AgriNext

Module 3

Up-to-date Teacher

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OVERVIEW

In an increasingly globalised world, marked by energy and sociopolitical crises, the development of more sustainable and short-distance production is becoming increasingly significant. This production should provide citizens with the necessary resources and inputs under the highest quality standards. In order to achieve this and delve into the exciting world of Multifunctional Agriculture, it is becoming increasingly important to update and inform the key players in its development — namely, educators. They are responsible for instilling new knowledge and rural development practices that are in line with modern times. In the sustainable production of crops, for example, digital tools are becoming increasingly crucial alongside new technologies, such as drones with multispectral cameras and the combination of situational diagnostics by means of artificial intelligence. This should not overshadow other types of production that increase the income of the rural population. When we talk about Multifunctional Agriculture, we are changing the concept of production, where resources are not only used for a single/simple production, but new products are created that must be produced with the best quality, seeking the long term and the improvement of results. For this, the teachers who will train future employees in multifunctional agricultural must have a set of skills that instils an entrepreneurial culture and a diversification in the offer of their farms/enterprises. To this end, it is necessary to train teachers in certain areas that will later affect the actors of multifunctional agriculture. Training in agritourism, agrarian economy, renewable energies, compatibility and social development is considered necessary and should be a fundamental pillar based on the intrinsic values of each production area.

LEARNING OBJECTIVES

Knowledge

The learner will be able to:

Deepen the knowledge and development of Multifunctional Agriculture, learning new productive approaches that improve the quality of life in the rural environment, using an approach that is not simply productivism but also diversification and rural development.

Skills

The learner will be able to:

Develop activities in multifunctional agriculture and transmit this knowledge to potential actors in agriculture.

Acquired attitudes

The learner will be able to:

Assertively develop multifunctional agriculture that avoids productivism approaches and promotes sustainable development.

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Abbreviations/Acronyms

AI	Artificial Intelligence
CAP	Common Agricultural Policy
ENRD	European Network for Rural Development
IT	Information Technology
IoT	Internet of Thing
MA	Multifunctional Agriculture
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Cooperation and Development
PBL	Project Based Learning
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WWF	World Wildlife Fund

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1 AGROTOURISM AND FOOD TOURISM

1.1 Responsible Tourism

The World Conference on Sustainable Tourism held in Lanzarote (1995) resulted in the Charter for Sustainable Tourism, the main international reference in the field, which is based on the principles of the "Earth Summit" and the Rio Agenda 21 (Ref. 1). The document was updated two decades later by the World Charter for Sustainable Tourism+20 (Ref. 2).

After sustainable tourism (Ref. 3), responsible tourism (Ref. 4) emerged as a further development, defined as tourism "that satisfies tourists, maintains and improves the destination's environment and benefits residents" (Ref. 5). These are its principles:

- Tourism should be part of a wider support for sustainable development and conservation.
- Tourism should use natural resources in a sustainable way.
- Tourism should eliminate unsustainable consumption and minimise pollution and waste.
- Tourism should respect local culture and provide benefits and opportunities to local communities.
- Tourism should be informative and educational.

In 1997, with the support of UNESCO, the Responsible Tourism Institute was founded, an international non-profit NGO that promotes responsible tourism at an international level and supports all actors involved in the tourism sector in developing a new way of travelling and getting to know our planet (Ref. 6).

Activity:

See more about *Tips for being a responsible tourist*, at https://www.youtube.com/watch?v=Rtgol50g0iw

Watch the interview *Thuelma and Tearras de Jaen Group manager talking about agrotourism business* at: https://www.youtube.com/watch?v=hB4YqokRY6Y

1.2 Agrotourism

Agrotourism (also known as farmhouse tourism) dates back to the early 20th century: in Tyrol, the German Alps and Bavaria (linked to mountaineering and mountain climbing) and in England (as bed & breakfast). From the 1960s onwards, it spread to several countries such as Belgium, the Netherlands, Luxembourg, France and Italy. Later, in the 1980s, many governments adopted this model as a means of combating the crisis of family farming, mainly with the help of European subsidies for agriculture and rural development. Thus, many farmhouses, estates, wine press houses, village houses, mills, etc. were set up as rural accommodation to provide economic diversity, income supplementation and a formula to revalue the rural family heritage. Many of the oldest regional or national regulations on agrotourism or rural tourism date back to the 1970s and 1980s, e.g. in Italy, Portugal or Catalonia and Euskadi (both in Spain).

After more than thirty years, the concept of rural tourism acts as an umbrella term for tourist modalities that share a common setting – the rural environment (as opposed to the city) – but have different characteristics in terms of both tourist supply and demand. This leads to the existence of various segments of tourism (both current and potential), such as ecotourism, agrotourism, ornithological tourism, adventure sports, camping, glamping, food tourism, etc., which often overlap in the same place. The boundaries between them are sometimes blurred (Ref. 7).

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Figure 1: Fattoria Poggio Alloro in San Gimignano, Tuscany (Italy).

In this type of tourism, the key element is the farming activity and the rural way of life itself. Thus, tourists want to immerse themselves in the rural world, get to know it first-hand and even participate in some of the farm's tasks, such as milking a cow or a goat, feeding the cattle, picking fruit or vegetables from the orchard, harvesting, baking bread or cakes, cooking traditional recipes, etc. They can visit the surroundings and even participate in other activities (cultural visits, trekking, horseback riding, adventure sports, bird watching, etc.), but these are a complement, not the main purpose of the holiday.

In conclusion, agrotourism is not merely rural tourism, but tourism in which the farm is the main attraction.

1.3 Food Tourism

According to the *World Food Travel Association*, food tourism (also known as food travel, gastronomy tourism or culinary tourism) is the act of travelling to taste a place to get a feel for the place (Ref. 8).

Figure 2: Local products and recipes are often preferred by food tourists.

The concept evolved from the pursuit of unique and memorable food and drink experiences (in the 2010s). It became a mainstream interest with the help of social media and TV shows, and eventually turned into a primary motive for many travellers when choosing a destination. Thus, travellers began to spend more time and money on unique food and beverage experiences, making the exploration of local cuisine the focal point of a cultural adventure.

Food tourism includes a whole range of experiences such as cooking classes, visits to producers, street food, locals-only pubs, rustic winery tours and unique restaurant experiences. We are witnessing an increasing number of food tour companies, food and drink-focused events and marketing focused on food and drink experiences.

Food tourism is a journey through the flavours, aromas and traditions of each dish. Every bite and every sip tells a story and reveals the identity and cultural heritage of a territory, promoting

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understanding and respect between different cultures. Travellers are not only looking for destinations, but also for authentic experiences that combine culture and gastronomy. And when they visit small family restaurants, local producers and traditional markets, they strengthen local economy, support the community network and promote authenticity.

Activity:

See more about "WHAT IS FOOD TOURISM? FOOD TRAVEL | Food Tourism, Culinary Tourism or Gastronomy Tourism?" at: https://www.youtube.com/watch?v=bBzbvWTnmTw

1.4 Links Between Agrotourism, Food Tourism and Multifunctional Agriculture

Rural tourism has been described as a new trend in tourism worldwide for decades. It is growing year on year but is still a long way from sun and beach tourism. The global COVID-19 pandemic has led to changes in tourism demand: a collapse in international tourism, acceleration of the digitalisation process of the sector (Big Data, artificial intelligence, IoT and sensors, telematics processing), changing priorities of tourists (more concerns about safety and health, desire for open spaces and social distancing, peace and freedom), etc. Thus, in this first stage, less crowded, sustainable and closer experiences that guarantee trust and a sense of control were desired: national family tourism, travelling by car and to local destinations – which benefits villages and rural areas, back to nature, etc.

On the other hand, Europe has experienced a decline in the profitability of traditional agriculture and livestock farming, increasing depopulation and an ageing rural population. Rural areas account for half of Europe's land area and 20% of its population, but most areas are disadvantaged. Multifunctional farming has emerged as a strategy to combat this trend, and the bet on rural tourism and agrotourism is one of the oldest and has shown one of the greatest profitability potentials.

From 1992 onwards, the Common Agricultural Policy (CAP) evolved from a traditional productivity approach (providing citizens with food at affordable prices and ensuring a fair and reasonable income for farmers) to a rural and multifunctional approach. Farming production has undergone a revolution: not only is it necessary to produce food, but this must also be done in an environmentally friendly way, with the CAP as the guarantor (Ref. 9). Thus, multifunctional agriculture produces both private goods (such as food, raw materials of agricultural origin or agrotourism) and public goods, which are divided into social (contribution to the viability of disadvantaged rural areas, protection of cultural and heritage values associated with the rural environment or protection against rural depopulation) and environmental (protection of landscape values, promotion of biodiversity and reduction of soil erosion processes).

Millions of euros of EU funding have been allocated to rural tourism initiatives, many of which can be identified as agrotourism and food tourism businesses. There are many examples of this, such as investments to restore old buildings as accommodation (farmhouses, mills, stables, etc.), the construction or renovation of cellars or cheese factories to receive visitors, etc.

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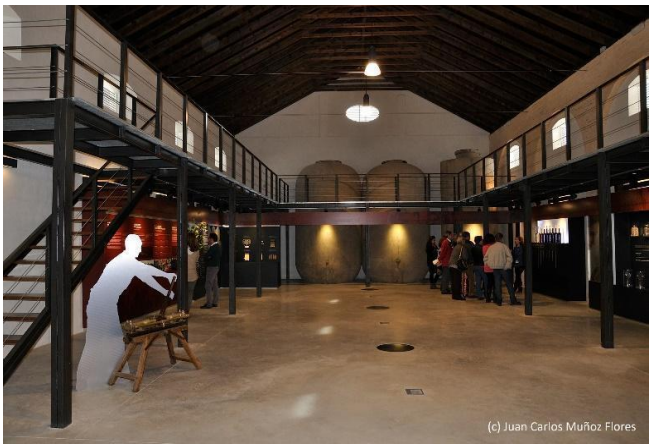

Figure 3:Visitors in a wine museum located in an ancient cellar.

The links between agrotourism and other niche products (such as food tourism, wine tourism or olive oil tourism) can be strong and sometimes, the boundaries between these tourism models can be blurred. Ultimately, it is more about which element we identify as the key one to define the model from a theoretical point of view.

1.5 Agrotourism and Food Tourism Business Model: Case Studies

Dozens, even hundreds of agrotourism or food tourism ventures across Europe can be selected as good practices since this supply segment has grown fast lately and the tourism industry works under the market rules, thus competency pushes the businesses to raise their quality standards.

We have selected some examples from other Erasmus+ projects in which some of the AgriNext consortium partners have been involved, since we know some of the businesses first-hand. Students are welcome to not only check these few examples but to search for additional ones.

The STAY (Still Tourism Around Yard) project (2022-1-SI01-KA220-VET-000087663) identified 18 case studies on agrotourism across Europe, including best practices from Slovenia, Spain, Italy, Portugal, Czech Republic, Croatia and Sweden (Ref. 10).

Figure 4: La Pariera, espacio rural (Spain), one of the selected best practices in STAY Erasmus+ project.

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The Farms Charm project (2022-1-CZ01-KA220-ADU-000089506) identified 22 case studies offering inspiring first-person stories from active agrotourism providers in Spain, Italy, Austria, Cyprus and Czech Republic.

