Co-funded by the European Union

Agriculture 4.0: Equipping young NEETs with basic & advanced digital and green skills

Module 1

Agriculture 4.0, Introduction

Developed by

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Contents

1. Introduction

Following the analysis of the findings from the literature review and field research activities, there is a strong need to train and upgrade rural young people to become attractive, and employable and to take up central positions in the circular and regenerative economy.

Adapted training material will be further described and developed for practical implementation within our project. The training material will provide young / women NEETs with a package of digital learning resources designed based on the concept of micro-learning: short and coherent learning nuggets delivered in multimedia formats aiming to promote blended learning methodologies. The digital learning nuggets will include a variety of resources such as interactive games, podcasts, e-learning videos, interactive case studies, infographic resources, etc.

2. Content

Main objectives

Introduce the target group to the theme of Agriculture 4.0 and offer insights into its components.

Learning outcomes

The target group will be provided with the main idea of Agriculture 4.0 of the training curriculum, building a solid base for the following contents.

What is Agriculture 4.0?

There is no doubt that the increasing population around the world, creates a growing need for intensive food production. Nowadays, the conventional concept of the food industry experiences colossal changes and transforms with the support of the latest technology evolution. Agriculture 4.0 is a new notion in the field of farming where technological tools and science constitute the core of it. There are several terms created over this short period of time for reference to Agriculture 4.0. For example, the European Agricultural Machinery Association (CEMA) refers to Agriculture 4.0 as 'Smart Agriculture', 'Intelligent Agriculture', 'Digital Farming', or 'Digital Agriculture' (Sponchioni et al., 2019). Sometimes it can also be described as 'Smart Farming'. If we define the current term, Agriculture 4.0 can be viewed as the latest evolution of precision farming, attempting to incorporate a variety of digital tools such as automated equipment, sensors, data analysis and artificial intelligence in the farming process.

In other words, Agriculture 4.0 as the agricultural revolution of our era targets:

Enlarge food productivity

As we previously mentioned, population growth is a challenge for the food industry. More specifically, according to CBO (Congressional Budget Office), it has been predicted to be an average growth of 0.3% per year in the existing global community (CBO,2022). This is an addition of an extra 34 million people. Thus, the demand for more food resources becomes visible and requires immediate action measures.

Equal and rational spread on a worldwide scale

Another focus of Agriculture 4.0 is to combat food poverty. Reducing the food crisis with sustainable farming is vital for eliminating food hunger as 2022 is the year considered to be as a year of unprecedented hunger. About 1 billion people are experiencing hunger and earning 1 dollar or less per day to cover their needs (UN World Food Programme, 2022). With the assistance of technology, Agriculture 4.0 expands the areas suitable for agriculture, by searching lands to cultivate or convert barren areas. In addition, another aspect that is being explored currently by Agriculture 4.0 is the diminution of the water resources used for maintaining land cultivation providing further financial incentives.

Acclimatize to global warming

Climate change has been an alarming topic over the last decades. A significant factor affecting climate is the emissions of Greenhouse Gases (GHGs). In addition, side effects produced by climate change context are fires, floods, and extreme weather conditions (Althor et al., 2016). Agricultural products are now exposed to the above impacts and it seems they are lacking efforts in adapting to the new framework. As a result, there are many cases of bad-quality food.

Reduce any food waste

Food waste is inextricably linked at any stage of the agricultural cycle. First and foremost, due to the ignorance of global warming and extensive use of fertilizers, food products may appear to be unsuitable to consume, leading to massive food waste. Then, we should consider that food delivery is a time-peculiar procedure that often ends up in food waste as well. Last but not least, wasted food has proved to be harmful to the natural habitat and it would be more wasted resources than available ones (McDonough & Braungart,2017).

Reduce the cost of farming

Having control over planning all stages of cultivation, sowing and harvesting save of a great deal of money. Agriculture 4.0 can help farmers to maximize their cultivation at the minimum cost. Technology trials have shown that digital tools noted a 4% growth in crop production, a 7% decrease in fertilizers usage and a 4% reduction in water resources (De Clercq et al., 2018).

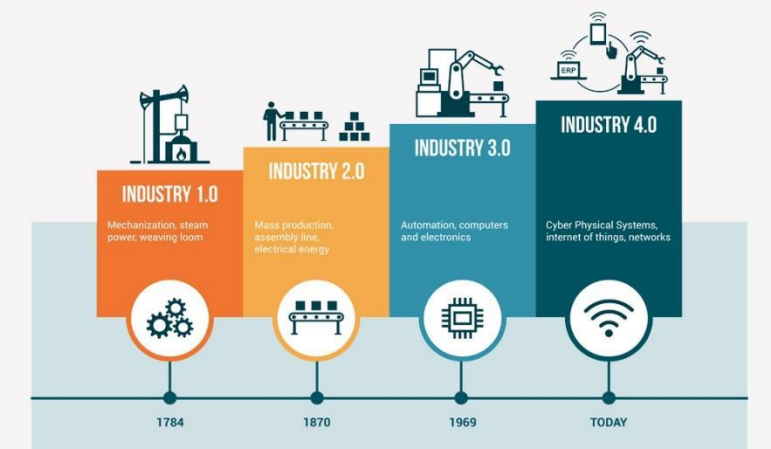
Time-saving of farming

Through Smart farming, people are able to control crops remotely using sensors and IoT (Internet of Things). For instance, in China, they are currently using drones to examine 20 million cotton hectares.

