

Hydroponic Vertical Farming:

Developing VET for addressing vertical hydroponic farming skill needs

Hydro-Farm-VET

R.2.2: EU-wide Review on Hydroponic VET training courses and job opportunities



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INTRODUCTION

This document was produced in the framework of the ERASMUS+ programme, KA220-VET - Cooperation partnerships in vocational education under the project entitled: Hydroponic Vertical Farming VET- Developing VET for addressing vertical hydroponic farming skills needs and within the activity: A.2.1: Extensive analysis on best practices, applied initiatives and policies in vertical hydroponic farming

The aim of Hydro_Farm_VET project is to increase the flexibility of VET opportunities, develop a new VOOC on vertical Hydroponic and create opportunities for integration into labor market establishing the conditions for human capital capacity development, and career opportunities for agriculture workers and entrepreneurs who want to start or expand their business in that field.

Hydro_Farm_VET anticipates to respond to the following needs:

- Scarcity of training programmes and courses on Vertical hydroponic technology especially if looking at European dimensions and a need to address existing skills mismatches, resulting from the dynamic penetration of hydroponic agriculture as a method to create an environment that encourages sustainable urban life and promotes a state of good health.
- Lack of Hydroponic knowledge and skills in the agricultural sector, as well as lack of well-timed and well-aligned training provisions that addresses these skills shortages, gaps and mismatches
- Lack of training tools and resources in field of Hydroponics with integrated online approaches based to facilitate learning and increase students and learner's motivation towards training
- Lack of political discussion in the sense of restructuring and re shaping the rules governing organic production, labelling and control and the role of soil on organic products definition (Council Regulation No 834/2007).

In order to meet the above needs and more specifically the lack of knowledge and resources as well as the lack of training tools in the field of Hydroponics partners conducted an extensive analysis and desktop research which focused on the collection of current training curricula in the Hydroponic field.

The final aim of the activity was to gain a comprehensive understanding of the present situation of Hydroponic Farming in today's agricultural education sector. The analysis examines:

- The current state of the European agricultural education and skill needs
- The educational offers on Hydroponic VET courses from France, Slovenia, Greece, Czech Republic, Italy.

I.METHODOLOGICAL APPROACH

A literature review was conducted by European Knowledge Spot to provide insights of the agricultural education, skill needs and job opportunities at EU level and further facilitate the HydroFarmVET curricula development. Partners implemented the data gathering of current Vocational courses at country level. The data and information were gathered in France, Slovenia, Greece, Czech Republic, Italy, via desk research. Programmes were identified via various search engines (Google, Bing etc) and terms used to identify programmes included “Hydroponic farming”, “vocational education and training”, ‘Hydroponic education’.

For the in-depth analysis of offered VET curricula in project's participating countries, Partners documented a common ground among curricula, analyzing similar elements as follows:

- content (teaching modules, learning outcomes)
- method of delivery, duration
- type of assessment
- training/teaching methods
- target groups
- digital skills offered

For the desk research, partners were guided by the below listed questions (see Annex 1).

2.EXECUTIVE SUMMARY

The information presented in this report summarizes the approach to and results of the desk-based study into the Hydroponic related Vocational Education and Training curricula offered at the Partner Countries.

Desk Research Objectives

- Map the agricultural education sector at EU level, and review the skill needs and job opportunities
- Investigate the organizations which offer Hydroponic related certificates/degrees
- Investigate the structure and content of these programs

Partners and countries involved:

Partners	Country
Coopérative pour le Développement de l'emploi dans les métiers du patrimoine (PPC)	France
Biotehniski center Naklo (Naklo)	Slovenia
European Knowledge Spot (EKS)	Greece
Asociace soukromeho zemedelstvi Ceske republiky (APF CR)	Czech Republic
Univerista degli Studi di Firenze (UNIFI)	Italy

In particular each partner identified the currently existing educational courses that address Hydroponic Farming. Twelve (12) courses have been identified which are presented in the analysis below. Overall Hydroponic education is offered mainly as (C)VET through various types of programmes, curricula and courses of different categories – from those for beginners to those for advanced people who need specialized training and by higher educational institutions as formal education.

Given the information provided in the courses, some main conclusions can be drawn that highlight the current training offer:

1. The majority of the lifelong learning courses which are exclusively dedicated and relevant to Hydroponics are mainly short online hybrid trainings/seminars offered by educational institutions in the respective countries. In particular, for France, the Hydroponic trainings presented are courses of a maximum of 5 days, equivalent to EQF level 3, and combine both theory and practice (on-the-job training; on-farm training). For Greece, the Centre for Lifelong Learning of the Hellenic

Open University offers an 18 weeks course exclusively dedicated to Hydroponic farming which upon successful completion, provides individuals with a Training certificate equivalent to 12 ECVET credits and is not classified in a particular level of the national qualifications' framework (HQP). In Slovenia and the Czech Republic, there is a lack of specific IVET or CVET courses focused solely on this topic and Hydroponic farming is mainly taught as an elective course in the framework of Bachelor degrees. In Italy, the trainings offered such as Vertical Agriculture (Agricoltura Verticale) are short courses issuing a certificate of attendance and providing ECTS credits but are also not classified in the National Qualifications Framework.