Some interesting examples both for agrotourism and food travel arise from the project *Benvinguts a Pagès* promoted by the regional government of Catalonia (Spain). Starting in 2016, the project is a promotional action for the marketing of local and proximity agro-food products and for supporting participating farms, aimed at the wider public but, above all, at families, senior citizens, foodies and young people.

Activity:

Read more about the *case studies from the STAY project* https://stay-erasmus.eu/case-studies, *Farm's Charm* at: https://learning.farmscharm.com/case-studies, and *project Benvinguts a Pagès* at: https://benvingutsapages.cat/

1.6 Agrotourism and Food Tourism Business Model: Business Plan

Setting up and running a tourism business requires a wide range of knowledge (legal and tax aspects, advertising and marketing, customer service, languages, IT, etc.) and multiple elements to be considered. Therefore, it is important to follow a working methodology that helps entrepreneurs not to overlook any important aspects.

Defining a business plan allows entrepreneurs to consider the main elements related to starting and running a tourism business so that they can turn an idea into a successful company. A business plan is a detailed document that sets out the objectives of a business, the strategies to achieve them and the resources required to implement them. The plan guides entrepreneurs to make decisions and is vital for attracting investors and securing funding (Ref. 11).

Well-structured business plans provide a comprehensive overview of the market, analyse the competition and define the marketing and sales strategies necessary for success. Without a solid business plan, companies risk losing their way and failing in a demanding and constantly evolving market.

AgPlan (Ref. 12) is a software tool developed by the Centre for Farm Financial Management, which is part of the Department of Applied Economics in the College of Food, Agricultural and Natural Resource Sciences at the University of Minnesota (Ref. 13). It was designed to help agricultural businesses create a business plan. AgPlan is free and can be used by anyone individually or in educational programmes.

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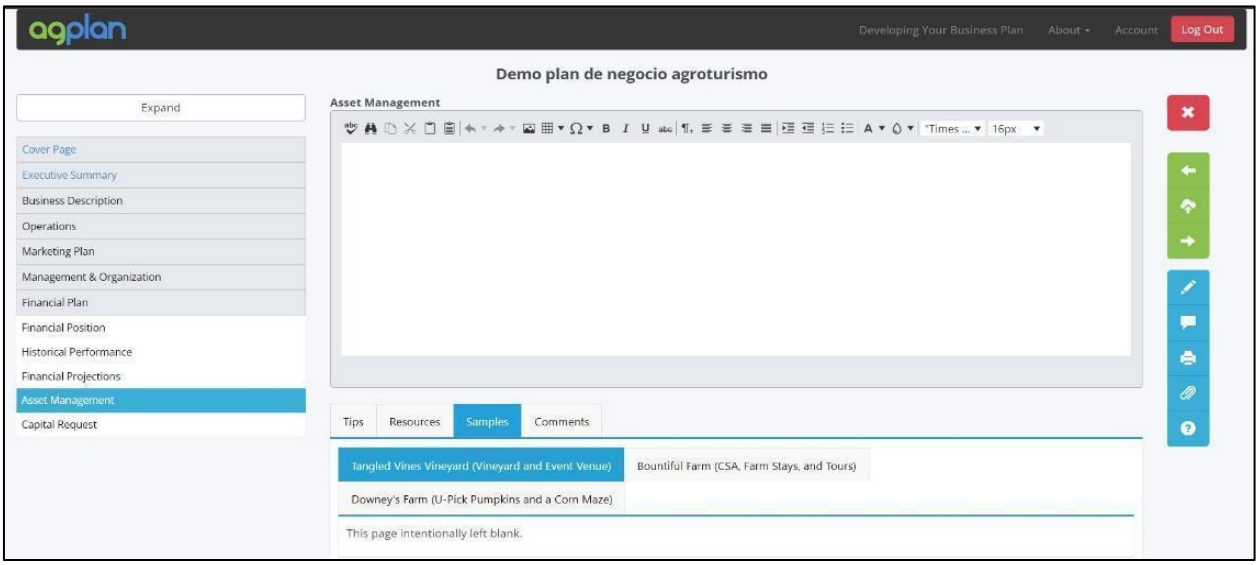

Figure 5: AgPlan software screen capture.

AgPlan was designed to provide customised assistance to different types of agricultural businesses, among which agrotourism may be highlighted, as specific templates have been designed (although the tool is useful for other types of companies as well). Each template has an outline designed specifically for that type of business, tips or questions to help entrepreneurs develop each section of the plan, sample business plans, and links to additional resources for each section of the plan.

1.7 Agrotourism and Food Tourism Business Model: Business Plan Presentations

Once students develop their own business plan for a real or hypothetical agrotourism or food tourism business using AgPlan or a similar tool, they will present it to the rest of the group in a 10- to 15-minute presentation.

The students will have the opportunity to ask questions and comment. In this way, everyone will be enriched by each other's point of view.

Conclusion

Agrotourism and food tourism are two froms of tourism, both defined by a clear key element: the farm and rural life on the one hand and local food, drinks and food products on the other. Thus, they share some points of interest and characteristics (even if the boundaries between them are blurred when food tourism chooses farms as destinations) and are very close to the principles of multifunctional agriculture.

As far as entrepreneurship in these activities is concerned, it is highly recommended to draw up a solid business plan that takes into account the main elements related to the professional activity, so that starting up the business goes more smoothly.

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2 STAYING UP TO DATE WITH ECONOMIC ASPECTS OF MULTIFUNCTIONAL AGRICULTURE FOR VOCATIONAL TEACHERS

2.1 Introduction

Have you ever wondered why agriculture is about so much more than just producing food? What role do the economy and society play in this overall picture? Why is it important for you as a teacher to keep up to date with the latest economic trends and policies in multifunctional agriculture? In a world that is changing so quickly, what sources of information would help you keep up with the challenges and opportunities in agriculture?

These questions are meant to spark your interest and prepare you to discover how multifunctional agriculture is much more than just farming. As a teacher, being informed about the latest economic developments will not only equip you with better teaching tools but also help your students tackle current challenges with a more informed and up-to-date perspective. In this unit, we will explore various sources of information, international strategies and the economic aspects of multifunctional agriculture, empowering you to stay up-to-date and effectively guide your students in this ever-evolving field.

2.2 Reliable Sources for Continuous Updates on the Economic Aspects of Multifunctional Agriculture

Continuous updates on the economic aspects of multifunctional agriculture are crucial for understanding how agricultural practices can evolve to meet the demands of modern society while contributing to sustainable development. This involves keeping track of various economic trends, policies and market dynamics that influence agricultural productivity and sustainability (Ref. 14). By regularly engaging with diverse sources of information, such as academic research, government reports, and news articles, teachers can gain insight into the impact of international strategies like the Common Agricultural Policy (CAP), the Green Deal and other initiatives promoting rural development. Staying informed not only enhances teachers' knowledge, but also enables them to better prepare their students for challenges and opportunities in the agricultural sector, creating a more resilient and better-informed generation of agricultural professionals.

Figure 6: Agriculture Economics (IStock image).

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To identify reliable sources for continuous updates on the economic aspects of multifunctional agriculture, focus on reputable organisations like the Food and Agriculture Organisation (FAO), OECD, and the World Bank, which provide comprehensive reports and analyses. Academic journals such as the *Journal of Rural Studies* and *Agricultural Systems* (Ref. 15) offer peer-reviewed articles on current trends. Additionally, government publications can give insights into agricultural policies, while reputable news outlets provide timely articles.

Here are two links (Figures 1 and 2) to two reliable sources that provide comprehensive information on the economic aspects of agriculture:

Figure 7: FAO Publications.

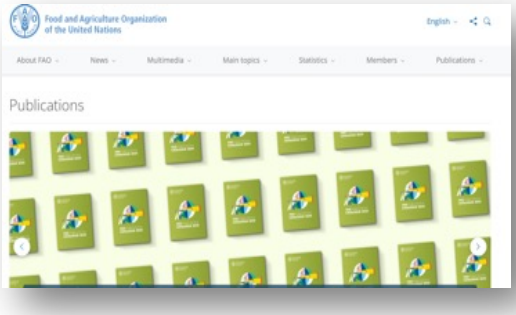

Figure 8: OECD.

You can explore their extensive library of documents that cover various topics within multifunctional agriculture and its economic implications.

For monitoring multifunctional agriculture (MA), the European Network for Rural Development (ENRD) (Ref. 16) provides valuable resources, reports, and updated information on rural development policies, including the role of agriculture in promoting sustainability and economic growth. The website provides access to case studies, policy documents and tools to help you follow the development of rural and multifunctional agricultural initiatives across Europe.

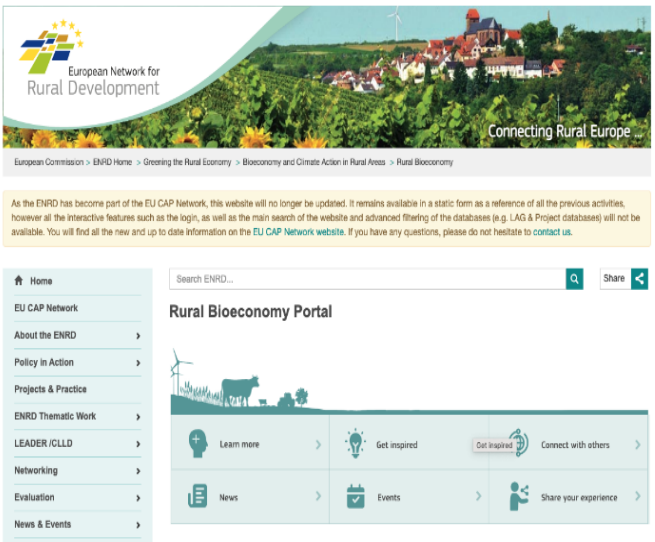

Figure 9: ENRD Resources. Rural Bioeconomy Portal.

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2.3 Digital Tools for Accessing Relevant Documents, Articles and Videos for Monitoring MA

To explore and use digital tools for accessing relevant documents, articles, and videos on multifunctional agriculture (MA), platforms such as Google Scholar are excellent for finding peer-reviewed articles and research papers on the subject. You can also use FAO's E-Learning Academy, which offers free courses and resources on sustainable agriculture, including videos and publications that focus on rural and multifunctional agricultural practices. For example, you can access webinars on sustainable farming practices and the economic role of agriculture through FAO's platform.

Another useful tool for accessing resources on multifunctional agriculture is ResearchGate, a platform where researchers share their work, including papers, articles and presentations on agricultural topics. You can follow experts, participate in discussions, and access the latest research relevant to the economic aspects of MA. For instance, you can explore studies on the economic impacts of rural development strategies or multifunctional land use, in ReserchGate.

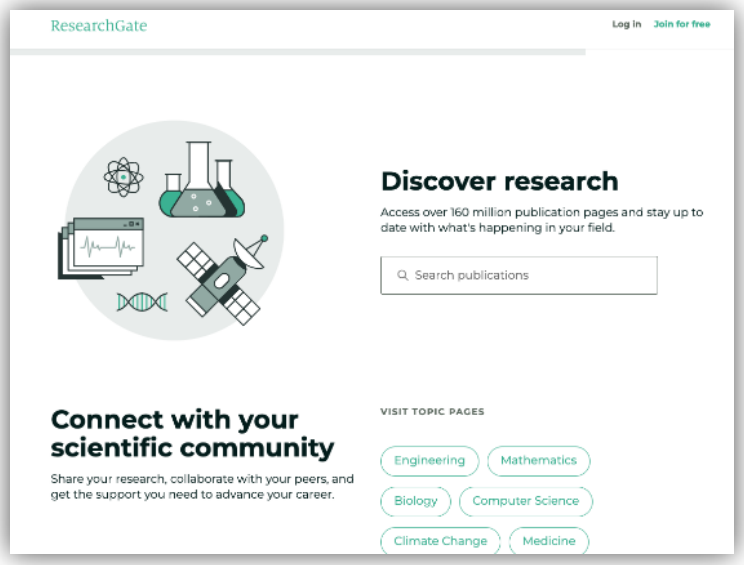

Figure 10: Research Gate home page.

