdoor class and visits as topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Applied Grapevine Eco-physiology: Written test. Three open questions each one worth 5 points; 16 multiple choice questions (4 possible answers) each one worth 1 point; Disease and Pest Management towards sustainable viticulture - A. Diseases: Written test with 31 questions to be addressed in a maximum of 60 minutes. The questions may require, for example, single or multiple answers, the identification of correct options in a list or their ordering based on relative importance; there are no open answers. The commission will assign a score from zero to one to each of the written replies given by the student; Disease and Pest Management towards sustainable viticulture - B. Pests: Written test with 31 questions to be addressed in a maximum of 60 minutes. The test will require an open answer and single or multiple answers, the identification of correct options in a list or their ordering based on relative importance. The open answer evaluation will consider the question comprehension and the pertinence of the answer to the question, the organization of the answer, the use and mastery of the scientific language, the proficiency in the subject, and the student ability to make use of the knowledge acquired. A score from zero to one will be assigned to each of the written replies given by the student;Grape and Wine Biotechnology: Oral presentation of 30 – 40 minutes prepared by students on one of the topics of the course. The speech must not be just a simple exposure of what was learned during the lessons. Students must deepen the selected topics autonomously, searching and processing new information on the basis of scientific papers selected, if requested by students, with the teacher. At the end of the exposure the teacher will pose 3 questions on the topics of the presentation to test students' knowledge. The score assigned, out of 30, will be determined by students' knowledge and clarity in the presentation of the topics (up to 15 points), mastery of specialized terminology (up to 5 points) and capacity of the candidate to search, process autonomously and report the information retrievable from scientific literature (up to 10 points).
Delivery Mode	Face to face

COURSE DESCRIPTION	
Course Title	Disease and Pest Management Towards Sustainable Viticulture- A. Diseases
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Look at vineyards as complex ecosystems, in which several components interact dynamically.

	LOut2: Consider grape pathogens as one of these components and understand the relationships among pathogens and other components (e.g., weather, soil, plants, other microorganisms). **LOut3**: Critically exploit this knowledge to develop sustainable vineyard protection strategies and tactics. **LOut4**: Plan and conduct monitoring activities in vineyards with traditional and innovative (e.g., based on IoTs) methods. **LOut5**: Autonomously manage the information and data necessary to support decision-making for crop protection, also with the help of innovative tools (e.g., mathematical models, web-based decision support systems). **LOut6**: Analyze the results to point out mistakes or knowledge gaps. **LOut7**: Develop the capability of autonomously elaborating on and critically analyzing the current knowledge by using a multidisciplinary approach. **LOut8**: Communicate what they have learned in a clear, exhaustive and unambiguous way to their interlocutors.
Topic(s)	1. Introduction to sustainable grape protection 2. Methods for sustainable grape protection 3. Mathematical models for grape disease and protection 4. Decision support tools for sustainable grape protection 5. Field visits and practical exercises
Learners' profile	Graduated students from FCUP and AgriParisTech
Duration	6 months Semester exchange (February - July)
Participation prerequisites	- Basic knowledge of plant biology and physiology, horticulture and viticulture, plant pathology and on grape diseases caused by oomycetes, fungi, bacteria, phytoplasmas and viruses, genetics. - Attend outdoor class and visits as topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Applied Grapevine Eco-physiology: Written test. Three open questions each one worth 5 points; 16 multiple choice questions (4 possible answers) each one worth 1 point; Disease and Pest Management towards sustainable viticulture - A. Diseases: Written test with 31 questions to be addressed in a maximum of 60 minutes. The questions may require, for example, single or multiple answers, the identification of correct options in a list or their ordering based on relative importance; there are no open answers. The commission will assign a score from zero to one to each of the written replies given by the student; Disease and Pest Management towards sustainable viticulture - B. Pests: Written test with 31 questions to be addressed in a maximum of 60 minutes. The test will require an open answer and single or multiple answers, the identification of correct options in a list or their ordering based on relative importance. The open answer evaluation will consider the question comprehension and the pertinence of the answer to the question, the organization of the answer, the use and mastery of the scientific language, the proficiency in the subject, and the student ability to make use of the knowledge acquired. A score from zero to one will be assigned to each of the written replies given by the student;Grape and Wine Biotechnology: Oral presentation of 30 – 40 minutes prepared by students on one of the topics of the course. The speech must not be just a simple exposure of what was learned during the lessons. Students must deepen the selected topics autonomously, searching and processing new information on the basis of scientific papers selected, if requested by students, with the teacher. At the end of the exposure the teacher will pose 3 questions on the topics of the presentation to test students' knowledge. The score assigned, out of 30, will be determined by students' knowledge and clarity in the presentation of the topics (up to 15 points), mastery of specialized terminology (up to 5 points) and capacity of the candidate to search, process autonomously and report the information retrievable from scientific literature (up to 10 points).
Delivery Mode	Face to face