2. There is currently no IVET program that addresses Hydroponic farming in exclusivity. Only one course from Greece: The Greenhouse & Cover Crops Technician is an IVET program classified as NQF 5 (EQF5). However, this Initial Vocational Training Course with a duration of two years is not exclusively dedicated to Hydroponics. Hydroponic Crops and Soil science are only part of the courses taught in the framework of the curricula which mainly deal with greenhouse and agricultural techniques.
3. Practical experience and/or laboratory exercises are included in all provided courses.
4. The target groups of the courses include any individual interested in the Hydroponic sector except the courses offered by universities which refer to students of the specific specialization/ professions. (Students in Horticulture or landscape architecture)
5. Main modules that are common in more than one training courses include: Greenhouse management Crops management; Hydroponic systems Soil Science.

The desk research highlighted the need for a VET curriculum in Hydroponic training. In this respect, selected recommendations coming from Partners include:

- The VET course in Hydroponics must comprise not only the theory and principles of hydroponics but also practical experience and guidance on specific practices and techniques that can be used in real-world -conditions.
- The programme should be accessible to different target groups such as farmers, entrepreneurs and VET educators. Therefore, the programme should be flexible in order to adapt to the different needs and interests of the participants.
- Pedagogy should include a range of theory and applied practice including best practice examples;
- Careful consideration should be given to the exact title of the programme to ensure that there is enough market opportunity for the Hydroponics course.

- Skills referenced to the 2019 Cedefop report (Cedefop: Farmworkers and gardeners: skills opportunities and challenges - 2019 update) should be taken into consideration when developing the Hydroponic Farm VET online course.
- Modern technologies and digital aspects that can be used in hydroponic greenhouses should also be considered as a separate course in the framework of the curricula.



3. BRIEF OVERVIEW OF EUROPEAN AGRICULTURAL EDUCATION, SKILL NEEDS AND JOB OPPORTUNITIES

The information revolution that is driving changes throughout the economy, along with advances in science and technology, are transforming the agricultural industry at an increasing pace and making agriculture a more knowledge-intensive industry. It is fundamental that young farmers are adequately trained to be able to adapt to evolving and increasingly specialized agricultural techniques. They also need to cope with a challenging economic context and meet society's new requirements on environmental protection, the fight against climate change, and healthy and balanced diets. More experienced farmers also need to adapt constantly to economic and technological developments and to new consumer trends.

However, on average, only 8.5 % of the present generation of European farmers have received full agricultural training, and 70 % learned their skills through practical experience alone (Briefing EU Parliament 2017- Agricultural education and lifelong training in the EU).

Below you can see the share of farm managers with basic training, practical experience or full agricultural training (as their highest level), 2013, EU-28