2.4 Analysis of the International Strategic Documents from an Economic Perspective

Understanding and analysing international strategic documents such as the Common Agricultural Policy (CAP), the Green Deal and the Farm to Fork strategy from an economic perspective is essential for vocational educators in agriculture. These strategies are not only about sustainability but are also closely intertwined with economic growth, market stability, and rural development.

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The CAP, for example, is designed to support farmers economically by providing subsidies and financial assistance, ensuring that agriculture remains a viable sector. By familiarising yourself with these policies, you can help students understand how economic incentives and regulations shape modern farming and rural economy.

The Green Deal (Ref. 17) and the Farm to Fork (Ref. 18) strategy also have a significant economic dimension, as they focus on transitioning to sustainable practices without compromising farmers' livelihood or the competitiveness of agricultural markets. They promote investment in green technologies which can open new economic opportunities for farmers and rural businesses. As a teacher, you can emphasise how these strategies aim to balance environmental goals with economic sustainability and show students how the transition to a greener economy can create new jobs and income streams in the agricultural sector.

Bringing this economic analysis into the classroom allows students to see how these international strategies directly impact farm profitability, market access, and resource allocation. For example, discussions around CAP funding or Farm to Fork initiatives can demonstrate how policy decisions affect production costs, access to markets, and even consumer demand. This helps students make the connection between policy frameworks and the economic realities of farmers and rural communities. It also encourages them to think critically about how to adapt and thrive in this evolving landscape.

Incorporating this economic perspective into your teaching will prepare your students to engage with the real-world challenges and opportunities in agriculture. Not only will they learn about sustainable practices, but also how to navigate the financial aspects of farming in a policy-driven environment. By understanding the economic implications of these international strategies, students will be better equipped to make informed decisions, whether they are managing a farm, working in agribusiness, or influencing policy in the future. As a teacher, you play an important role in guiding them through these complexities and ensuring they have the knowledge to succeed in an ever-changing agricultural economy.

2.5 International Networks and Associations

Connecting with international networks and associations dealing with multifunctional agriculture is a great way for teachers to stay informed about the latest economic trends and strategies in agriculture. These organisations, such as the European Network for Rural Development (ENRD) and the International Federation of Organic Agriculture Movements (IFOAM), provide valuable insights, research and case studies that show how multifunctional practices can boost rural economies. By actively engaging with these networks, educators can access real-time data, global perspectives and best practices, which they can bring into the classroom to enrich student learning. Sharing this up-to-date information helps students understand how international economic policies and market dynamics impact local agriculture and provides them with a broader, more comprehensive view of the agricultural sector.

By connecting with these networks, teachers can also create opportunities for collaboration and exchange by attending webinars, joining forums or participating in workshops. Bringing this experience into the classroom can help students understand the relevance of these global conversations and learn how they relate to local agricultural practices. As educators share these insights, students can analyse case studies from different regions and compare the economic impacts and strategies to their own context, preparing them for a globalised agricultural economy.

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Activity:

1. Reflect on what one of the primary goals of this unit on multifunctional agriculture is meant to help educators accomplish.
2. Think about what this unit encourages educators to do.
3. Read more about the *understanding of the economic aspects of MAgriculture* on the FAO website: https://www.fao.org/agrifood-economics/en/

Conclusion

This unit has highlighted the crucial role of understanding the economic aspects of Multifunctional agriculture (MA) within the context of global agricultural policies. By exploring frameworks such as the Common Agricultural Policy (CAP) and the Farm to Fork strategy, educators can better equip their students to address the challenges of sustainability and economic viability in agriculture. To further enhance your understanding and teaching practices, resources from the Food and Agriculture Organisation (FAO) and the European Commission are invaluable. Engaging with these materials will empower teachers to create impactful educational resources based on comprehensive information and updates on MA.

3 DIGITALISATION IN THE AGROFORESTRY AND LIVESTOCK SECTOR

3.1 Introduction

Digitalisation can be defined as the process of switching from a traditional way of working to the use of digital technologies in order to improve work processes and procedures in order to increase the efficiency and productivity of daily tasks.

It is evident that the new technologies used in the agroforestry and livestock sector have come to stay and facilitate the daily work of professionals in the sector. There are a new society (digital natives) new tools and paradigm changes.

The digitalisation of agriculture and rural areas in the EU is based on the modernisation, competitiveness and sustainability of agriculture. It promotes the integration of digital technologies and data-driven approaches while improving the well-being of rural communities.

Digitalisation means the adoption of digital technologies by farmers and rural communities, as well as improving access to knowledge and training. It also contributes to the modernisation of the sector in terms of infrastructure.

3.2 Objectives

- One of the main objectives of the CAP 2023-2027 is the modernisation of agriculture and rural areas by promoting and sharing knowledge, innovation and digitalisation. The main objectives of the CAP include the use of digitalisation tools such as:

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- Investments in precision agriculture, smart towns, rural companies and information and communication technology infrastructure through the installation of broadband or digital technologies in agriculture, forestry and rural areas.
- Ecological regimes and agro-environmental and climate commitments to support precision agriculture technologies that optimise the use of production factors.
- Sectoral interventions to acquire digital technologies at any stage of the supply chain, such as knowledge sharing or product quality monitoring.
- Advisory services to farms on digital aspects in agriculture and rural areas, such as the use of an agricultural sustainability tool for nutrients.
- Cooperation to prepare and launch AEI task forces, local development and 'smart towns' strategies as determined by the EU countries.
- Knowledge and information sharing: supporting training in digital skills, increasing awareness and knowledge about digital technologies and promoting the sharing of experiences with digital technologies (e.g. model farms).

However, there are many challenges and problems that the agricultural sector has to overcome, such as:

- Drought or lack of water resources as well as the efficient use of irrigation systems.
- Sustainability of production systems.
- European requirements in terms of ecology.
- Internal and external competitiveness.
- Generational change (on average 61 years).
- Population increase until 2050: 9.7 billion people.

Faced with these challenges and problems in the sector, the new agro-digitalisation policies and the emergence of new tools and technologies, the training, education and acquisition of professional skills of our students and future professionals in the sector is essential.

3.3 Concepts of Agriculture 4.0

Agriculture 4.0. (Ref. 19**,** Ref. 20**,** Ref. 21**):**

An agriculture that integrates a series of innovations in the production of agricultural products. These innovations encompass precision agriculture, IoT and big data to achieve a greater efficiency of production.

Artificial intelligence (AI): The ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings (Encyclopaedia Britannica, 2020). AI can consist of programmes that behave, operate and think like humans, or have their own rational way of processing information or behaviour. Its applications are endless in the many facets of technological development.

Remote sensing: The science of obtaining information about objects or areas from a distance, usually from aircrafts or satellites (NOAA, 2020). Images can be captured at different wavelengths of the light spectrum using active or passive sensors. Passive sensors record light as it reflects off the Earth's surface, while active sensors use their own stimuli to produce the image, such as laser

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light. Applications of remote sensing in natural resource management (e.g. for agricultural land use) are useful for monitoring, agricultural production, yield and droughts, among other things.

Internet of Things (IoT) (Ref. 22): Global network infrastructure in which physical and virtual objects with unique identities are discovered and seamlessly integrated (taking into account the security and privacy concerns) into the associated information network, where they can offer and receive services that are elements of the business processes defined in the environment in which they are activated (Kyritsis, 2010).

Information and Communication Technologies (ICT): Various types of technologies that transmit information to users through telecommunications. These technologies include wireless networks, Bluetooth, Internet, mobile phones, SMS and MMS.

LIDAR or Lidar system: Method that combines different sensors with different frequencies and types of light to measure distances, which can then be used to create 3D images. Laser light is used to create light that is reflected from the surface and then captured by a sensor. The types of light used are ultraviolet, visible and near infrared. It is a common technology in autonomous vehicles and equipment.

The document presents several key concepts related to Agriculture 4.0 that would have a significant impact on how educators teach agriculture students. These are some of the implications:

1) Educators will need to continuously update their knowledge of new technologies and concepts, such as precision agriculture, AI, IoT, remote sensing and LIDAR. They will need to familiarise themselves with the use of specific software and hardware for precision agriculture, big data analysis and IoT device management. Teaching agriculture must integrate these new technologies both in the classroom and in the field.
2) Educators will need to teach students how to analyse data, interpret results and apply technological solutions to specific agricultural problems. The focus on problem solving may represent a change in methodology or an adaptation of Project-Based Learning (PBL).
3) Educators will need to collaborate with professionals from various disciplines to provide a comprehensive training for students. This interdisciplinary collaboration should involve technicians from companies, educators, university researchers and other professionals in the sector.
4) The agriculture curriculum needs to be updated to include concepts and skills relevant to Agriculture 4.0. This may involve creating new courses, modifying existing ones to integrate new technologies and approaches, or developing more specialised courses on new technologies for the agricultural sector.
5) Teaching Agriculture 4.0 must go beyond theory and provide students with practical learning opportunities with new technologies. This could include visits to agricultural, forestry and farming operations that use precision technologies, hands-on experience with data analysis software, and research projects involving the application of IoT or remote sensing.

3.4 Use of Drones in Agriculture, Forestry and Livestock

The use of UAS (Ref. 23) (Unmanned Aerial Systems) or drones for the digitalisation of measurement and monitoring systems has gained popularity in various fields due to their ability

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to perform tasks efficiently and accurately. Below are some of the most common uses of drones in photogrammetry and vegetation index monitoring:

Photogrammetry with Drones (Ref. 24)

Photogrammetry is the process of obtaining geometric information about objects and surfaces from photographs. Drones equipped with high-resolution cameras and specialised sensors can fly over an area of interest and capture images from multiple angles. These images are processed using specialised software to create three-dimensional models and detailed maps. The key steps in drone photogrammetry are:

1. **Flight Planning**
2. **Image Capture**
3. **Image Processing**
4. **Data Analysis and Extraction**

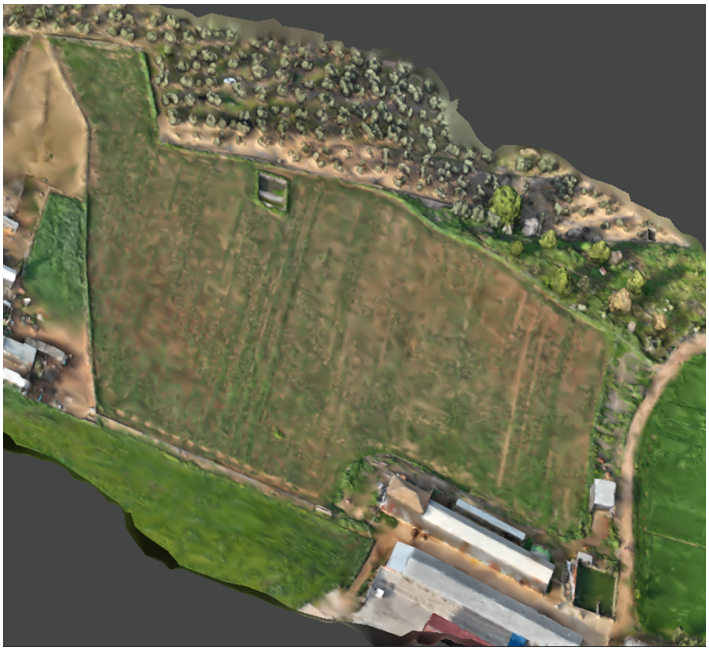

Figure 11: Orthomosaic of the plot of the IES Virgen de la Cabeza in Marmolejo (Jaén), Spain.