COURSE DESCRIPTION	
Course Title	Disease and Pest Management Towards Sustainable Viticulture- B. Pests
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Acquire knowledge of: a) the biology, ethology, and ecology of the key-pest of grape and of their interactions with agro-ecosystem components (eg: environmental conditions, beneficials pest natural enemies, etc.); b) the methods and tools for monitoring and sampling pests; c) the current integrated, organic and biotechnological pest management strategies to implement vineyard protection according to IPM guidelines. **LOut2**: Identify grape pests, symptoms and damages (direct and indirect, if any) on the host plant, as well as the most important natural enemies. **LOut3**: Take decisions if, when, which and how to apply integrated control techniques to avoid and/or reduce pest damages. **LOut4**: Develop the capability of autonomously elaborating on and critically analyzing the current knowledge by using a multidisciplinary approach. **LOut5**: Communicate what they have learned in a clear, exhaustive and unambiguous way to their interlocutors.
Topic(s)	1. Introduction to vineyard entomology 2. Vine cultivation changes and their influence on endemic and recently introduced species 3. Pest monitoring 4. Pest Management
Learners' profile	Graduated students from FCUP and AgriParisTech
Duration	6 months Semester exchange (February - July)
Participation prerequisites	- Basic knowledge of plant biology and physiology, horticulture and viticulture, plant pathology and on grape diseases caused by oomycetes, fungi, bacteria, phytoplasmas and viruses, genetics. - Attend outdoor class and visits as topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Applied Grapevine Eco-physiology: Written test. Three open questions each one worth 5 points; 16 multiple choice questions (4 possible answers) each one worth 1 point; Disease and Pest Management towards sustainable viticulture - A. Diseases: Written test with 31 questions to be addressed in a maximum of 60 minutes. The questions may require, for example, single or multiple answers, the identification of correct options in a list or their ordering based on relative importance; there are no open answers. The commission will assign a score from zero to one to each of the written replies given by the student; Disease and Pest Management towards sustainable viticulture - B. Pests: Written test with 31 questions to be addressed in a maximum of 60 minutes. The test will require an open answer and single or multiple answers, the identification of correct options in a list or their ordering based on relative importance. The open answer evaluation will consider the question comprehension and the pertinence of the answer to the question, the organization of the answer, the use and mastery of the scientific language, the proficiency in the subject, and the student ability to make use of the knowledge acquired. A score from zero to one will be assigned to each of the written replies given by the student;Grape and Wine Biotechnology: Oral presentation of 30 – 40 minutes prepared by students on one of the topics of the course. The speech must not be just a simple exposure of what was learned during the lessons. Students must deepen the selected topics autonomously, searching and processing new information on the basis of scientific papers selected, if requested by students, with the teacher. At the end of the exposure the teacher will pose 3 questions on the topics of the presentation to test students' knowledge. The score assigned, out of 30, will be determined by students' knowledge and clarity in the presentation of the topics (up to 15 points), mastery of specialized terminology (up to 5 points) and capacity of the candidate to search, process autonomously and report the information retrievable from scientific literature (up to 10 points).

Delivery Mode	Face to face

COURSE DESCRIPTION	
Course Title	Grape and wine biotechnology
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Acquire knowledge of: a) the biology, ethology, and ecology of the key-pest of grape and of their interactions with agro-ecosystem components (eg: environmental conditions, beneficials pest natural enemies, etc.); b) the methods and tools for monitoring and sampling pests; c) the current integrated, organic and biotechnological pest management strategies to implement vineyard protection according to IPM guidelines. **LOut2**: Identify grape pests, symptoms and damages (direct and indirect, if any) on the host plant, as well as the most important natural enemies. **LOut3**: Take decisions if, when, which and how to apply integrated control techniques to avoid and/or reduce pest damages. **LOut4**: Develop the capability of autonomously elaborating on and critically analyzing the current knowledge by using a multidisciplinary approach. **LOut5**: Communicate what they have learned in a clear, exhaustive and unambiguous way to their interlocutors.
Topic(s)	1. Development and use of molecular markers 2. Genetic improvement of grape 3. Traceability 4. Biotechnology of yeasts 5. Tutorials
Learners' profile	Graduated students from FCUP and AgriParisTech
Duration	6 months Semester exchange (February - July)
Participation prerequisites	- Basic knowledge of plant biology and physiology, horticulture and viticulture, plant pathology and on grape diseases caused by oomycetes, fungi, bacteria, phytoplasmas and viruses, genetics. - Attend outdoor class and visits as topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Applied Grapevine Eco-physiology: Written test. Three open questions each one worth 5 points; 16 multiple choice questions (4 possible answers) each one worth 1 point; Disease and Pest Management towards sustainable viticulture - A. Diseases: Written test with 31 questions to be addressed in a maximum of 60 minutes. The questions may require, for example, single or multiple answers, the identification of correct options in a list or their ordering based on relative importance; there are no open answers. The commission will assign a score from zero to one to each of the written replies given by the student; Disease and Pest Management towards sustainable viticulture - B. Pests: Written test with 31 questions to be addressed in a maximum of 60 minutes. The test will require an open answer and single or multiple answers, the identification of correct options in a list or their ordering based on relative importance. The open answer evaluation will consider the question comprehension and the pertinence of the answer to the question, the organization of the answer, the use and mastery of the scientific language, the proficiency in the subject, and the student ability to make use of the knowledge acquired. A score from zero to one will be assigned to each of the written replies given by the student;Grape and Wine Biotechnology: Oral presentation of 30 – 40 minutes prepared by students on one of the topics of the course. The speech must not be just a simple exposure of what was learned during the lessons. Students must deepen the selected topics autonomously, searching and processing new information on the basis of scientific papers selected, if requested by students, with the teacher. At the end of the exposure the teacher will pose 3 questions on the topics of the presentation to test students' knowledge. The score assigned, out of 30, will be determined by students' knowledge and clarity in the presentation of the topics (up to 15 points), mastery