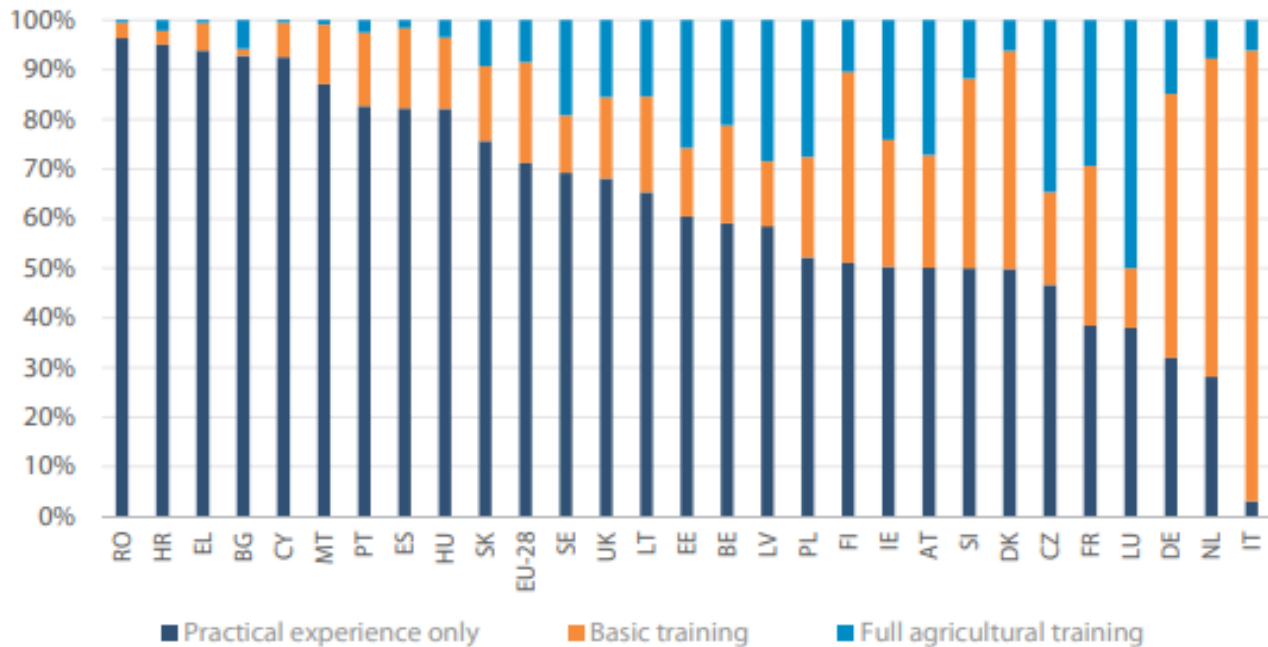


Figure 1: Eurostat data of the share of farm managers with basic training, practical experience or full agricultural training (2013), EU-28

To successfully address and react to the educational and training gaps, the agri-food workforce needs new skills and competences, which, in turn, require the identification of needed existing and emerging skills.

According to Eurofound's Job Monitor, autonomy, creativity, resolution, gathering and evaluating information are the most important tasks and skills of farmworkers and gardeners followed by the use of machines, literacy, dexterity and strength. (Cedefop: Farmworkers and gardeners: skills opportunities and challenges (2019 update). In the following figure, you can see the importance of tasks and skills as measured from scale 0-1, where 0 means least important and 1 means most important