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Vegetation Indices with Drones (Ref. 25**)**

Vegetation indices, such as the NDVI (Normalised Difference Vegetation Index), are used to monitor the health and vigour of vegetation. Drones equipped with multispectral or hyperspectral cameras can capture images in different bands of the electromagnetic spectrum, which are essential for the calculation of these indices. The key steps in using drones to monitor vegetation indices are:

1. Sensor Selection
2. Flight Planning
3. Multispectral Image Capture
4. Image Processing
5. Analysis and Monitoring

Practical Applications (Ref. 26, Ref. 27)

1. Precision Agriculture.
2. Forest Management.
3. Topography and Cartography.
4. Environmental Conservation.

Advantages of Using Drones

- Efficiency: Significant reduction in time and costs associated with traditional data collection methods.
- Precision: Obtaining highly precise and detailed data.
- Access to Remote Areas: Ability to access and monitor areas that are difficult to reach or dangerous for humans.

The use of drones for the digitalisation of measurement systems and the monitoring of vegetation indices is a powerful and versatile tool that is evolving with technological advances.

3.5 Use of Sensors

The use of sensors and automated systems in the primary sector is developing exponentially (Ref. 28, Ref. 29). The use of sensors provides real, accurate and real-time data on different environmental conditions and helps in decision-making for efficient use of agricultural and livestock farms as well as in the forestry sector.

Implementation in Small and Medium Farms

1.Soil Moisture Sensors	- TDR (Time Domain Reflectometry) - FDR (Frequency Domain Reflectometry) - Tensiometry
2. Climate Sensors	- Meteorological Stations - Solar Radiation Probes
3. Flow and Pressure Sensors	- Flow Metres - Pressure Sensors
4. Nutrient Sensors	- Electrical Conductivity (EC) Sensors - Nitrate and Phosphate Sensors

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5. Plant Status Sensors	- Multispectral Cameras - Chlorophyll Sensors
6. Automation and Control Systems	- Automated Irrigation Controllers - Irrigation Management Software

For small and medium-sized farms, it is essential to find a balance between the investment in technology and the benefits it can bring. Some recommendations for its implementation are:

- Evaluation of Specific Needs: Analyse the characteristics of the farm, the type of crop, the type of soil, and water availability.
- Gradual Investment: Start with basic sensors such as soil moisture and weather stations and expand to more advanced technologies as needed.
- Education and Training: Train staff in the use and maintenance of sensors and automation systems.
- Integration with Existing Agricultural Practices: Ensure that sensor implementation fits seamlessly with existing agricultural practices without causing significant disruption.

Application Examples

1. Vineyards: Use of soil moisture sensors and weather stations to optimise irrigation and improve grape quality.
2. Vegetables: Implementation of nutrient and chlorophyll sensors to adjust fertigation and maximise production.
3. Fruit trees: Use of flow and pressure sensors together with multispectral cameras to guarantee a uniform irrigation and an early detection of tree health problems.

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3.6 IoT in the Agroforestry and Livestock Sector

The Internet of Things (IoT), Big Data, smart rural and home automation, are terms that are becoming increasingly present in our everyday lives. This is more evident in Generation Z, which has already been born into the digital world. It is not the future, it is the present. All this technology needs to be integrated into our education system. It is already happening through plans and programmes, but it is necessary for the students themselves to participate in the creation, development and application of all these new technologies.

The products of the Internet of Things (IoT) are countless, and they all show us how companies are taking advantage of new possibilities. The point is not that the future will be more connected to the network, because it already is.

In the rural world and in the agricultural, forestry and environmental industries, there are many examples of new technologies in precision agriculture such as soil mapping, crop sensing, self-guided machinery, photogrammetry with drones, etc.

Thanks to the connectivity of the different systems, we can highlight applications as diverse as those already mentioned above, to which we can add:

Big Data (Ref. 30)

For predictive analysis to improve the planning and management of crops and agricultural farms. In the optimisation of forest products by analysing data to improve the efficiency of harvesting, transporting and processing forest products.

Blockchain

- Transparency and Traceability: Ensures the traceability of forest products from their origin to the end consumer and guarantees sustainable and legal practices.
- Digital Certifications: Facilitates the management of forestry certifications and ensures that products meet sustainability standards.

Mobile Applications

- On-site Forest Management: Applications that allow workers to record data in real time, access maps and carry out inventories from mobile devices.
- Education and Training: Applications that provide educational resources and training on the best forestry practices.

Artificial intelligence (AI)

Image Recognition: Uses AI to analyse satellite and drone images to identify areas affected by deforestation, pests or disease.

Simulation Models (Ref. 31, Ref. 32): AI to simulate different forest management scenarios and predict their environmental and economic impacts.

Augmented and Virtual Reality (AR/VR)

- Immersive Training: Uses AR and VR to train forestry workers in a safe and controlled virtual environment.
- Planning and Design: Allows the visualisation of forest management projects and their potential impacts before their implementation.

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Collaborative Platforms

- Knowledge Networks: Platforms that connect researchers, managers and communities to share knowledge, data and best practices.
- Community Management: Digital tools that enable local communities to participate in decision-making and management of forest resources.

LPWAN Technologies

LoRaWAN

LoRaWAN is a networking specification designed for low-power IoT devices that communicate over long distances. This technology operates in licence-free frequency bands, allowing it to be used worldwide without the need for special permissions.

Figure 12: Integration of LPWAN Technology for Smart Agricultural Monitoring and Management.

Applications in the agricultural and forestry sector:

Crop monitoring: Sensors that measure soil moisture, temperature and other environmental factors.

- Water resources management: Control and optimisation of irrigation in real time.
- Early detection of forest fires: Smoke and temperature sensors distributed in large areas of a forest.

NB-IoT (Narrowband IoT)

NB-IoT is an LPWAN technology that operates on licensed spectrum and can be integrated into existing telecommunications networks.

Applications in agriculture:

- Monitoring weather conditions: Sensors that record weather data to predict events such as frost or drought.

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- Monitoring of agricultural machinery: Management and preventive maintenance based on the actual use of machinery.

Benefits of LPWAN in the Agricultural, Forestry and Livestock Sector

- Resource optimisation: saving water, fertiliser and food through precise monitoring.
- Improved decision making: Real-time data enables farmers and ranchers to make informed decisions to maximise production.
- Reduced operating costs.
- Sustainability: Minimisation of environmental impact through greater efficiency.

Challenges and Considerations

Despite the benefits, the adoption of LPWAN technologies in agriculture and forestry faces some challenges:

- Infrastructure: In rural areas, telecommunications infrastructure may be limited, making the introduction of some technologies difficult.
- Initial costs: Although LPWAN solutions are economical in the long run, the initial implementation costs can be high for small producers.
- Training: To ensure optimal utilisation of these solutions, workers need to be trained in the use of the new technologies.

Success Stories (Ref. 33**)**

- "Smart Rural" project in Spain: Use of LoRaWAN to monitor vineyards and improve the efficiency in wine production.
- "Smart Livestock" Program in Brazil: Implementation of NB-IoT for the monitoring and control of livestock on large farms, improving productivity and animal health.
- Forest monitoring initiative in Sweden: Use of Sigfox for early fire detection and sustainable management of forest resources.

Conclusion

LPWAN technologies such as LoRaWAN, NB-IoT are transforming the agricultural, forestry and livestock sector. Their ability to offer efficient monitoring and management solutions at low cost and with low energy consumption makes them important tools to face the challenges of the 21st century in these industries. However, infrastructure and training challenges have to be addressed to ensure widespread and effective adoption of these technologies.

3.7 Guidance, Autonomous Driving Systems for Agricultural and Forestry Machinery and Robots in Livestock

Young people must join this sector, but they have to do so using new technologies.

Agricultural and forestry machinery and robots used in livestock farming are increasingly common on our farms and young professionals must know, use and apply these new technologies to carry out different daily tasks effectively and efficiently with an objective that is not only economic, but also social and environmental.

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Automatic and self-guided agricultural and forestry machines (Ref. 34) have revolutionised operations in the field, providing unprecedented precision in execution of tasks such as sowing, spraying phytosanitary products and harvesting crops. These systems use global positioning technologies such as GPS (Global Positioning System), GLONASS (Global Navigation Satellite System), and BeiDou (China's navigation satellite system) or Europe's own Galileo that enable machines to move around the field with precision, minimising human error and optimising the use of resources.

The objectives to achieve with our students can be:

- Know the different manual and automatic guidance systems using GPS.
- Develop the abilities and skills to manage forestry agricultural machinery considering new technologies.
- Increase precision and efficiency in field work.
- Save time and reduce costs: By improving accuracy and efficiency, they can complete their task in less time and with less fuel, resulting in significant cost savings.
- Facilitate tracking and planning: GPS technology makes it possible to track work in the field and collect accurate data on the performance of your crops. This facilitates planning and decision making.
- Improve safety: Using GPS to guide farm machinery can also improve safety in the field.

Automatic and Self-Guided Guidance Systems

1. Automatic Guidance (Ref. 35)

Applications and advantages: Used in planting, fertilisation, spraying and harvesting, where precision is crucial to avoid overlapping or untreated areas. It reduces operator fatigue, increases operational efficiency and improves the use of inputs.

2. Self-Guided Guidance

Applications and advantages: Used in tasks that require a high degree of automation, such as precision crop management, where the machinery can automatically adjust planting depth, the forward speed or the dosage of applied inputs. Optimisation of operations in real time, reduction of input waste, improvement of agricultural sustainability and the ability to operate in poor visibility conditions.

3. Milking robots in dairy cattle (Ref. 36).

Milking robots are advanced technologies that are transforming the livestock industry (Ref. 37). These automated systems are designed to milk cows efficiently and with minimal human intervention.

Advantages

- Operational Efficiency: Reduces the need for labour by automating the milking process
- Improved Animal Welfare
- Increased Productivity
- Data Collection

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Future Trends

Robotic milking technology continues to advance. Innovations in artificial intelligence, machine learning and more precise sensors continue to improve efficiency and animal well-being. In the future, these systems are expected to become more accessible and sophisticated.

Conclusion

Currently, new technologies offer an infinite field of work. The primary sector, including agriculture, livestock and forestry, must be able to keep up with any other industrial sector. Therefore, it is essential to modernise, digitalize and implement measures to ensure that the agricultural, forestry, and livestock sectors keep pace with other industrial sectors.

The increase in the world population, worldwide policies, climate change and many other factors influence the need for current and future farmers and ranchers — who are our students today — to know how to tackle new challenges. This requires an understanding of new technologies, such as the use of equipment and systems (apps, management software, decision-support tools, etc.).