	of specialized terminology (up to 5 points) and capacity of the candidate to search, process autonomously and report the information retrievable from scientific literature (up to 10 points).
Delivery Mode	Face to face

The course "New Sustainable Practices – Viticulture" offered by UCSC will include a comprehensive assessment through both written and oral evaluations, designed to test students' knowledge, analytical skills, and ability to apply sustainable viticulture practices. The final written exam will consist of a test with three open questions (worth 5 points each) and 16 multiple-choice questions (worth 1 point each). In another final written test, students will have 60 minutes to answer 31 questions, which may include open answers, single or multiple selections, identification of correct options from a list, or their ordering based on relative importance. Open answers will be assessed based on comprehension, organization, use of scientific language, and proficiency in the subject, with scores assigned from zero to one for each response. Additionally, students will prepare and deliver a 30-40 minute oral presentation on a selected course topic, going beyond lesson content by conducting independent research, often using scientific literature. Following the presentation, the teacher will ask three questions on the topic to further assess the students' knowledge. The final grade, on a 30-point scale, will be based on the quality and clarity of the presentation (up to 15 points), mastery of specialized terminology (up to 5 points), and the ability to independently search, process, and present information from scientific sources (up to 10 points).

4.10.6 "New sustainable practices – Viticulture"

COURSE DESCRIPTION	
Course Title	Applied Agronomy and Horticulture -Part A, Horticulture
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Own fundamental knowledge about fruit trees anatomy and physiology **LOut2**: Know the role of main factors affecting plant productivity and fruit quality towards sustainable orchard management. **LOut3**: Apply physiological principles in order to design a new orchard and to identify the most appropriate practices for canopy and soil management. **LOut4**: Assess fruit ripening for setting harvest operations according to commercial targets. **LOut5**: Assess the impact of growing site and cultural practices on plant growth, yield and fruit composition. **LOut6**: Identify cropping issues affecting fruit trees, and to find solutions by considering technical and economic aspects. **LOut7**: Successfully provide a correct description of plant organs, phenology and physiological status. **LOut8**: Discuss different technical items by using appropriate language. **LOut9**: Improve knowledge on fruit trees and orchard management issues
Topic(s)	1. Tree morphology and plant propagation 2. Fundamentals of tree physiology and ecophysiology 3. Orchard management 4. Invited seminars on specific topics
Learners' profile	Undergraduate students from University of Applied Sciences (VIVES)
Duration	6 months Semester exchange (February - July)
Participation prerequisites	- Basic knowledge of plant physiology, chemistry, biochemistry, food microbiology, entomology and math.