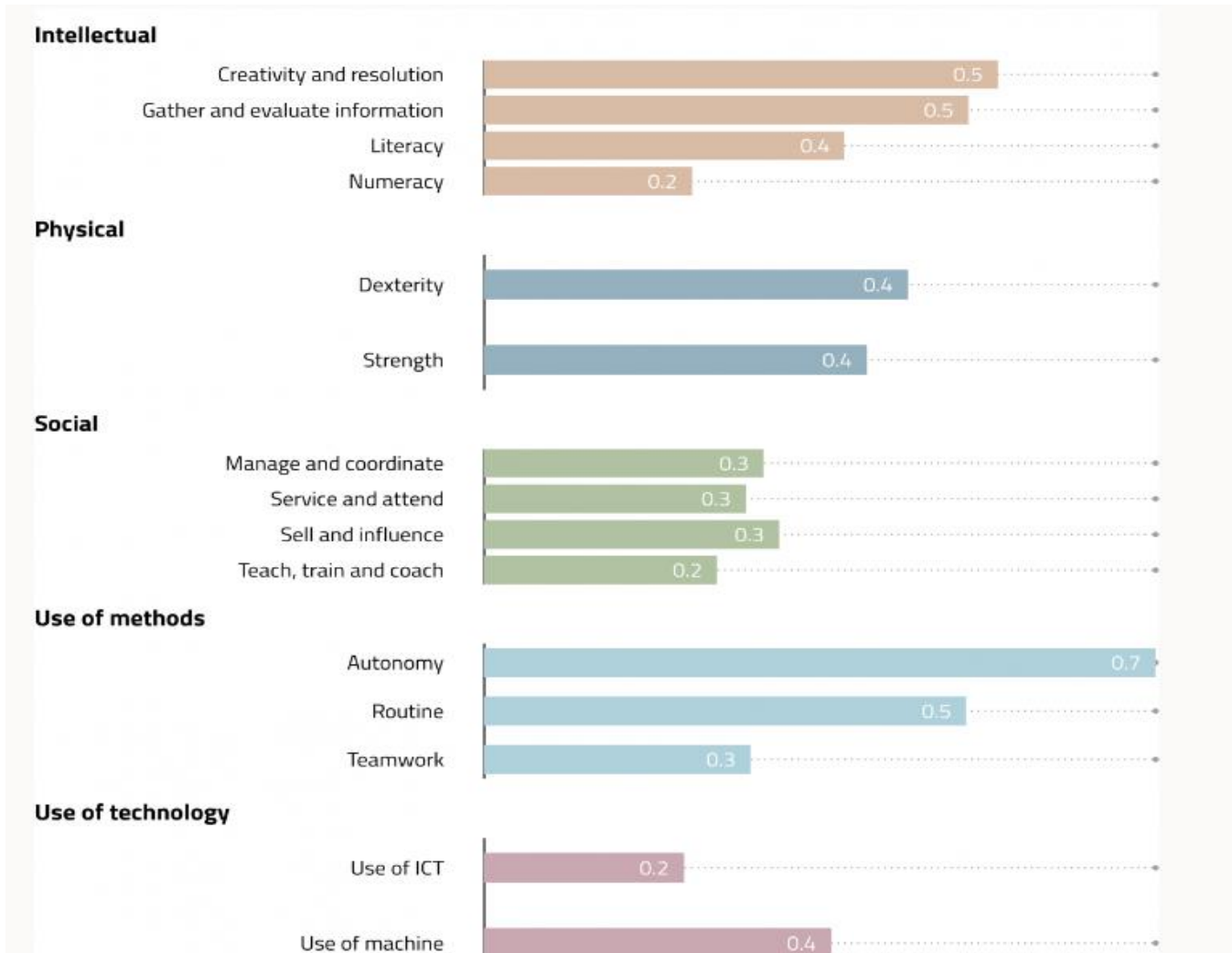


Figure 2: Importance of tasks and skills of farmworkers and gardeners

Further, farmers will need the means and skills to meet the new agriculture challenges. Those include improving productivity while ensuring the sustainable management of natural resources, coping with climate change, providing ecosystem services and public goods, ensuring the sustainable management of forests and adapting to shifting consumer demand. Indeed, according to the 2019 Cedefop report (Cedefop: Farmworkers and gardeners: skills opportunities and challenges - 2019 update) the sector relevant skills need to adapt to changing production processes, and to other sector-specific changes and challenges which include:

- Increased use of advanced machinery and robotics: farmers will need to adapt their operations and maintenance expertise to use the equipment effectively, and maximize the productivity and lifespan of machines.

- Data management is likely to become an important skill in farming practice, allowing workers to process information collected from different sensors and mapping system. Software can also store digital evidence to be presented to national and EU agricultural regulators on the fulfilment of subsidy conditions.
- Climate change and environmental degradation increases the need for skilled agricultural workers to understand how environmental sustainability is integral and applicable to their everyday practice.
- EU and national level regulations, including the Common Agricultural Policy (CAP), have been implemented across the EU with the aim of reducing some of the negative externalities of farming, fishing and forest management. CAP regulations require farmers to have an up-to-date understanding of evolving regulations and awareness of sustainable practices to make the most efficient use of resources.

In addition, the ERASMUS+ “FIELDS” project started in 2020 aimed at addressing the current and future skill needs for sustainability, digitalization, and bioeconomy in the agri-food and forestry sectors and revealed that farmers selected business planning/model and strategic management as the most important skill. Following that skill, farmers deemed sustainability skills to include mitigation and adaptation to climate change, good agricultural practices, water management, and soil nutrient and health management very important. In the same line, Bailey, N. E., Arnold, S. K., & Igo, C. G (2014) identified business management skills, legal knowledge, communication skills, and skills associated with technologies as educational needs. Barriers such as distance, time, and lack of awareness prevented educational event attendance. Programs were considered successful if they provided networking opportunities, relevant content, and a positive, interactive environment. The importance of soft skills was also revealed from European surveys and were categorized by importance as described in the following figure:

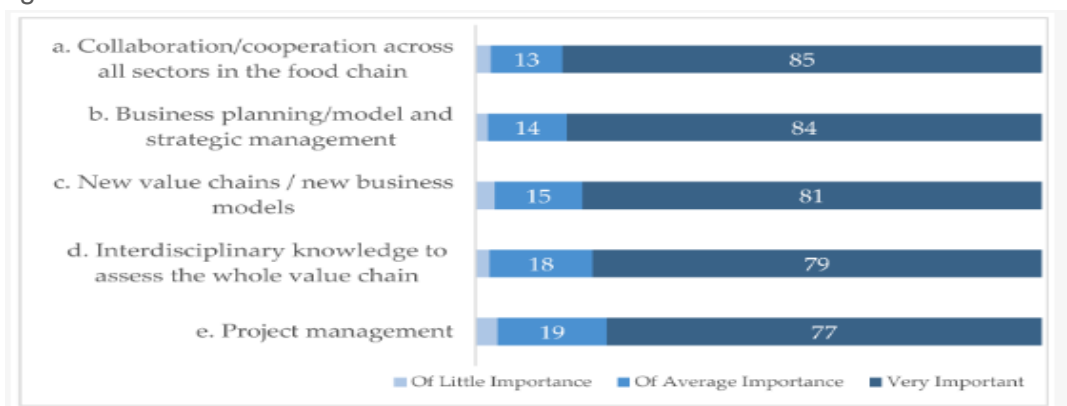


Figure 3. Categorization of five selected soft skills by importance. Values represent the percentage of answers for each skill.

Concerning job opportunities, employment for farmworkers and gardeners is projected to fall by a further 7 per cent over the period 2018 to 2030. This will entail the loss of around 600,000 jobs. This fall in employment is not as pessimistic as it might first appear. It is estimated that around 6.3 million people will leave their jobs as farmworkers and gardeners over the same period and they will need to be replaced. The upshot of this is that there will be around 5.7 million job openings that will need to be filled by 2030.



4. HYDROPONIC TRAININGS AVAILABLE IN ALL PROJECT PARTNER COUNTRIES

FRANCE

1.Course Title : Formation à l'hydroponie (Hydroponics training).

<https://lessourciers.com/fr/formation-hydroponie-2/initiation-a-lhydroponie/>

Course Overview: This online Vocational Training course (Level: NQF 3) is divided in 3 stages, is open to anyone interested and willing to start a hydroponic farm or to learn about hydroponics and is delivered through Video and

Pdf presentations. It comprises of 17 hours presentations + 1 session of practical training (3 days).