Concepts such as precision agriculture, the use of drones for photogrammetry, calculating vegetation indices, computer vision for pest detection, software and apps for crop management, as well as Big Data, IoT communication systems, prediction sensors and devices, and the use of self-guided agricultural machinery such as robotic milking systems are becoming an integral part of farmers' and ranchers' vocabulary. This is not only crucial today but is also the key to the future of smarter, more sustainable and more profitable agricultural production.

4 RENEWABLE ENERGY IN RURAL AREAS

4.1 Introduction

The use of renewable energy in rural areas has become a priority due to several factors. The energy crisis and the pandemic have highlighted the need to use sustainable energy sources, especially in rural areas where connectivity and access to energy are limited. The transition to clean and sustainable energy sources is essential to meet international sustainability commitments, as set out in the European Green Deal and the 2030 Agenda for Sustainable Development. In Spain, the Integrated National Energy and Climate Plan 2021-2030 includes goals to reduce emissions and increase renewable energy capacity. An example of this type of project is the one developed by Covap in the Pedroches Valley, which includes a photovoltaic solar energy installation that not only reduces CO_2 emissions, but also helps to save water.

4.2 Different Sources of Energy in Rural Areas

4.2.1 Energy Needs in Rural Areas

In rural areas, energy needs are diverse, and their satisfaction depends on the productive activities of the area, such as agriculture, livestock, food processing and the basic needs for drinking water and heating. In agriculture, energy needs include the use of machinery, irrigation systems and the storage of products. In livestock farming, energy is essential for the operation of refrigeration systems and product processing. In addition, the use of renewable energy also extends to the extraction and distribution of water, especially in areas with limited water resources. Wind and solar energy are used to power water pumps, which is a more sustainable option than using diesel engines.

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Activity:

Read more about *Renewable energy for agri-food systems* at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Nov/IRENA_FAO_Renewables_Agrifood_2021.pdf and about *Off Grid Pv Power Systems* at: https://www.ppa.org.fj/wp-content/uploads/2019/08/Off-Grid-Design-Guidelines-V3.1-July-2019.pdf

4.2.2 Environmental Impact of Renewable Energy

While renewable energy is crucial to the energy transition, its implementation in rural areas can have certain environmental impacts. Solar energy requires large areas of land for the installation of photovoltaic panels, which can affect the landscape and local biodiversity. Manufacturing and recycling solar panels also have an impact on the environment, although it is smaller compared to fossil fuels. Wind energy can change rural landscapes and affect local fauna, such as birds and bats. Hydroelectric energy has an impact on aquatic ecosystems, although micro-hydro projects and appropriate design of dams and reservoirs can reduce this impact. Biomass, although considered a renewable energy, can have negative effects if not managed properly, such as air pollution or soil degradation.

Activity:

1. Reflect on what is one of the main environmental impacts associated with the large-scale implementation of solar energy technologies in rural areas.
2. Read more about *Environmental Impacts of Renewable Energy Technologies* at: https://www.ucsusa.org/resources/environmental-impacts-renewable-energy-technologies

4.2.3 Benefits Associated with the Implementation of Renewable Energy

The implementation of renewable energy in rural areas offers a series of benefits. Among them, the following stand out:

- **Solar energy**: It offers access to clean energy in areas without access to electricity, promoting local economic development by reducing energy costs and generating jobs in the installation and maintenance of solar panels.
- **Wind energy**: It allows the generation of local electricity, which favours energy autonomy and contributes to the reduction of greenhouse gas emissions.
- **Biomass**: It helps the management of organic waste and promotes sustainable agriculture, since it provides fertilizers and improves soil quality.
- **Biogas**: It produces clean energy and fertilizers from organic waste, reducing greenhouse gas emissions and improving sanitary conditions.
- **Micro-hydroelectricity:** It provides constant energy in rural mountain areas along permanent rivers with low environmental impact and supports agriculture by using water for irrigation.

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Activity:

1. Think of renewable energy technology that helps improve public health by reducing indoor air pollution.

2. Read more about the *Benefits of Renewable Energy Use* at: https://www.ucsusa.org/resources/benefits-renewable-energy-use and about *When We Lean Into Clean Energy, Rural America Thrives* at: https://www.usda.gov/media/blog/2022/04/18/when-we-lean-clean-energy-rural-america-thrives

4.3 Renewable Energy Roadmap

The integration of renewable energies into agricultural and livestock activities is increasing with examples such as agrivoltaics, which combines solar energy production with agricultural activity. This model enables more efficient use of land, increasing productivity and reducing the carbon footprint. However, potential negative impacts on biodiversity and local ecosystems must be considered. Renewable energy projects must therefore be designed in such a way that they do not interfere with agricultural and livestock activities and that they promote decarbonisation and the preservation of biodiversity.

Figure 13: Iberdrola's El Segredal wind farm in Asturias (Spain).

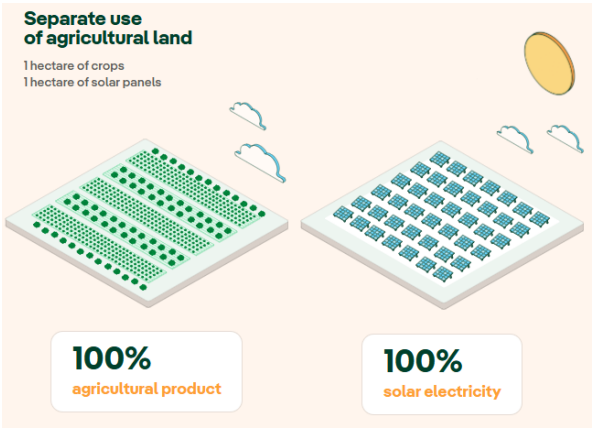

Figure 14: Separate use of agricultural land.

4.3.1 Advantages of the Coexistence of Renewable Energy and the Primary Sector

There are several advantages to integrating renewable energy into the primary sector, including:

- **Increased land use efficiency:** Combining agriculture and renewable energy can increase productivity, reducing greenhouse gas emissions and encouraging a more sustainable use of natural resources.

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- **Promoting energy self-sufficiency:** Farms and livestock farms can generate their own electricity, which reduces dependence on the electricity grid and improves the competitiveness of the sector.

- **Boosting rural development:** Integrating renewable energy contributes to the creation of local jobs and the diversification of the rural economy.

4.3.2 Projects to Preserve Biodiversity

Iberdrola's commitment to preserving biodiversity includes the implementation of projects such as agrivoltaics, which enable higher agricultural production while benefiting the environment. One example of this is the Winesolar system, which uses artificial intelligence to optimise vineyard conditions based on energy requirements and weather conditions. In addition, the livestock in solar parks helps to manage vegetation, avoiding the use of chemicals and contributing to the protection of local ecosystems.

Activity:

1. Consider the main objective of the strategic alliance between Iberdrola and the Agrarian Association of Young Farmers (ASAJA).

2. Read more about *Energy* at: https://www.fao.org/energy/en/

4.4 Regulations and Legal Framework for Renewable Energy

Legislation plays a fundamental role in the development and implementation of smart grids. It establishes the necessary regulatory frameworks to ensure that these technologies are not only sustainable and efficient but also accessible and safe for all users. With the growth of renewable energy and the need for more resilient systems, current laws and regulations need to be adapted to foster innovation and ensure a balance between technological advancement and environmental protection.

Figure 15: The Integration of technological advancement in the Modern Legal System (AI generated).

The following regulations shall apply from July 1, 2024, so it is very important to take note of it in order to be up to date when initiating a new project renewable energy project:

(1) Council Regulation (EU) 2022/2577 of December 22, 2022, establishing a framework to accelerate the deployment of renewable energies.

(2) Directive (EU) 2023/2413 of the European Parliament and of the Council of October 18, 2023, amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999, and Directive 98/70/EC concerning the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

(3) Directive (EU) 2018/2001 of the European Parliament and of the Council of December 11, 2018, on the promotion of the use of energy from renewable sources.

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(4) Regulation (EU) 2018/1999 of the European Parliament and of the Council of December 11, 2018, on the governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU, and 2013/30/EU of the European Parliament and of the Council, and Directives 2009/119/EC and (EU) 2015/652 of the Council, and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council.

(5) Council Directive 92/43/EEC of May 21, 1992, on the conservation of natural habitats and of wild fauna and flora.

Activity:

Read more about *Laying down a framework to accelerate the deployment of renewable energy* at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R2577 and about *The promotion of the use of energy from renewable sources* at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018L2001

4.5 Incentives and Support for the Implementation of Renewable Energy Systems

Grant Plan Launched by the Government to Bring Self-Consumption Photovoltaic Installations to Homes and Businesses

The Third Deputy Prime Minister of Spain and Minister for the Ecological Transition and the Demographic Challenge, Teresa Ribera, has already announced an additional 500 million euros in aid to the autonomous communities for various initiatives to promote self-consumption installations in line with the provisions of the Plan +SE.

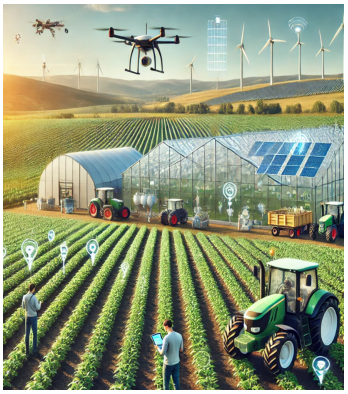

Figure 16: Render of future implementation of renewable energy systems (AI generated).

However, the photovoltaic sector will also face some challenges during this new year:

- **Storage of Surpluses**: Solar panels generate a significant amount of energy that is not fully utilised. One of the challenges will be to enable an efficient storage system through batteries so that consumers with photovoltaic installations can use this surplus energy at any time.
- **Allocation of Aid and Bonuses**: The autonomous communities and municipalities must continue to allocate part of the budget for bonuses and aid to further promote photovoltaic installations.

Activity:

Read more about the *EU energy policy* at: https://energy.ec.europa.eu/index_en

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Conclusion

The objective of this unit is to train and guide teachers towards multifunctional agriculture, with a focus on renewable energy. They should integrate activities that combine agriculture with renewable energy into their practices and content, adapting to the demands of the environment in which we live and in which there is a progressive energy transition towards the use of inexhaustible and environmentally sustainable energy sources.

5 Compatibility of Activities in MA

5.1 Introduction

Multifunctional agriculture (MA) promotes a series of tasks and activities in the rural areas that require the organisation of activities and resources for the correct development of the multifunctional activity. Resources such as labour, facilities or equipment, to name a few, must be planned in advance so that they are not overused or inadequately optimised.

As this is a module aimed at agricultural teachers, as well as other interested trainers with or without experience in the agricultural world, it is essential to address the management and compatibility of activities in multifunctional agriculture. To this end, a development of chapters is proposed in which different aspects are analysed. First, the activities that are carried out in the company and those that can potentially be implemented are studied. Secondly, the available resources are analysed to proceed with their management and, finally, the planning of activities is proposed to carry them out successfully, with the aim of achieving the effectiveness and efficiency of all activities and their optimisation.

Figure 17: Natural space with potential for Mycological exploitation (MA Fiñana).

It is also important to obtain all the information from a prospectus of the company, which will give us an idea of the objectives that can be achieved, the resources available, the activities to be carried out in order to achieve these objectives and finally the subsequent re-planning to obtain results that correct deviations from the business plans. It is interesting to include a number of tools in this last phase, such as the Key Performance Indicator (KPI), which provides us with the most relevant information for decision-making and shows the development of business results.