	- Attend outdoor class and visits as topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Applied Agronomy and Horticulture - Part A: Written exam. 11 open questions with 5 rows available per each answer. Score will reflect the following items: a) effective knowledge of the subject and good overall handling of the matter; b) language clarity; c) ability to make connections and links between different topics; Part B: Written exam with 16 multiple-choice questions (3 choices) and 1 open question (5 points) that cover all the main topics addressed during the course and 2 exercises (9 points). Students will be given 2 h time to answer all questions and to solve the exercise; Applied Enology: Written test. The test will last two hours and will be based on thirty choice questions. The overcoming of the final test, within one year, will exempt the student from preparing the corresponding part of the program for the final examination. This will be oral and will result in the assignment of a score that, out of thirty, will be averaged with the marks obtained in the written test; Applied Viticulture: Written exam by combining multiple-choice and open questions; 16 multiple-choice questions will be valued a maximum score of 16 (true answer = 1 each). Additional 3 open questions with 5 text rows available per each answer will be scored on a 0–5 scale corresponding to a maximum score of 15. Score will reflect the following items: a) knowledge of the subject; b) language clarity; c) ability to make connections between different topics. Final score will be the sum of the two section scores and will be expressed on a 0–30 cum laude scale ; Integrated vineyard protection: Written exam. It will be delivered at the end of the course and/or on official exam dates. The students will have 45 minutes to answer 30 questions (different types of questions: multiple choice, put in the right order, link concepts, ect.) plus one open question (minimum and maximum number of words). Scores will be provided on a scale of 30/30 (“cum laude” for really praiseworthy students).
Delivery Mode	Face to face

COURSE DESCRIPTION	
Course Title	Applied Agronomy and Horticulture -Part B, Applied agronomy
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Be familiar with successful in-field agronomy, applied to each decision, needs a combination of practical and academic knowledge **LOut2**: Recognize and manage crop production factors and to interpret numerical data behind them. **LOut3**: Critically read and address the challenges that the existing farmers are facing nowadays. **LOut4**: Assess fruit ripening for setting harvest operations according to commercial targets. **LOut5**: Assess the impact of growing site and cultural practices on plant growth, yield and fruit composition. **LOut6**: Identify cropping issues affecting fruit trees, and to find solutions by considering technical and economic aspects. **LOut7**: Successfully provide a correct description of plant organs, phenology and physiological status. **LOut8**: Discuss different technical items by using appropriate language. **LOut9**: Improve knowledge on fruit trees and orchard management issues
Topic(s)	1. Introduction 2. The soil 3. Cropping systems 4. Plant nutrition and irrigation 5. Practical and field visit
Learners’ profile	Undergraduate students from University of Applied Sciences (VIVES)
Duration	6 months Semester exchange (February - July)

Participation prerequisites	- Basic knowledge of plant physiology, chemistry, biochemistry, food microbiology, entomology and math. - Attend outdoor class and visits as topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Applied Agronomy and Horticulture - Part A: Written exam. 11 open questions with 5 rows available per each answer. Score will reflect the following items: a) effective knowledge of the subject and good overall handling of the matter; b) language clarity; c) ability to make connections and links between different topics; Part B: Written exam with 16 multiple-choice questions (3 choices) and 1 open question (5 points) that cover all the main topics addressed during the course and 2 exercises (9 points). Students will be given 2 h time to answer all questions and to solve the exercise; Applied Enology: Written test. The test will last two hours and will be based on thirty choice questions. The overcoming of the final test, within one year, will exempt the student from preparing the corresponding part of the program for the final examination. This will be oral and will result in the assignment of a score that, out of thirty, will be averaged with the marks obtained in the written test; Applied Viticulture: Written exam by combining multiple-choice and open questions; 16 multiple-choice questions will be valued a maximum score of 16 (true answer = 1 each). Additional 3 open questions with 5 text rows available per each answer will be scored on a 0–5 scale corresponding to a maximum score of 15. Score will reflect the following items: a) knowledge of the subject; b) language clarity; c) ability to make connections between different topics. Final score will be the sum of the two section scores and will be expressed on a 0–30 cum laude scale ; Integrated vineyard protection: Written exam. It will be delivered at the end of the course and/or on official exam dates. The students will have 45 minutes to answer 30 questions (different types of questions: multiple choice, put in the right order, link concepts, ect.) plus one open question (minimum and maximum number of words). Scores will be provided on a scale of 30/30 (“cum laude” for really praiseworthy students).
Delivery Mode	Face to face

COURSE DESCRIPTION	
Course Title	Applied Enology
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Have a fundamental knowledge about winemaking and wine composition. **LOut2**: Acquire the most suitable techniques needed to get wine stability and to improve wine shelf-life. **LOut3**: Provide autonomous analysis and thinking inspired by the acquired knowledge rather than based on popular “rule of thumbs” applications. **LOut4**: Successfully deliver, in both oral and written forms, a correct diagnosis and discussion of the different winemaking practices using proper technical language. **LOut5**: Improve knowledge on winemaking practice even not discussed during class by consulting handbooks, specific websites as well as scientific and technical journals.
Topic(s)	1. Wine chemistry and microbiology 2. Managing wine making factors 3. Plants and design optimization in winemaking 4. Wine bottling and closures 5. Practical experience
Learners’ profile	Undergraduate students from University of Applied Sciences (VIVES)
Duration	6 months Semester exchange (February - July)
Participation prerequisites	- Basic knowledge of plant physiology, chemistry, biochemistry, food microbiology, entomology and math. - Attend outdoor class and visits as topics covered during these sessions have to be considered part of the teaching program.