Content of the Training Course

The course is divided in 3 stages:

Stage 1: Theory e-course-10 Hours

- Introduction

- Plant needs
- Substrate
- Water management and equipment
- Hydroponic systems
- Soilless farming

Learning outcomes:

1. Concretize a production model
2. Know the characteristics of hydroponics
3. Know and determine the characteristics and needs of hydroponically grown plants
1. Know and understand how to select a hydroponic system
4. Identify and characterize the different methods of soilless cultivation
2. Know different professional hydroponic projects over the world

Stage 2: Theory E-course-10 hours ½

- Nutrition
- Insects and deficiencies
- Greenhouse management
- Crops management
- Farming

2. Course Title *Vocational training "Starting a hydroponic/bioponic and aquaponic farm"*

Course Overview: This 5-day course on-site training (EQF level 3) directly elaborated on the farm aims to train interested individuals as a soilless market gardener, using bioponics, hydroponics and/or aquaponics techniques. It will also address how to start a professional project (from the birth of the project to the sale of the products), how to develop the business plan, (how to finance one's business), and how to manage a company on a daily basis and what gestures to have.

Learning outcomes:

1. Understand the role of each nutritive element-Compare commercial and home-made solutions- Develop and use an in-house, tailor-made solution.
2. Set the location of the greenhouse- Ensuring the greenhouse management in order to maximize its use- Understand the climatic gestion approaches of the farming greenhouse
3. Crops management and planning

Stage 3: On-the-job training- Practical course 3 days

Day 1

Reception and introduction

Tour of the Plants and greenhouse

Understanding systems

Designing and building systems

Day 2

- Nutrition 1
- Nutrition 2
- Seeding and planting
- Transplanting

Content of the Training Course:

Day 1

- Reception and introduction of the participants
- Learning of the hydroponics/aquaponics/bioponics basics (Plant needs, systems)
- Farm tour

Day 2

- Business model
- Develop your agricultural business project: customers, legal status, financing...

- Hands-on workshop in the greenhouse (the basics of soilless

market gardening (sowing, multiplying plants, transplanting, planning seedlings...)

Day 3

Business plan

- Preparing the site to create your farm: installing electricity and water, authorizations to be obtained before starting,...
- Hands-on workshop in the greenhouse: the daily gestures to have, from the control of the electro-conductivity of the water and its PH, to the management of the inputs in a sensitive living system, the dosage of fertilizers and fish food

Day 4

- Starting your business

- Canvassing new customers, managing orders, offering attractive products, designing balanced vegetable baskets
- Designing the graphic identity of the farm: designing a logo and a brand, its website, the related costs, etc.
- Hands-on workshop in the greenhouse: maintenance and upkeep of systems, management of breakdowns or technical incidents, pest management via Integrated Pest Management (release of beneficial insects)

Day 5

- Last details and Q&A session
- Hands-on workshop in the greenhouse: harvesting for restaurants and individuals, packaging and preparation of deliveries, explanations on the different ways of preserving products and their presentation.

SLOVENIA

1.Course Title: Hydroponic Plant Cultivation - elective course at level 1 of Agronomy and Horticulture

<https://www.bf.uni-lj.si/sl/studij/studijski-programi/predmetnik/2020091415130211/20210105093170/hidroponsko-gojenje-vrtnin>

Course Overview: This elective course is held at University of Ljubljana, Biotechnical Faculty and is intended for students of the Horticulture 1st degree programme. It comprises of 15 hours of lectures and 15 hours of laboratory exercises and is an SQF level 7/EQF level 6

Content of the University Course:

In-depth coverage of hydroponic cultivation of selected vegetables for production purposes. Students are introduced to the characteristics of

hydroponic vegetable production systems, equipment and the most appropriate techniques and measures for successful vegetable cultivation.

Thematic strands:

Description and breakdown of hydroponic systems;

- Selection and preparation of hydroponic cultivation facilities;
- Hydroponic cultivation techniques (aeroponic, NFT, Floating systems, Aggregate systems (in solid substrates), Thin layer cultivation systems);
- Selection and description of substrates for hydroponic cultivation (rockwool, peat

- substrates, perlite, sawdust, vermiculite, mixtures of substrates);
- Selection and preparation of nutrient solutions (concentrated, dilute, for individual vegetables);
 - Design and care of hydroponically grown vegetable crops (seedling production, planting, care);
 - Selection of cultivation techniques for selected vegetables (leafy vegetables, fruiting vegetables, herbs, ornamentals);
 - Cost-effectiveness of hydroponically grown vegetables (calculations, cost analyses).