Agriculture 4.0 can be seen as an evolution of precision farming while implementing automated equipment, and sensors and exploiting data analysis derived from them. At the same time, it supports the creation of new knowledge in the decision-making processes of the agricultural sector nullifying rigid boundaries. The ultimate aim is to maximize profitability and socio-economic-environmental sustainability of agriculture.

The evolution of agriculture

Humankind has been occupied with farming since ancient times. These practices known also as agriculture have been evolving over time from Agriculture 1.0 to 4.0 as is visible in the figure below.



Source: https://www.seekmomentum.com/the-evolution-of-industry-from-1-to-4/

Agriculture 1.0 reflects conventional methods relying on human physical strength and animal support. At this point, simple forms of tools were used in farming occupations alongside serious manual labor forcing productivity to remain at a low level. Moving forward to the 19th century, engines using steam have been improved and used in all aspects of life including agriculture.

Once it came to Agriculture 2.0 era, machines were developed and operated manually by people. In addition, there is the first introduction of chemicals and fertilizers which obviously grew the productivity and effectiveness of agriculture occupation to a greater extent. It also should be noted that this evolutionary change had a significant impact alongside its facilitation of farming. These impacts make their appearance as chemical infections, pollution of the natural habitat, overindulgence of available energies and wastage of raw material.

Towards the 20th century, Agriculture 3.0 comes into sight since computers and electronic devices take over every aspect of daily life. Advanced software and machine learning systems (robotics) provide the opportunity for an effective and less time-consuming farming procedure. This step, proved to be a vital support for the Agriculture 3.0 era, improving the existing strategies and methods of Agriculture 2.0. In other words, the developed technology contributed to the downturn in chemicals used, better exploitation of water allocation and any other farming activity.

At present, we are experiencing the Agriculture 4.0 revolution based on the latest technologies such as IoT (Internet of Things), Artificial Intelligence and Robotics, Big Data, Blockchains, Scout drones, Cloud Computing, etc. These applications have managed to maximize the performance of farming procedures to a notable extent. The latest research in the field revealed that the mentioned applications resulted in a decrease of 13% in farming costs and a 30% saving in resources used such as water and fertilizers. The overall cost of Agriculture 4.0 has been estimated to be $7 billion so far on a global scale and 210 million within Europe (De Clercq et al., 2018).

A new path towards Agriculture 5.0?

Source: https://www8.cao.go.jp/cstp/english/society5_0/index.html

Smart farming is now inextricably linked with agricultural activities. However, as we are headed to Agriculture 5.0 era, farming technologies such as IoT, Big Data, Blockchains, etc. would not be limited to that. The main idea that lies at the heart of the upcoming evolution, combines renewable energy resources with the continuous development of technologies that seem to be particularly profitable to the sector. Thus, farmers are about to use renewable resources such as wind, solar, hydro and biomass to maximize cultivation effectiveness while 'acting green'.

Agriculture 4.0 in the European context

The first relevant reference to Agriculture 4.0 within Europe, was first detected in Germany in 2015. In 2011, the German government bodies highlighted the title of Industry 4.0 which constituted the base for Agriculture 4.0 two years later. Its aim was to create a production model based on the digitalization of products, and services within the production procedure. Along the way, the Food and Agriculture Organization (FAO) of the United Nations uses the term "Digital Agricultural Revolution" while other sources give the title "Agriculture 4.0" (Araújo et al., 2021).

In general, the theme of social, financial, and conventional aspects of digital farming was highlighted in various scientific conferences in the EU context. Instances are the 2018 International Farming Systems Association symposium, the European Society for Rural Sociology

Conference (2019), and the International Rural Sociology Association Conference (2020), with multiple discussions, included and workshops taking place. In addition, there is a large-scale scientific and innovative European fund for several programs addressing digital agriculture and its features. An example is the growing popularity of the European Horizon 2020 projects which received funding of 9 billion Euros in total. Some indicative projects are: 'The Internet of Farm & Food' (IoF2020), DESIRA and Smart-AKIS. As a matter of course, there is an emerging interest regarding the policies of digital agriculture and its practices. For example, the EU Standing Committee on Agricultural Research is focusing on Smart Farming through the Agricultural Knowledge and Innovation Systems Strategic Workgroup.

EU Green Deal

It is obvious that global trends are influencing all sectors of life including the agriculture process.