Assessment Method	Applied Agronomy and Horticulture - Part A: Written exam. 11 open questions with 5 rows available per each answer. Score will reflect the following items: a) effective knowledge of the subject and good overall handling of the matter; b) language clarity; c) ability to make connections and links between different topics; Part B: Written exam with 16 multiple-choice questions (3 choices) and 1 open question (5 points) that cover all the main topics addressed during the course and 2 exercises (9 points). Students will be given 2 h time to answer all questions and to solve the exercise; Applied Enology: Written test. The test will last two hours and will be based on thirty choice questions. The overcoming of the final test, within one year, will exempt the student from preparing the corresponding part of the program for the final examination. This will be oral and will result in the assignment of a score that, out of thirty, will be averaged with the marks obtained in the written test; Applied Viticulture: Written exam by combining multiple-choice and open questions; 16 multiple-choice questions will be valued a maximum score of 16 (true answer = 1 each). Additional 3 open questions with 5 text rows available per each answer will be scored on a 0–5 scale corresponding to a maximum score of 15. Score will reflect the following items: a) knowledge of the subject; b) language clarity; c) ability to make connections between different topics. Final score will be the sum of the two section scores and will be expressed on a 0–30 cum laude scale ; Integrated vineyard protection: Written exam. It will be delivered at the end of the course and/or on official exam dates. The students will have 45 minutes to answer 30 questions (different types of questions: multiple choice, put in the right order, link concepts, ect.) plus one open question (minimum and maximum number of words). Scores will be provided on a scale of 30/30 (“cum laude” for really praiseworthy students).
Delivery Mode	Face to face

COURSE DESCRIPTION	
Course Title	Applied Viticulture
Learning Outcomes	*By the end of this module, the learner will be able to*: **LOut1:** Own fundamental knowledge about grapevine anatomy and physiology, source-to-sink relationships and short to long term solutions allowing achievement of vine balance and high grape quality standards. **LOut2**: Apply the learned physiological principles to design a new vineyard by performing the most appropriate decisions in terms of site selection, plant material and vine density. **LOut3**: Identify the most appropriate cultural practices considering that their timing and severity can vary according to environmental conditions and enological targets. **LOut4**: Assess technical issues and economic convenience of several cultural practices including adoption of mechanical operations in traditional vineyard management and grape harvesting. **LOut5**: Demonstrate, in both oral and written forms, good handling of technical language and confidence to participate, with a good degree of interaction, to stakeholders’ panels or focus groups discussing various viticulture items. **LOut6**: Improve knowledge on general viticulture and vineyard management issues even not discussed during class by consulting handbooks, specific websites as well as scientific and technical journals.
Topic(s)	1. Botany and anatomy 2. Gas exchange 3. Berry development and ripening 4. Grapevine propagation and vineyard planting 5. Winter pruning 6. Canopy management and summer pruning 7. Tutorials
Learners’ profile	Undergraduate students from University of Applied Sciences (VIVES)

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Duration	6 months Semester exchange (February - July)
Participation prerequisites	- Basic knowledge of plant physiology, chemistry, biochemistry, food microbiology, entomology and math. - Attend outdoor class and visits as topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Applied Agronomy and Horticulture - Part A: Written exam. 11 open questions with 5 rows available per each answer. Score will reflect the following items: a) effective knowledge of the subject and good overall handling of the matter; b) language clarity; c) ability to make connections and links between different topics; Part B: Written exam with 16 multiple-choice questions (3 choices) and 1 open question (5 points) that cover all the main topics addressed during the course and 2 exercises (9 points). Students will be given 2 h time to answer all questions and to solve the exercise; Applied Enology: Written test. The test will last two hours and will be based on thirty choice questions. The overcoming of the final test, within one year, will exempt the student from preparing the corresponding part of the program for the final examination. This will be oral and will result in the assignment of a score that, out of thirty, will be averaged with the marks obtained in the written test; Applied Viticulture: Written exam by combining multiple-choice and open questions; 16 multiple-choice questions will be valued a maximum score of 16 (true answer = 1 each). Additional 3 open questions with 5 text rows available per each answer will be scored on a 0–5 scale corresponding to a maximum score of 15. Score will reflect the following items: a) knowledge of the subject; b) language clarity; c) ability to make connections between different topics. Final score will be the sum of the two section scores and will be expressed on a 0–30 cum laude scale ; Integrated vineyard protection: Written exam. It will be delivered at the end of the course and/or on official exam dates. The students will have 45 minutes to answer 30 questions (different type of questions: multiple choice, put in the right order, link concepts, ect.) plus one open question (minimum and maximum number of words). Scores will be provided on a scale of 30/30 (“cum laude” for really praiseworthy students).
Delivery Mode	Face to face