2. Course Title: Growth in controlled systems- elective course at 2nd level

<https://www.bf.uni-lj.si/sl/studij/studijski-programi/predmetnik/2020091415434804/20201223165569/pridelava-vrtnin-v-nadzorovanih-sistemih>

Course Overview: This course is held at the University of Ljubljana, Biotechnical Faculty and is intended for students of the Horticulture 2 and degree programme. It comprises of 15 hours of lectures, 10 hours of laboratory exercises and 5 hours of seminars and is an SQF level 8/EQF level 7

GREECE

1.Course Title: Introduction and Applications of Innovative Hydroponic Crops in Greenhouses- Management and Production of Vegetable Products

(https://kedivim.eap.gr/?page_id=6716)

Course Overview: This Course is Offered by the Centre for Lifelong Learning of the Hellenic Open University and is of a total duration: 300 HOURS/18 WEEKS, ECVET units:12 and is addressed to a wide audience of people involved or interested in agricultural production and in particular in innovative hydroponic cultivation of

Content of the University Course:

An introduction to controlled-growing systems and their relevance for agricultural practice.

Description of systems for the production of vegetables under controlled growing conditions: a range of hydroponic systems, systems for controlling light, heat, relative humidity, end-tidal humidity, etc. CO₂, water and nutrients.

Examples of good practice using LED luminaires (length of day adjustment (DLI), light intensity, composition of the light spectrum).

Selection of vegetables to be grown in controlled systems: salad crops/ fruit crops/ brassicas/ herbs/ young vegetables (sprouts).

Growth cycle of selected plant species for cultivation in controlled systems.

Measures to be taken in the cultivation of selected vegetables: crop design, care and control of growth factors (light, heat, moisture, nutrients, CO₂), prediction of technological maturity and harvesting, and preparation of the vegetables for the market.

Cost-effectiveness of vegetable production in systems with growth factor control compared to conventional production in sheltered areas.

vegetable crops. Graduates of IVET in relevant fields; Amateurs of plant production in urban environments (balconies, terraces, small courtyards of houses); farmers/women

The program aims to provide specialized and practical knowledge and familiarization of participants on issues related to the production of vegetable crops in greenhouse conditions and innovative hydroponics systems, on a small (amateur) or professional scale.

Upon successful completion of the program, a "Training Certificate" is issued. and an 'Annex to

the Certificate, which shall contain the following information a) the duration of the programme in hours, b) the method of teaching, c) the credit hours, d) the number of credits (ECVET); and (d) the titles of the thematic or teaching modules of the programme.

A hybrid teaching and monitoring system is used: face-to-face training and modern distance learning (described in the programme). The instructional design follows the methodology supporting Open and Distance e-learning. Teaching via an asynchronous tele-education system is mainly based on the asynchronous study of educational material and development of activities in order to ensure a high degree of learner autonomy. However, in addition, and based on educational needs, synchronous learning through a synchronous tele-education system is also carried out on a case-by-case basis.

Content of the Course:

Curricular Units of the Programme:

1. Introduction to greenhouse crops
2. Introduction to plant management in greenhouses
3. Hydroponic substrates
4. Hydroponic cropping systems
5. Standardization and value addition of greenhouse products
6. Practical Work/FINAL EXAMINATION

After the end of the programme the trainee will be able to:

- understand on a theoretical and practical level the basic principles of hydroponic systems in greenhouses,
- understand, select tools and apply methods and practices for sustainable production of vegetable crops in greenhouses,

- understand the use of innovative technologies in controlled cultivation of vegetable crops,
- calculate and communicate the economic and environmental benefits that necessitate the adoption of innovative hydroponics practices,
- perform some basic analyses to diagnose soil/substrate/irrigation water quality,
- Use innovative technologies with sustainable results in the production process,
- Promote the principles of sustainability and use of innovative hydroponic cropping systems for cole crops,
- Promote "urban agriculture" and the use of space in housing, balconies, rooftops in the urban fabric, which remain unused,
- Advocates and supports simple but innovative and low-cost and low-environmental impact methods of food production for social strata of low economic status

2. Course Title: Greenhouse & Cover Crops Technician (<https://lidia.edu.gr/greenhouse-technicians>)

Course Overview: This VET educational training programme HQF level: 5, is offered by the Vocational Institute Lidia with a duration of 2 years and is divided into theoretical and laboratory part.

The Institute comprises modern classrooms for theoretical courses, computer laboratories and presentation rooms. A large percentage of laboratory courses are carried out in partner companies which use the most modern methods. The curriculum is followed consistently and scheduled study visits are carried out.

Course Content: The graduate greenhouse technician has the opportunity to be trained on

modern methods and work in a wide range of applications such as :

- greenhouse equipment
- the construction of greenhouses
- maintenance and renovation
- production
- and advisory services for the production of agricultural greenhouse products.

The courses taught are:

- Greenhouses
- Greenhouse equipment
- Agricultural Technique I
- Agricultural Technique Equipment
- Equipment of Horticulture
- General Horticulture
- Greenhouse Crops
- Hydroponic Crops
- Soil Science
- Plant Protection
- Agricultural Economics
- Occupational Health and Safety - Environmental Protection

3.Course Title: Digital Operation of Hydroponic Greenhouses Center of Life Long Learning (<https://e-learning.ntua.gr/programs/digital-operation-of-hydroponic-greenhouses-2>)

Course Overview: This Vocational Training Course of 100 hours duration provides Synchronous Learning: 10% and Asynchronous Learning:90%, gives ECVET: 4 credits and is an EQF level 3 course.