Source:https://www.lifeenvision.eu/ennuvi-and-eu-farm-to-fork/2022)

At this point, the European Green Deal sets a goal to be the first continent by 2050 to has ever achieved to be climate neutral via sustainable policy strategies and approaches (European Commission, The Parliament approved the above target in 2021 adding the decrease of gas emissions by 55% until 2030 to ensure climate neutrality in the next two decades. On this milestone, the 'Farm to work strategy' is dedicated to equalizing agriculture products and promoting them towards a circular-bio-based economy system. Some further suggestions and prompts regard the usage of bio-fertilizers, protein feed and bio-chemicals which also create the framework for new job opportunities. In order to achieve the above, the existence of innovation and research are essential. Consequently, a new strategy that will be adopted for agriculture purposes is the use of digital technologies in order to maximize the capabilities of the farming sector.

The European Union's goal of digital transformation (2020) was devised by the European Commission and supports the target of a climate-neutral Europe in 2050. The mission is to incorporate the usage of the latest technology in every aspect of the workplace in line with the EU values. At the indefinite time, it is worth mentioning that the White Paper on Artificial

Intelligence (AI) is one of the pillars shaping the European Commission's Digital Strategy. It is focused on achieving excellence in the AI sector and it is expected to have investments of 1 billion years per year.

Overall, it can be said that the European Union is actively promoting technologies related to Agriculture 4.0 and encourages people towards a sustainable path. Conforming with global trends focuses on precision farming to help farmers maximize their production.

Agriculture 4.0 and education

Undeniably, the majority of the technologies used tend to be automated. Thereby, key skills are required in order for someone to cope with the current digitalized context. Automation technologies are capable of revolutionary changes saving time and maximizing results. As they are predicted to be necessary within the next years, people engaging in farming are in need of new skills. Therefore, it is crucial to raise awareness and form several types of training on a national and EU level reaching small and medium-sized farms and providing them with relevant technologies. Farming expertise and Innovative services can have a significant impact on spreading essential knowledge and information for Smart Farming. The mentioned rising opportunities are the base for ongoing learning generating vital knowledge and creating new job openings. Flexible training programs could also be incorporated into school curricular introducing digital learning from an early stage.

Source: https://www.123rf.com/photo_84779997

Education is highlighted as the main means to address the current digital transformation. Nevertheless, the agreement around the skills essential to the professionals is still blurred. There has been little progress in terms of educating farmers and encouraging them towards adopting digitalization procedures. The European Agricultural Machinery (CEMA) published 2017 an article relevant to data management to introduce farmers' skills in managing efficiently their production

(CEMA, 2022). It becomes notable that we are referring to a demanding change of direction requiring new skills and converting to sustainable practices at the same time. The available research for sustainable agriculture education is unlimited and there are a lot of debates about practices and theories, perceptions and severance of issues.

Nevertheless, there are two factors in need of attention in order to start farming a proper basis for an upcoming educational setting dedicated to Agriculture 4.0.

Life-long learning

Regarding life-long learning skills, there are three main categories needed to be conquered by professionals to step out of conventional farming.

- Adaptability
- Deal with uncertainties
- Being proactive

More specifically, the skill of being adaptive is vital during this continuous change. Even though the concept of risk is not new to the agriculture sector, there is now the additional challenge of digitalization. Therefore, farmers need to be proactive and experiment through the process of problem-solving issues that arise. This perspective presupposes the willingness to be involved in current changes and examine the late developments in terms of new technologies.

Knowledge Integration

In this section, the term 'Knowledge' is used to describe the essential data that someone needs to be aware of to address this digital/sustainable transition. This also includes the knowledge that has been acquired through personal experience in the field. Nevertheless, the practices that have been used so far, are not considered to be 'sustainable enough'. This points toward new scientific knowledge that needs to be combined with hands-on experience knowledge. Thus, the ideal model seems to be a hybrid one. The need to incorporate more and more learning material is vital to overcome conventional challenges and move towards Agriculture 4.0. This could provide farmers into a potential step of sustainable farming for covering their needs. However, taking into consideration the variety of contexts that agriculture is developing, we need to ask what kind of

knowledge should be integrated with each context. This implies the need to address diversity at a local, national and international level.

Importance of Agriculture 4.0

We are currently witnessing the 4rth Agricultural Revolution named Agriculture 4.0. Having as main characteristics the adoption of late technology and digitalized practices, Agriculture 4.0 is considered to be the evolution of conventional farming.

Source: https://www.agmatix.com/blog/the-role-of-industry-4-0

As a matter of fact, it is about a dualistic phenomenon where sustainable strategies and digitalization are combined to maximize crop production, increasing product quality while reducing harmful impacts on the environment. In other words, farmers now are able of decreasing inputs while increasing their yields forming in a flexible way partnerships boosting their marketability as well. At the same time, they are adapting to climate changes, diminishing gas emissions, water usage and fertilizers saving precious money and time and contributing to biodiversity.

So far, Agriculture 4.0 has drawn a global interest, affecting every aspect of human life as a primary sector. Within the EU there are several initiatives regarding sustainable practices while setting the goal of being climate neutral until 2050. European projects are also another step towards the provision of training, raising awareness and highlighting the skills needed to keep up with the current digitalized framework.

Having comprehended the concept and value of Agriculture 4.0, within the next modules a detailed description of the field will be presented, providing information relevant to digital skills and technologies used, challenges and future practices.

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