COURSE DESCRIPTION	
Course Title	Integrated Vineyard Protection
Learning Outcomes	*By the end of this course, the learner will be able to*: **LOut1:** Provide the future Bachelor graduates with the skills, knowledge and capacities to maintain and improve vineyard’s and grapevine production’s quality, sustainability and market performance. **LOut2**: Know and comprehend the major biotics and abiotics causes of disease for grapevine production. **LOut3**: Apply specific knowledge and also general concepts about crop protection in order to select and properly justify the most adapted intervention requested by the specific conditions of the vineyard environment. **LOut4**: Communicate with the scientific and technical language in order to describe and transfer both in oral and written form the acquired concepts. **LOut5**: Hold learning capacities suitable to either lead them to higher study courses or to successfully tackle a job appointment.
Topic(s)	1. Diseases 2. Diseases management 3. Fungicides 4. Practical classes/Tutorials
Learners’ profile	Undergraduate students from University of Applied Sciences (VIVES)
Duration	6 months Semester exchange (February - July)
Participation prerequisites	- Basic knowledge of plant physiology, chemistry, biochemistry, food microbiology, entomology and math.

	- Attend outdoor class and visits as topics covered during these sessions have to be considered part of the teaching program.
Assessment Method	Applied Agronomy and Horticulture - Part A: Written exam. 11 open questions with 5 rows available per each answer. Score will reflect the following items: a) effective knowledge of the subject and good overall handling of the matter; b) language clarity; c) ability to make connections and links between different topics; Part B: Written exam with 16 multiple-choice questions (3 choices) and 1 open question (5 points) that cover all the main topics addressed during the course and 2 exercises (9 points). Students will be given 2 h time to answer all questions and to solve the exercise; Applied Enology: Written test. The test will last two hours and will be based on thirty choice questions. The overcoming of the final test, within one year, will exempt the student from preparing the corresponding part of the program for the final examination. This will be oral and will result in the assignment of a score that, out of thirty, will be averaged with the marks obtained in the written test; Applied Viticulture: Written exam by combining multiple-choice and open questions; 16 multiple-choice questions will be valued a maximum score of 16 (true answer = 1 each). Additional 3 open questions with 5 text rows available per each answer will be scored on a 0–5 scale corresponding to a maximum score of 15. Score will reflect the following items: a) knowledge of the subject; b) language clarity; c) ability to make connections between different topics. Final score will be the sum of the two section scores and will be expressed on a 0–30 cum laude scale ; Integrated vineyard protection: Written exam. It will be delivered at the end of the course and/or on official exam dates. The students will have 45 minutes to answer 30 questions (different type of questions: multiple choice, put in the right order, link concepts, ect.) plus one open question (minimum and maximum number of words). Scores will be provided on a scale of 30/30 (“cum laude” for really praiseworthy students).

The course "New Sustainable Practices – Viticulture" offered by UCSC will utilize a variety of assessment methods to evaluate students' understanding of key concepts and their ability to apply them to viticulture practices. The final written exam will consist of 11 open questions, each with 5 rows for the answer, focusing on the student's knowledge of the subject, clarity of language, and ability to make connections between topics. Another written exam will feature 16 multiple-choice questions (worth 1 point each), one open question (worth 5 points), and two exercises (worth 9 points), with students given two hours to complete the exam. Attending students will also have the option of taking a two-hour written test at the end of the course, consisting of 30 multiple-choice questions. Successful completion of this test within one year will exempt them from preparing that part of the program for the oral final exam, where the score will be averaged with the marks from the written test. Students may opt out of this exemption and take the full oral exam. Both the written and oral exams will assess the student's knowledge, appropriate use of terminology, ability to structure arguments coherently, and capacity to identify conceptual links. Another assessment will combine 16 multiple-choice questions (maximum score of 16) with 3 open questions (scored up to 15 points), with a final score expressed on a 30/30 scale, including "cum laude" for outstanding students. In some instances, students will have 45 minutes to complete 30 questions of various types and one open question.

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5 Development Phase

This chapter outlines the Development Phase of the AF4F Curriculum Programme, representing a crucial step where the conceptual framework established in the Design Phase is transformed into practical learning experiences. During this phase, comprehensive educational content is produced, combining the knowledge of subject matter experts with the skills of multimedia professionals to craft engaging and impactful learning materials. A key focus is the careful preparation of the MOOC platform to host this content, ensuring that participants have an intuitive and accessible learning experience.