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5.2 Activities of the Multifunctional Agricultural Company

Normally production in traditional agriculture was based on crop rotation, productivity, the characteristics of the means of production such as the availability of water, the type of soil or simply the climate and microclimate of the area (Ref. 38). This changed with the CAP, which somewhat modelled production, favouring a series of agricultural activities over others.

Figure 18: Exploitation of natural resources (A.Seco de Herrera).

In multifunctional agriculture, we will orient our production not only from an agrarian point of view, but also in global terms, correlated with the externalities of the geographical area and its characteristics in which the multifunctional agricultural use is located.

Figure 19: Viticulture (A.Seco de Herrera).

Figure 20: Plant production activity (A. Seco de Herrera).

Figure 21: Rural tourism with equestrian rides (V. Paputsevich).

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For the successful development of the company, its objectives must first be defined. Then, the activities that can be developed will become visible, both the eminently agricultural ones (agriculture, livestock and forestry) and the potentially multifunctional ones, such as rural tourism (wine tourism, food tourism, mycotourism…) or renewable energies, to mention a few.

In relation to the objectives to be defined in the company, it is necessary for the reorientation of the business plan to carry out a survey of the conventional agricultural company to know what resources it has and their availability, as well as its location and the potential that this area represents; an agricultural company located near the coast is not the same as one in the middle of a natural park, since the possibilities for exploiting resources and getting a return on them vary considerably. Additionally, some legal restrictions may exist depending on the area.

A prospectus is a document that analyses all the elements of the company, which will be explained in the resources section, but it is necessary to be able to define the activities of the company and the subsequent planning.

In order to properly assess the activities that can be carried out in MA, they can be classified according to their typology:

1. Traditional Agrarian (Agricultural, Livestock and Forestry)
2. Rural tourism (Food tourism, wine tourism, mycological tourism, tourist routes, rural accommodation, etc.)
3. Renewable energies (Wind and mini-wind energy, photovoltaic energy, solar thermal energy, biomass, biogas, etc.)
4. Production of the informative agricultural audio-visual material
5. Collaboration
6. Cultural and Ethnographic Activities
7. Rural and Environmental Education Activities
8. Others

The activities listed are a set of actions that can be implemented as part of the concept of the multifunctional agriculture.

Activity:

1. Think about the activities that can be carried out in multifunctional agriculture. Are they closely linked to their environment?
2. Read more about Cultivating Our Futures at: https://www.fao.org/4/x2777s/X2777S00.htm#TopOfPage

5.3 Resources of the Multifunctional Agricultural Company

Resources (Ref. 39, Ref. 40) are very important for any economic activity and therefore also for activities related to MA. In this case and following the different theoretical bases on the company's resources, we find two types of resources, tangible and intangible. Both are equally important for the development of the economic activity of the company. A clear example of an intangible resource is the “know-how” or the “soft skills”.

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From a global point of view, resources can be classified as follows (Ref. 41):

1. Financial resources
2. Human resources
3. Material resources
4. Technical or technological resources

Financial resources, which for some authors include material resources, are very important for the development of the MA business project. They are responsible for covering the costs incurred during the development of the business activity in the different development phases of the business plan. It is obvious that the planning of financial resources is essential for the development of a business activity. It is therefore essential to plan a budget that covers the company's costs over time and provides for the possibility of certain contingencies and unforeseen costs.

Human resources are those that do not belong to the company and are essential for the development of activities and the achievement of objectives. In these resources we can find different skills and competencies that are not initially discovered but become more and more evident with the development of activities. This allows them to be assigned to the most appropriate activities based on the personal skills of the person as an employee. There is no doubt that the first decision that must be made is the correct management of this resource, both in terms of the number of workers and the skills and competencies they must have.

Figure 22: Human resources (V.Paputsevich).

Figure 23: Know-how abilities (MA Fiñana).

Material resources are movable and immovable property. Movable property includes raw materials, machinery and tools, as well as other resources necessary in the production process.

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Figure 24: Examples of material resources of the company (A. Seco de Herrera).

Technical or technological resources are the technological means of a tangible or intangible type. The tangible resources are computers, smartphones, security systems etc. Intangible resources include computer programmes, operating and security systems, etc. It should be noted that in some cases, tangible technological resources could be considered as material resources. Due to their technological nature, however, they are included in the former.

Figure 25: Detail of technical resources, GPS positioner and computerised control panel (P.Ledesma).

Activity:

1. Think about resources of two types: tangible and intangible. Can time be considered an intangible resource?
2. Consider human resources management. Is “know-how” a key aspect?

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5.4 Resource Management

Resource management aims to optimise their use and maximise their productivity, i.e. to make more of what is available and increase efficiency.

Resource management is used to ensure that the resources required for the development of the company's activities are always available. To do this, it is necessary to always know the availability of each resource, the schedules of each activity, their prioritisation and the most appropriate human resources to carry out these activities. To this end, it is important to consider the available resources in terms of personnel, budget, different assets, including the time required to develop each activity, as well as possible overlaps in order to ultimately achieve the set objectives.

It is important to note that nowadays there are countless technological tools for resource management that facilitate the task of management. Currently, there are platforms that help with planning and even monitoring results (Ref. 42, Ref. 43).

Figure 26: Activities and resources in Multifunctional Agriculture (MA Fiñana).

According to some authors, resource management techniques can be divided into four areas:

- Resource allocation
- Resource utilisation
- Resource forecasting
- Resource levelling

The first is an attempt to allocate resources as efficiently as possible, assigning them to tasks based on their greatest suitability, especially with regard to human resources.

Resource utilisation uses tools such as utilisation reports and time tracking software to determine whether resources are underutilised so that workload can be better managed, similar to resource levelling.

The aim of resource levelling is to identify those resources that are underutilised in order to utilise them by increasing the benefit and use of these resources.

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Finally, resource forecasting is a technique that is used in the planning phase by predicting the resource needs that will arise during the development of activities.

In the implementation of resource management, several stages can be distinguished (Ref. 44):

- Identification of the essential resources (for example, if we propose a horseback riding activity, we need horses and an expert to lead the groups)
- Adaptation of resources to the activity, that is, allocating the most suitable resources for each activity
- Estimation of the duration of each activity (think not only about the beginning and end, but also of the duration in hours/day or days/week)
- Resource scheduling
- Monitoring of resource management
- Analysis and modification of the resource management programming

Figure 27: Examples of material (physical) resources of the MA company (P.Ledesma).

Activity:

1. Read more about *What is resource management* at: https://asana.com/resources/resource-management-plan
2. Reflect on the key distinction between resource allocation and resource levelling. How does resource allocation differ from levelling, which focuses on achieving efficiency with underutilised resources?

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5.5 Activity Planning

Before starting to plan activities and once you have the overview of the available resources, you need to define a series of productive objectives in order to be able to carry out appropriate planning. It is also important to create schedules or other similar tools such as the Gantt chart. The logical sequence for planning activities would therefore be (Ref. 45, Ref. 46, Ref. 47):

1. **Resource analysis**. This section has already been covered previously, although it is an essential part of the activity planning, as no type of activity can be carried out without resources.
2. **Objective setting**. This is one of the key aspects of activity planning, as the objectives must be appropriate to the company and the area in which it is located, they must always be realistic and achievable.
3. **Production schedules and plans**. Schedules are an essential point in activity planning. There are computer programmes and companies that specialise in this type of tasks. The well-known "outsourcing" could be important when the availability of management in the company is limited. This involves hiring external experts who focus on planning activities by creating teams that improve and promote the achievement of objectives. The use of the Gantt chart should be emphasised, which uses modern computer tools to create schedules and work plans. It is therefore a tool that allows us to create and manage a project, determine the logistics and dependency of tasks and finally monitor the progress of a project, which refers to the next point.
4. **Analysis of results**, KPIs (Ref. 48). This point is important from the perspective of comparing the planned progress and the achievement of objectives during the development of the business plan. An economic analysis of the results can be carried out that will give an idea of the long-term survival of the project. From a management perspective, various metrics can be used to understand how the project is evolving, creating achievable milestones. Key Performance Indicators can be used for this purpose, i.e. a set of measures that are relevant to the development of the management plan and the achievement of objectives.
5. **Reformulation of planning**. A business project is open-ended and can be modified and improved. To this end, and on the basis of the previous point, the achievement of objectives is analysed, and planning is reformulated, starting with the reformulation of objectives if necessary.

Activity:

1. Read more about What *are Gantt charts and how to create one* at: https://www.atlassian.com/es/agile/project-management/gantt-chart
2. Consider how KPIs function as tools that reflect the results of a company's activities. What challenges arise in effectively understanding and utilising these indicators?

Conclusion

The aim of this unit is to ensure that teachers and training technicians in multifunctional agriculture have an approach to effective and efficient planning of activities so that there are no bottlenecks or stressful situations in the development of activities of the company or individual

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entrepreneur, therefore improving the compatibility of activities in multifunctional agriculture. There is no point in proposing new activities if you only have a few employees dedicated exclusively to one or two activities. In this case, the objectives and therefore the activities should be reconsidered or the human resources necessary for the efficient development of the activities should be increased.

6 SOCIAL DEMANDS AND ACTIVITIES IN MA

6.1 Introduction

Unit 60 focuses on the role of multifunctional agriculture (MA) in meeting social challenges in rural areas, especially in the EU, by supporting employment, sustainability, and cultural preservation. It highlights strategies for rural development, including combating depopulation, promoting gender equality, enhancing food self-sufficiency and social dynamization.

6.2 Viability of Rural Areas through Multifunctional Agriculture in the EU

Multifunctional agriculture is key to rural sustainability by diversifying activities such as tourism, artisanal production, agro-industry, and ecosystem services, which support economic, social, and environmental resilience (Ref. 50). The examples such as agritourism in Tuscany, artisanal production in Provence, and payments for ecosystem services in Spain demonstrate how it boosts local economies, preserves culture, and promotes environmental conservation. This approach enhances infrastructure, creates jobs, improves services, and fosters innovation ultimately by strengthening rural economies and reducing reliance on volatile agricultural markets. (Ref. 51)

Activity:

Think about the various activities encompassed by multifunctional agriculture. How do rural tourism, artisanal production, agro-industry and the provision of ecosystem services contribute to its broader scope?

6.3 Protection of Cultural and Heritage Values

Through the development of activities related to multifunctional agriculture, the cultural heritage of different rural communities is transmitted from generation to generation (Ref. 52).

Cultural heritage and traditional values are essential to rural communities. Multifunctional agriculture supports the preservation of these traditions by integrating them into modern systems, thereby sustaining cultural and community identity. Multifunctional agriculture can play a crucial role not only in the social cohesion of rural communities but also in their economic development (Ref. 53). Agricultural activities not only generate employment for many families but also preserve community ties by building shared identities among people in the same rural environment, based on common values and culture (Ref. 54), by promoting cooperation, exchanging resources among farmers, and sharing knowledge with neighbors.

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Figure 28: Examples of Traditional agricultural practice.

Multifunctional agriculture is closely tied to cultural representations and traditions such as fairs, festivals, rituals, gastronomy, and other cultural and social events that ensure the cohesion and survival of the community. People belonging to a rural community feel identified with and emotionally connected to that community by sharing cultural codes and creating common spaces for social events, such as celebrations aligned with the agricultural calendar (Ref. 55).

Figure 29: Traditional rural Andalusian festival.

Activity:

Reflect on how multifunctional agriculture contributes to rural communities. In what ways does it play a crucial role in preserving and revitalising cultural and heritage values?