Upon completion of the course, participants will be able to know the modern technologies that can be used in hydroponic greenhouses.

They will also learn about the technologies used, including the selection of appropriate sensors, the design of electronic measuring devices, the

use and programming of microcontrollers, and 3D design and manufacturing of components.

The above will be made more understandable through making measurements using sensors, as well as through the use of all necessary software and tools.

The programme can be attended by:

- Graduates of high schools, and VET graduates
- Graduates of universities, polytechnics, universities of higher education and universities of applied sciences
- Officials of public and private bodies, public sector bodies and public sector employees of public and private institutions
- Teachers, executives of ministries, etc.

Course Content

- Sensor technologies, greenhouse and automation applications
- Sensor technologies
- Fundamentals in Electronics
- Introduction to microcontrollers
- Component design and manufacturing
- Greenhouse technologies
- Greenhouse basics
- Construction materials
- Environmental control in hydroponic greenhouses
- Parameters affecting hydroponic cultivation
- Hydroponics in substrates (characteristics, selection criteria)
- Hydroponic growing equipment
- Humoral development
- Smart greenhouse - Smart farming - Automation
- Precision agriculture
- IoT technologies in a greenhouse
- Ground stations

- Robotics in greenhouses
- Types of sensors
- Wireless Sensor Network
- Parameter measurements

Examples of applications

Automation in greenhouse, composting and hydroponics greenhouses

Skills that the programme aims to acquire

Basic skills

- Familiarization with technologies related to greenhouses and hydroponic greenhouses.
- Learning the tools (sensors, microcontrollers, communication methods) to use in these applications.

Advanced skills

- Use the knowledge acquired to monitor and automate the operation of hydroponics greenhouses.
- Design and construction of electronic circuit boards for the required application.

CZECH REPUBLIC

1. Course Title: Sustainable Agriculture - Hydroponic Farming

<https://www.fld.czu.cz/en/r-9407-study/r-10013-study-programmes/r-10216-sustainable-agriculture.html>

Course Overview: The course is offered by the Czech University of Life Sciences Prague under the Faculty of Agrobiolgy, Food and Natural Resources. The program level is Bachelor (EQF level 6) based on the national level definition provided by Cedefop. The course is delivered through a combination of lectures, laboratory sessions, and field trips. The course duration is one semester (15 weeks) and is offered on-site. The course assessment is based on a combination of multiple-choice exams, individual assignments, and group projects. The target group for this course is VET students pursuing a degree in Sustainable Agriculture. The course uses a variety of training/teaching methods and techniques, including lectures, video lectures, case studies, group discussions, and hands-on training in laboratory and field settings. The course includes training in digital skills such as data analysis, record-keeping, and online marketing of hydroponic produce.

Course Content The course aims to introduce students to the principles and practices of hydroponic farming and its applications in sustainable agriculture. It covers topics such as plant nutrition, water management, greenhouse management, pest and disease control, and marketing of hydroponic produce. The learning outcomes include an understanding of the advantages and disadvantages of hydroponic farming, the ability to design and manage a hydroponic system, and the knowledge to make informed decisions regarding the production and marketing of hydroponic crops.

2. Course Title: Landscape architecture

(<https://zf.mendelu.cz/studijni-programy/krajinarska-architektura/?rup=aHR0cHM6Ly96Zi5tZW5kZWx1LmN6L3VjaGF6ZWVvc3R1ZGlqbmktcHJvZ3JhbXkvP3Bzbj0xOTA4JnQ9YmFjaGVsb3lmbD1jemVjaCZmPWZ1bGxUaW1l>)

Course Overview: This Bachelor Degree is offered by the Horticultural and Landscape Architecture at the Faculty of Agronomy of Mendel University in Brno and includes a wide range of teaching modules, including those focused on hydroponic agriculture. Students will

learn the basics of hydroponic growing, including the use of different types of substrates, nutrient solutions and lighting. In addition, they will also study a range of other topics related to horticulture and landscape design.

Teaching is carried out in the form of lectures, seminars and case studies. The duration of the course is 4 years and the teaching takes place on site. The level of the programme is set at level 6, which corresponds to a bachelor's degree at university. Students are assessed in a variety of ways, including answer-based assessments, open questions and presentations. Assessment takes the form of evaluation by teachers based on oral examinations, written tests and seminar papers

The target group is mainly students who want to become professionals in the field of horticulture

and landscape architecture, but also farmers, entrepreneurs and teachers in the field of vocational education and training. The course introduces students to different techniques and teaching methods, including video lectures and case studies. Work-based learning (WBL) options and apprenticeship programmes are also available. The digital skills offered are tailored to the needs and requirements of the horticulture and landscape architecture industry.

Teaching is carried out in the form of lectures, seminars and case studies. The duration of the course is 3 years and the teaching takes place on site. The level of the programme is set at level 6, which corresponds to a bachelor's degree at university. Students are assessed in a variety of ways, including assessment by answers, open questions and presentation.