The main deliverables of this phase include: (a) the creation of learning materials, featuring a selection of core and supplementary Learning Objects/Activities, along with collaborative and assessment tools, (b) the development of a comprehensive Quiz Bank for evaluations, (c) a set of reflection activities, (d) multiple choice questions, which serve as user manuals for the MOOC platform.

5.1 Educational Material

In the development phase of the AF4F project, emphasis is placed on the design and creation of educational materials that align with the European Qualifications Framework (EQF) levels 6, 7, and 8. The AF4F curricula leverage the ADDIE model, ensuring a structured instructional design that meets both the learning needs of students and the regulatory frameworks of higher education institutions across Europe. The creation of course materials follows the analysis of gaps identified in the bioeconomy sector, particularly in sustainable practices, resource valorization, and biological and chemical engineering.

Curriculum Design: Course Integration

The curricula will be composed of multiple courses that address key areas in the bioeconomy and sustainability sectors. For example, the "Business Sustainability and Valorisation of Resources" course will introduce students to sustainable business practices and the efficient use of biological resources. This course will be assessed through written exams and assignments to ensure that students can apply theoretical knowledge to real-world challenges.

Another course , "Biological and Chemical Engineering for a Sustainable Bioeconomy", focuses on training future research and innovation managers in bio-based industries. It integrates theoretical knowledge with practical skills in circular economy systems and biodiversity preservation. The assessment will involve written exams, individual and group reports, oral presentations, and field trip analyses. These assessments are designed to test students' ability to synthesize, analyze, and apply scientific research to bioeconomy challenges.

Specialized Learning Pathways: Viticulture

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The project also includes specialized pathways, such as the "New Sustainable Practices – Viticulture" curriculum. For both the Fall and Spring semesters, students will engage in courses like "Advances in Enology," "Environment and Biota," and "Vineyard Variability: Traditional and Precision Approaches" for a total of 24 ECTS. In addition to classroom-based learning, students will complete a 6-ECTS internship that allows them to gain hands-on experience in vineyards and wineries. The internships will immerse students in grapevine cultivation, wine production, and decision-making processes critical to the industry.

The Spring semester will further explore topics such as "Applied Grapevine Eco-physiology," "Disease and Pest Management for Sustainable Viticulture," and "Grape and Wine Biotechnology." Assessment methods for these courses include written tests with open and multiple-choice questions, oral assessments, and group presentations. Each evaluation method is designed to test both the practical and theoretical understanding of students, ensuring that they can contribute meaningfully to the evolving wine industry.

Advanced Learning Outcomes and Evaluation Techniques

Drawing from Bloom’s Taxonomy, which is integral to the structure of higher education curricula, the AF4F project employs a mix of cognitive, affective, and psychomotor learning outcomes. Cognitive learning is emphasized in courses requiring students to remember, understand, and apply knowledge to case studies, fieldwork, and research projects. The revised cognitive domain by Anderson and Krathwohl, which stresses application, analysis, evaluation, and creation, guides the course design and assessment methods.

For example, students in the "Bioenergies and Lignocelluloses" course will prepare individual synthetic reports on site visits, reflecting the evaluation and analysis levels of Bloom's Taxonomy. Similarly, the "Environmental Assessment for a Sustainable Bio-economy" course will involve group work culminating in reports and oral defenses, ensuring that students can both create new solutions and evaluate existing bio-based projects.

The learning outcomes of the curricula will be expressed clearly in program descriptions, allowing educators, students, and stakeholders to understand what students will learn and achieve through the courses. These outcomes will focus on what students will do and what they will have done by the end of the program, ensuring that each course supports the overall programmatic objectives.

Assessment Techniques

The AF4F project employs a variety of assessment methods to ensure comprehensive student evaluation. For instance:

- Written exams: These test students' theoretical knowledge and ability to apply it in problem-solving scenarios.
- Assignments: Reflect the practical application of concepts learned in lectures.

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- Oral presentations: Assess students' communication skills, mastery of specialized terminology, and capacity to conduct independent research.
- Group work: Encourages collaboration and critical thinking, preparing students for real-world professional settings.

Assessments will not only focus on knowledge retention but also on the students' ability to connect concepts, demonstrate critical thinking, and create new approaches to solve complex challenges in sustainable agriculture and bioeconomy sectors.

By utilizing diverse assessment techniques, the AF4F project ensures a balanced approach that meets the needs of different learning styles, aligning with the ADDIE model's emphasis on practical, real-world applications of learning in higher education settings.

The AF4F curricula will be implemented following a three-semester mobility plan. Based on the timeline provided, the curricula will take place during the following semesters (Fall 2025 - Spring 2026 and Fall 2026) and students will attend only one of the three semesters.

Last but not least, this timeline was extended to M45 to accommodate low student enrollment numbers and to provide sufficient time for partnerships and agreements between universities to be formalized. Therefore, the full rollout of the curricula will start in Fall 2025 and run through Fall 2026.