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6.4 Protection Against Rural Depopulation: The Role of MA and Social Services in Sustaining Rural Communities

Rural depopulation is a significant challenge, particularly in Europe, where the migration of young people to urban centers threatens rural sustainability. Multifunctional agriculture deals with this by diversifying employment opportunities in tourism, craft production, and education, attracting younger generations (Ref. 57). Supporting programs such as the EU's LEADER initiative provide training and funding to rural entrepreneurs by boosting economic diversification and community revitalization (Ref. 58). Public policies, such as the "Contrat de Ruralité" in France, support multifunctional agriculture by providing financial incentives for projects that combine agriculture with environmental and cultural conservation (Ref. 59). Multifunctional agriculture enhances rural life quality, supports essential services such as healthcare and education, and fosters resilient, sustainable communities, and, thus, helps to curb rural depopulation and to revitalize rural areas, as Italy does (Ref. 60).

Activity:

Consider how multifunctional agriculture can address the challenge of rural depopulation. In what ways does it create diverse employment opportunities and improve the quality of life in rural areas?

6.5 Protection of Landscape Values, Biodiversity, Soil and Water Management in Rural Areas through Multifunctional Agriculture

Multifunctional agriculture is vital for preserving rural landscapes with ecological, cultural, and aesthetic values. For example, Italy's Amalfi Coast uses terraced viticulture to prevent erosion (Ref. 61) while Spain's Montseny Natural Park integrates farming, forestry, and tourism to combat urban sprawl (Ref. 62). Biodiversity is promoted through crop diversification and conservation, as seen in Navarre's and Russia's seed bank, initiatives such as France's "Fermes d'Avenir" (Ref. 63) and the Netherlands' ecological corridors (Ref. 64). Multifunctional agriculture addresses soil erosion and water management challenges through practices such as cover cropping in Germany (Ref. 65), crop rotation in Italy (Ref. 66), and water harvesting systems in Portugal (Ref. 67). These approaches, including organic fertilizers in Austria and reforestation in Scotland (Ref. 68) (Ref. 69), ensure long-term sustainability in rural landscapes.

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Figure 30: Landscape and degradation.

Activity:

Think about how multifunctional agriculture contributes to the preservation of rural landscapes. How does integrating various land-use practices help prevent urban expansion and promote biodiversity?

6.6 Restoration of Forests through MA: a Sociocultural Approach

Forest recovery and conservation are crucial to sustainability through offering ecosystem services such as carbon sequestration and biodiversity conservation. By integrating forestry with farming practices multifunctional agriculture, supports forest conservation through community-led initiatives such as Ireland's “Native Woodland Scheme” (Ref. 70) and Slovenia's “Life Kočevsko” project (Ref. 71). Agriforestry systems such as silvopasture in Croatia and the Dehesa in Spain promote biodiversity and enhance ecosystem services (Ref. 72). Sustainable forest management practices such as Slovenia's close-to-nature forestry (Ref. 73) and Croatia's Plitvice Lakes ensure long-term conservation. Policies such as Ireland’s “Forest Service Grant” and Slovenia's “Rural Development Programme” incentivize reforestation and sustainable forestry. Owing to multifunctional agriculture, community involvement is critical for successful forest recovery, as seen in Slovenia's “Gozdne Šole” initiative (Ref. 74) and Croatia’s “Green Phone Network”. In Slovenia, the “Life Kočevsko” project restored over 1,000 hectares of forest, with benefiting biodiversity and mitigating climate change. In Croatia, silvopasture practices reduce wildfire risks and support forest regeneration (Ref. 75). In Spain, the Dehesa system balances agricultural production with forest conservation while maintaining Mediterranean landscapes. In Ireland, the Native Woodland Scheme has created thousands of hectares of native woodland through contributing to carbon sequestration and rural landscape enhancement.

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Figure 31: Recovery forest.

Activity:

Reflect on the role of agroforestry in agricultural systems. How does the integration of trees contribute to improved soil health and increased biodiversity?

6.7 Promotion of Food Self-Sufficiency: the Role of Multifunctional Agriculture and Sociocultural Services in Rural Areas

Multifunctional agriculture supports food self-sufficiency by promoting locally adapted crops, such as buckwheat and spelt in Slovenia (Ref. 76), and the Istrian bean and Dalmatian olive in Croatia. Agricultural diversification, such as Spain's Dehesa system and Ireland's "Origin Green" initiative, reduces import dependency and supports local food production. Agro-ecological practices, which include crop rotation and organic farming, enhance soil health and long-term food security. Seed banks and native breed conservation, exemplified by Spain's "Red de Semillas" and Ireland's livestock preservation efforts, ensure resilience to climate change (Ref. 77). Integrating circular economy principles, as seen in Slovenia's "Zero Waste" and Spain's "Mercados de la Tierra" initiatives, boosts resource efficiency, reduces waste, and enhances local food systems.

Figure 32: Seed conservation

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Activity:

Consider the Dehesa system in Spain. How does the combination of livestock grazing and the management of oak woodlands support both biodiversity and food production?

6.8 Gender Promotion and the Role of Women in Rural Development through MA

Multifunctional agriculture empowers rural women by creating opportunities in agritourism, food production, and resource management. For instance, in Slovenia, women lead agritourism initiatives, which boost economic independence (Ref. 78), while Croatia's "Lika Destination" project increases women's involvement in decision-making (Ref. 79). Social services in Spain and Ireland provide business and governance training to enhance women's skills (Ref. 80,Ref. 81). Gender-sensitive policies in Slovenia and Croatia, such as equal land access and targeted grants, support women's leadership in agriculture (Ref. 82). Programs such as Slovenia's "Women on Farms" (Ref. 83) and Spain's "Entrepreneurial Women in Rural Areas" (Ref. 84) promote women's economic status and active participation in rural development.

Figure 33: Women in rural areas and their role in MA.

Activity:

Think about how multifunctional agriculture can enhance agricultural productivity and promote gender equality. In what ways does recognising and valuing the roles of women contribute to these outcomes in rural communities?

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6.9 The Role of Multifunctional Agriculture in Promoting Social Organization in Rural Areas

Social organization is key to sustainable rural development, especially in multifunctional agriculture, by fostering cooperation, collective decision-making, and resource management. Agricultural cooperatives in Slovenia and Croatia, such as the Agricultural Cooperative of Gorica and Zagorje Cooperative, support farmers in marketing produce and adopting sustainable practices. The networks such as Teagasc in Ireland (Ref. 85) and Asociación de Mujeres Rurales in Spain (Ref. 86) provide training and resources to empower rural communities. Participatory decision-making processes, as seen in Slovenia's Participatory Budgeting and Spain's LEADER program, ensure effective resource management (Ref. 87). Education and knowledge transfer initiatives, including Spain's Escuela de Pastores and Slovenia's Rural Development Network, enhance sustainable farming and agricultural productivity (Ref. 88).

Activity:

Reflect on how multifunctional agriculture fosters the creation of cooperatives and rural associations. Why are these organisations important for enhancing the collective strength of farmers?

Conclusion

This chapter highlights the issue of how multifunctional agriculture fosters social organization in rural areas by promoting cooperation, community participation, and knowledge transfer. Integrating social and cultural elements enhances community resilience, ensuring sustainable development while meeting various challenges, as shown by the examples from Slovenia, Croatia, Ireland, and Spain.

Copyright © 2023 Members of the AgriNext Consortium

References

Ref. 1: United Nations Sustainable Development. (1992). *Agenda 21*. United Nations Conference on Environment & Development, Rio de Janeiro.

Ref. 2: *World Charter for Sustainable Tourism*. (2015). World Summit on Sustainable Tourism +20, Vitoria-Gasteiz. http://www.institutoturismoresponsable.com/events/sustainabletourismcharter2015/wp-content/uploads/2015/12/World-Charter-for-Sustainable-Tourism.pdf

Ref. 3: Biosphere. (2024). *Sustainability certification*. Biosphere Responsible Tourism. https://www.biospheretourism.com

Ref. 4: *Turismo Sostenible y Responsable: Tipos y Beneficios*. (2023, October 19). Mardesia. https://mardesia.com/turismo-sostenible-y-responsable/

Ref. 5: World Wildlife Fund. (2001). *WWF Annual Report 2001*. https://wwf.panda.org/wwf_news/?5456/WWF-Annual-Report-2001

Ref. 6: Biosphere Responsible Tourism. (2018). *Home*. About Us. https://www.responsibletourisminstitute.com/en

Ref. 7: Finer, K., & Sajn, N. (2023). *Rural tourism*. European Parliamentary Research Service. https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2023)751464

Ref. 8: World Food Travel Association. (n.d.). *About Us*. World Food Travel Association. Retrieved November 19, 2024, from https://www.worldfoodtravel.org/about-us

Ref. 9: European Commission. (n.d.-a). *Common agricultural policy*. Agriculture and Rural Development. Retrieved November 19, 2024, from https://agriculture.ec.europa.eu/common-agricultural-policy_en

Ref. 10: European Commission. (2024, June 4). *About Us*. Still Tourism around Yard (STAY). https://stay-erasmus.eu

Ref. 11: University of Minnesota. (2021). *AgPlan*. AgPlan. https://agplan.umn.edu/

Ref. 12: Vimeo. (2023). *Developing Your Business Plan with AgPlan*. Vimeo. https://vimeo.com/showcase/8428877

Ref. 13: University of Minnesota. (2015). *Center for Farm Financial Management*. Experts@Minnesota. https://experts.umn.edu/en/organisations/center-for-farm-financial-management

Ref. 14: University of Nottingham. (2014, December 2). *Agricultural economics*. YouTube. https://www.youtube.com/watch?v=LLRYCFGUOps

Ref. 15: https://www.sciencedirect.com/journal/agricultural-systems (accessed on 20. Nov. 2024)

Ref. 16: European Commission. (n.d.-b). *The European Network for Rural Development (ENRD)*. The European Network for Rural Development (ENRD) - European Commission. Retrieved November 20, 2024, from https://ec.europa.eu/enrd/

Ref. 17: European Commission. (2019). *The European Green Deal*. European Commission; European Commission. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

Copyright © 2023 Members of the AgriNext Consortium

Ref. 18: European Commission. (2020). *Farm to Fork Strategy*. Food Safety; European Commission. https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

Ref. 19: Maria Veliz. (2023, March 21). *Agricultura 4.0 | Descubre todo al respecto*. YouTube. https://www.youtube.com/watch?v=gOJWVM4IwrI

Ref. 20: Euronews (en español). (2019, October 7). *La agricultura 4.0: tecnología sustentable para afrontar el futuro*. YouTube. https://www.youtube.com/watch?v=WccvffGgDms

Ref. 21: Podcast Industria 4.0. (2019, December 15). *La Agricultura de Precisión, Agricultura Inteligente o Agricultura 4.0*. YouTube. https://www.youtube.com/watch?v=37IeRmeGLUo

Ref. 22: Ana Delfina Tovar-Quiroz. (2023). Agricultura 4.0: uso de tecnológicas de precisión y aplicación para pequeños productores. *Informador Técnico*, *87*(2). https://doi.org/10.23850/22565035.5536

Ref. 23: González, A., Amarillo, G., Amarillo, M., & Sarmiento, F. (2016). Drones Aplicados a la Agricultura de Precisión. *Publicaciones E Investigación*, *10*, 23. https://doi.org/10.22490/25394088.1585

Ref. 24: Torres Sánchez, J. (2023, February 15). La teledetección con drones en la gestión del olivar, un avance en la digitalización del cultivo. *Interempresas*. https://www.interempresas.net/Grandes-cultivos/Articulos/462903-teledeteccion-con-drones-en-gestion-del-olivar-avance-en-digitalizacion-del-cultivo.html. Department of Graphic and Geomatic Engineering, University of Cordoba, Cordoba.