ITALY

1.Course Title: Agricoltore Verticale

(<https://www.euroformation.it/elenco-corsi/agricoltore-verticale/>)

Course Overview This Online Vocational 30 ECTS course has a one-month duration and is divided into four modules taught a weekly basis. At the end of each module a written report will have to be drawn up. At the end of the entire course, there will be a final examination, on an agreed date. The final examination consists of the writing of a final report which will be assessed by the Euro Formation Scientific Committee. The content of the course consists of the following modules:

Module I: vertical agriculture introduction

Module II: study process;

Module III: the phases of the work;

Module IV: importance and function of this work;

Module V: history and future developments in different contexts.

2.Course Title: Level 3 training seminar on the management of Hydroponic and Soil-Free Crops and Vertical Farming

(<https://www.fritegotto.it/Formazione-Seminario-di-formazione-di-3-livello-sulla-gestione-delle-Colture-Idroponiche-e-Fuori-Suolo-e-Vertical-Farming/>)

Course Overview: This 16 hours online course is dedicated to the teaching of innovative technologies for the management of hydroponic, soilless crops and vertical farming.

First day

- Vertical farming, 1st part (Technologies for vertical farming)
- Vertical farming, 2nd part (LED lights and system energy efficiency)

Second day

- Notes on the advantages and disadvantages, on the classification and diffusion of hydroponic systems; open systems and closed systems.
- Substrates used and their characteristics.
- Notes and guidelines for the formulation of the nutrient solution.
- Outline and guidelines for the realization of a soilless culture system.
- The water management of a soilless plant 1 part

Third day

- The water management of a soilless plant. 2nd part
- Checks to be carried out for correct management of soilless crops.
- Management of mineral replenishment in soilless and hydroponic culture.
- Exercise and simulations of management and some problems and physiopathies
- Sensors and automation in soilless and hydroponics.
- Cultivation innovations in soilless and hydroponics

Fourth day

- Main elements on biology and epidemiology of pathogens and parasites of crops in soilless environment. Diagnostic elements.
- Fungal and bacterial diseases reported on soilless grown crops

- Effects of soilless cultivation on pathogens of agricultural crops.
- Defense strategies: perspectives and innovations.

3.Course Title: Hydroponics and Soil-Free Training School

[\(https://ageon.it/scuola-italiana-di-idroponica-e-fuori-suolo/\)](https://ageon.it/scuola-italiana-di-idroponica-e-fuori-suolo/)

Course Overview: The training institute offers a package of modules with the aim of training on the management of a soilless greenhouse. The courses are held by the technical director dott. Vitangelo Di Pierro and his AgeonTech consultant colleagues, at the organization headquarters in the form of video lessons and also in situ at the premises and greenhouses of client companies. The organization aims not so much to provide mere theoretical notions, but to give a solid basis for practically approaching this sector and training figures capable of having mastery and autonomy in the management and conduct of soilless crops in a protected environment.

The lessons are divided into modules that can be suitably chosen by the students/clients according to their own interests. The courses can be both individual and in groups depending on the turnout and the specific requests of the individual modules.

The training organization issues a certificate of attendance and, at the request of the client company, can provide for an additional final exam with attribution of marks. The course for the Greenhouse manager includes the following modules:

- Understanding the plant: (Theory) – Tomato | Measure climate, irrigation, production and plant growth by interpreting the data. Theoretical notions.

- Converting/setting up a soilless greenhouse: minimum and optimal requirements | Planning the
- the transition to a soilless system or the construction of a new settlement.
- Substrates and hydroponic systems | Technical details of the most popular substrates, the Dry Hydroponics hydroponic system and the Radix module for Vertical Farm. Irrigation management | How to set the irrigation strategy in the different seasons.
- Climate management | How to choose greenhouses and plants to implement the right climate strategy in the different seasons.
- Plant nutrition, deficiencies and excesses | Elements of soilless plant nutrition with practical examples of nutritional imbalances.
- Nutrient analysis, uptake analysis and calculation of Nutrient Solutions | Details of analytical methods and use of Netfeed software

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ANNEX I.

Desk research template for the current existing VET programmes

Elements to be answered	Answers/ Brief Explanation
Course Name	<i>Title, web page</i>
Content (teaching modules, learning outcomes)	<i>Short description</i>
Method of delivery, Duration	<i>i.e. On-line, on site, blended, informal, formal, non-formal</i> <i>hour of effort, duration</i>
Program level *	<i>*(based on Annex for level definition on national level</i> http://www.cedefop.europa.eu/files/5566_en.pdf
Type of assessment	<i>i.e. multiple choice, self-assessments, per reviews, open response assessments, etc.</i>
Target groups	<i>i.e. farmers, entrepreneurs, VET educators</i>
Training/teaching methods and techniques	<i>i.e. lectures, video lectures, case studies,</i>
WBL and apprenticeship programs	<i>If applicable</i>
Digital skills offered	<i>if applicable</i>
General comments	