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6 Implementation & Evaluation Phase

The Implementation Phase of the Agrifood4 for Future (AF4F) curricula focuses on putting the developed programs into practice across the partner institutions. This phase will involve the actual delivery of the curriculum to students, ensuring that all materials, courses, and resources are available and align with the project's objectives.

Implementation

- **Student Enrollment and Mobility**

The program will be rolled out over a three-semester mobility plan: Fall 2025, Spring 2026, and Fall 2026, as previously outlined. During this period, students will engage in specialized courses and exchange programs at partner institutions, gaining diverse educational experiences across Europe.

The ERASMUS program will support student mobility, as the project budget does not cover this aspect. Agreements between the key partner institutions (UCSC, VIVES, FCUP, and AgroParisTech) are currently being negotiated to ensure smooth exchanges during the six-month exchange period.

- **Course Delivery**

Courses will be delivered both in-person and through online platforms, depending on the course structure and partner institution's resources. Courses such as "New Sustainable Practices in Viticulture" and "Biological and Chemical Engineering for a Sustainable Bioeconomy (Bioceb)" will be introduced, with a mix of lectures, laboratory work, field trips, and internships.

Internships and fieldwork will play a crucial role in providing practical experience, particularly in the viticulture and bioeconomy sectors, where students will work in vineyards, wineries, and bio-based industries to apply theoretical knowledge in real-world contexts.

- **Educational Materials**

The educational material will consist of a mix of textbooks, scientific papers, case studies, online resources, and practical guidelines. For example, the curriculum in Viticulture will require students to be focused on topics such as Grape and Wine Biotechnology and Disease and Pest Management, with materials focused on cutting-edge research and sustainable practices.

Custom resources will be developed for courses such as Business Sustainability & Valorization of Resources, emphasizing real-world applications through assignments, case studies, and written exams.

- **Evaluation**

After the initial implementation of the curricula, the Evaluation Phase will begin, focusing on continuous feedback and refinement:

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- **Assessment Techniques**

As highlighted in the educational material section, assessment methods will include written exams, oral presentations, lab reports, and practical fieldwork assessments. The variety in assessment techniques will ensure a comprehensive evaluation of student knowledge and skills.

For instance, courses like Environmental Assessment for a Sustainable Bio-Economy will involve both group work and oral defenses of bio-based projects, providing a mix of individual and collaborative assessments.

- **Program Refinements**

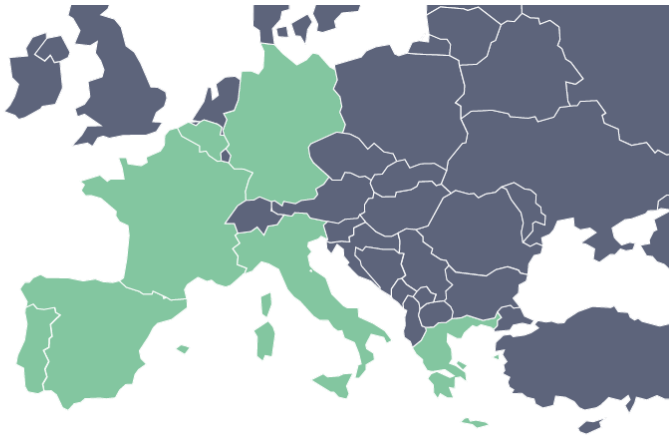
Based on the feedback and assessment results from the pilot phase, necessary adjustments will be made before moving into the second piloting phase. The ADDIE model will guide the refinement process, ensuring that the curriculum remains responsive to student needs and evolving industry demands.

Continuous dialogue with external stakeholders, including employers, industry partners, and academic peers, will provide additional insights to ensure the program's relevance and effectiveness in preparing students for future careers.

- **Scaling and Institutional Adoption**

As the pilot phase concludes, and the necessary refinements are made, the curriculum will be ready for wider implementation. New institutions may join the project, expanding the program’s reach across Europe and beyond, in alignment with the project’s goal of building a pan-European educational framework in agrifood studies.

This iterative process of implementation, feedback, and evaluation will ensure that the AF4F curricula remain innovative, cross-disciplinary, and aligned with the needs of both students and the growing agrifood sector.



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7 References

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CEDEFOP (2013) USING LEARNING OUTCOMES European Qualifications Framework Series: Note 4, p.3 (Link: https://www.cedefop.europa.eu/files/Using_learning_outcomes.pdf)

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8 Annexes

AF4F Curricula. Available at:

https://drive.google.com/drive/folders/1SudpJ_sZBIarnjfhZTppmOXlgw-1bo6e?usp=drive_link