Ref. 25: Auravant. (n.d.). *Vegetation indices and their interpretation: NDVI, GNDVI, MSAVI2, NDRE, and NDWI*. Auravant. https://www.auravant.com/en/articles/precision-agriculture/vegetation-indices-and-their-interpretation-ndvi-gndvi-msavi2-ndre-and-ndwi/

Ref. 26: HOBBYTUXTLA. (n.d.). *Drones para Agricultura - Mejora tu cosecha con tecnología*. HOBBYTUXTLA. https://www.hobbytuxtla.com/drones-agricultores/

Ref. 27: Pino V., E. (2019). Los drones una herramienta para una agricultura eficiente: un futuro de alta tecnología. *Idesia (Arica)*, *37*(1), 75–84. https://doi.org/10.4067/s0718-34292019005000402

Ref. 28: Elorza, P. B. (2007). *Sensores para la caracterizacion del suelo agricola usados en agricultura de precision*. *260*, 38–42.

Ref. 29: Jacto. (2023, June 13). Sensores para agricultura de precisión: aplicaciones y beneficios. *Tecnología Agrícola*. https://bloglatam.jacto.com/sensores-para-agricultura-de-precision/

Ref. 30: Costumbres Rurales. (2023, October 30). *Modelo de agricultura 4.0 - CR#943*. YouTube. https://www.youtube.com/watch?v=SM1CZR3IHnI

Ref. 31: GRAPEVINE project. (2020, February 11). *El proyecto GRAPEVINE en el programa Tempero de AragonTV*. YouTube. https://www.youtube.com/watch?v=RsuqLvwPZvA

Ref. 32: Plataforma Berria https://ec2ce.com/en/

Ref. 33: Grupo Hispatec. (2020, March 10). *Campogest en Trops, App para gestión Agronómica de Cultivos*. YouTube. https://www.youtube.com/watch?v=HVpQvhcgq0o

Copyright © 2023 Members of the AgriNext Consortium

Ref. 34: Revista de Robots. (2020). *¿Qué es un robot agrícola? Ejemplos de la ingeniería robótica agrícola 4.0.* REVISTA de ROBOTS. https://revistaderobots.com/

Ref. 35: Naïo Technologies. (2019, November 25). *#Dino - 2019 - Official presentation - Autonomous Mechanical Weeding Robot*. YouTube. https://www.youtube.com/watch?v=fW7UVHz9QYA

Ref. 36: DW Español. (2020, November 26). Enlaces - La granja electrónica. YouTube. https://www.youtube.com/watch?v=wabvUC-CnKo

Ref. 37: La Tercera. (2019, April 11). *Granjas pioneras en internet: estas son las vacas 5G*. YouTube. https://www.youtube.com/watch?v=MuNIZLBse5c

Ref. 38: *Cultivating Our Futures Exhibition document: The multifunctional character of agriculture and the earth*. (1999). FAO/Netherlands Conference on the Multifunctional Character of Agriculture and the Earth, Maastricht, Netherlands.

Ref. 39: Martins, J. (2024b, November 20). *What is resource management? A guide to getting started*. Asana. https://asana.com/resources/resource-management-plan

Ref. 40: Etecé. (2021). Recursos de una empresa. *Enciclopedia Concepto*. https://concepto.de/recursos-de-una-empresa/

Ref. 41: Virage Group. (n.d.). *¿Qué recursos se necesitan para que un proyecto sea un éxito? - Virage Group*. Virage. https://www.viragegroup.com/es/recursos/quelles-sont-les-ressources-necessaires-pour-reussir-un-projet/

Ref. 42: Wrike. (2019). *Your online project management software - Wrike*. Wrike. https://www.wrike.com

Ref. 43: Meardon, E. (n.d.). *What is a Gantt Chart?* Atlassian. https://www.atlassian.com/agile/project-management/gantt-chart

Ref. 44: Gantt. (2023). *What is a Gantt Chart? Gantt Chart Software, Information, and History*. Gantt.com. https://www.gantt.com/

Ref. 45: Ministerio de Industria y Turismo. (n.d.). *¿Qué es un Plan de empresa?* Plan de Empresa. https://planempresa.ipyme.org/InfGeneral/PlanDeEmpresa

Ref. 46: Fabregas, K. (2024, May 4). *Simple Business Plan Template (2023) - Forbes Advisor*. Www.forbes.com. https://www.forbes.com/advisor/business/simple-business-plan-template/

Ref. 47: Gov.uk. (2012, October 15). *Write a business plan*. GOV.UK. https://www.gov.uk/write-business-plan

Ref. 48: Martins, J. (2024a, March 1). *The ABCs of KPIs: Defining Key Performance Indicators*. Asana. https://asana.com/resources/resource-management-plan

Ref. 49: Erasmus+. (n.d.). *MÓDULO 1 DESARROLLO RURAL MEDIANTE LA AGRICULTURA MULTIFUNCIONAL Y EL PATRIMONIO CULTURAL*. European Comission. https://ec.europa.eu/programmes/erasmus-plus/project-result-content/95caace7-9746-40e5-a1e9-cc12e855d4ee/Training_Modules_1-5_ES.pdf&ved=2ahUKEwjBkZbF8oOIAxUORPEDHYkrFrcQFnoECCoQAQ&usg=AOvVaw2FIay62YlYdcPgBjuLXmbQ

Ref. 50: Nowack, W., Schmid, J. C., & Grethe, H. (2021). Social dimensions of multifunctional agriculture in Europe - towards an interdisciplinary framework. International Journal of

Copyright © 2023 Members of the AgriNext Consortium

Agricultural Sustainability, 20(5), 758–773. https://doi.org/10.1080/14735903.2021.19775204

Ref. 51: https://openknowledge.fao.org/server/api/core/bitstreams/ca90f1d1-eba2-4c0d-8651-a60632acf6e4/content

Ref. 52: Multifuncionalidad agraria https://www.juntadeandalucia.es/export/drupaljda/1337160963Multifuncionalidad_agraria_completo.pdf

Ref. 53: https://www.avanis.es/es/b/agricultura-tradicional-caracteristicas-y-beneficios

Ref. 54: Ander-Egg, Ezequiel (2005). Metodología y práctica del desarrollo de la comunidad. 2ª. Edición, Buenos Aires, Editorial Lumen Hvmanitas.

Ref. 55: https://uvadoc.uva.es/bitstream/handle/10324/26311/TFG-L1681.pdf?sequence=1&isAllowed=y

Ref. 56: https://citizens-initiative-forum.europa.eu/blog/boost-rural-growth-protect-and-promote-cultural-traditions-and-food-security_es

Ref. 57: https://openknowledge.fao.org/server/api/core/bitstreams/034c7cf9-9215-4304-a264-ecb0215a50d2/content

Ref. 58: Bosworth, G., & Glasgow, N. (2012). Entrepreneurial behaviour among rural in-migrants. In M. Shucksmith, D. L. Brown, S. Shortall, J. Vergunst, & M. E. Warner (Eds.), Rural Transformations and Rural Policies in the US and UK (pp. 138-155). Taylor & Francis. https://doi.org/10.4324/9780203144275

Ref. 59: Challenges in Agriculture https://www.europarl.europa.eu/RegData/etudes/STUD/2016/585898/IPOL_STU(2016)585898_EN.pdf

Ref. 60: Multifunctional and Agroecological Agriculture as Pathways of Generational Renewal in Italian Rural Areas https://www.researchgate.net/publication/369649038_Multifunctional_and_Agroecological_Agriculture_as_Pathways_of_Generational_Renewal_in_Italian_Rural_Areas/citations

Ref. 61: https://pirineos.revistas.csic.es/index.php/pirineos/article/download/318/465?inline=1

Ref. 62: https://turisme-montseny.com/en/european-charter-for-sustainable-tourism/

Ref. 63: https://www.terredetouraine.fr/fermes-davenir-un-echec

Ref. 64: The Use of the Concept of Ecological Networks in Nature Conservation Policies and Planning Practices https://www.researchgate.net/publication/40803139_The_Use_of_the_Concept_of_Ecological_Networks_in_Nature_Conservation_Policies_and_Planning_Practices

Ref. 65: Environmental and Economic Cost of Soil Erosion and Conservation Benefits https://www.researchgate.net/publication/6051747_Environmental_and_Economic_Cost_of_Soil_Erosion_and_Conservation_Benefits

Ref. 66: https://www.agronomy.it/agro/article/view/ija.2012.e15/434

Ref. 67: https://link.springer.com/article/10.1007/s11356-023-25137-y

Copyright © 2023 Members of the AgriNext Consortium

Ref. 68: Environmental impacts of organic farming
https://www.researchgate.net/publication/353864105_Environmental_impacts_of_organic_farming

Ref. 69: https://www.sciencedirect.com/science/article/abs/pii/S0012825207000165

Ref. 70: https://swsforestry.ie/forestry-services/native-woodland-scheme/

Ref. 71: Evaluating the influence of integrative forest management on old-growth habitat structures in a temperate forest region
https://www.researchgate.net/publication/320472115_Evaluating_the_influence_of_integrative_forest_management_on_old-growth_habitat_structures_in_a_temperate_forest_region

Ref. 72: The functioning Management and Persistence of Dehesas
https://www.researchgate.net/publication/225943202_The_Functioning_Management_and_Persistence_of_Dehesas

Ref. 73: https://eu-cap-network.ec.europa.eu/sites/default/files/2023-06/gp_si_medved_farm_aecm_534_web_fin.pdf

Ref. 74: https://zgds.si/wp-content/uploads/2017/01/gozdarskiVestnik2013.pdf

Ref. 75: https://www.nature.com/articles/s41598-024-56104-3

Ref. 76: Evaluation of Buckwheat Genetic Resources in Slovenia within the ECOBREED Project
https://www.researchgate.net/publication/373851249_Evaluation_of_Buckwheat_Genetic_Resources_in_Slovenia_within_the_ECOBREED_Project

Ref. 77: https://www.jstor.org/stable/26267733

Ref. 78: https://www.fm-kp.si/Media/Default/novice/2022/WE_GREEN_ARTICLE_DECEMBER.pdf

Ref. 79: https://www.pnud.camcom.it/allegati/estero/etgg/etgg_report.pdf

Ref. 80: https://eige.europa.eu/gender-mainstreaming/countries/spain

Ref. 81: https://eige.europa.eu/gender-mainstreaming/toolkits/gear/legislative-policy-backgrounds/ireland?language_content_entity=en

Ref. 82: Gender Dimension in EU Agricultural Policy
https://www.researchgate.net/publication/381670559_Gender_Dimension_in_EU_Agricultural_Policy

Ref. 83: https://www.mdpi.com/2076-0760/13/4/224

Ref. 84: https://burjcdigital.urjc.es/bitstream/handle/10115/28769/1-s2.0-S1877042814061321-main_procedia.pdf?sequence=1&isAllowed=y

Ref. 85: https://www.teagasc.ie/

Ref. 86: https://www.afammer.es/

Ref. 87: https://ec.europa.eu/enrd/leader-clld_es.html

Ref. 88: https://nationalruralnetwork.ie/eip-agri/