ENVIRONMENTAL COURSE MODULES & CONTENTS

ANNEX I

English Version

Green Vineyards

Co-funded by the European Union

AUTHORS

Joaquin Alonso, Alicia Fernández, Daniel Burgos
Universidad Internacional de la Rioja (UNIR)

Carine Herbin
Institut francais de la vigne et du vin (IFV)

Laura Rondoni, Fabio Maria Santucci
Centro per lo Sviluppo Agricolo e Rurale (CESAR)

Angelina Taneva-Veshoska, Ana Tomik
Institute for Research in Environment, Civil Engineering and Energy (IECE)

Trinidad Márquez, Julia Delgado
Federación Española del Vino (FEV)

Andreas Ziermann, Kerstin Fröhle
Lake Constanza Foundation (LCF)

DISCLAIMER

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MORE INFO AND CONTACT

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Contact email: research.opi@unir.net

More info: www.greenvineyards.eu

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UNIT 1- CLIMATE CHANGE AWARENESS

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

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	• Can identify areas for action in order to reduce the environmental impact. • Can name and list sustainable measures in the wine sector. • Can make informed decisions and take appropriate actions to minimise the negative impacts and maximise the positive impacts of climate change on the wine sector.
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Method for evaluation of course (by students, peer review etc.)	Peer review from partners Evaluation questionnaire by learners

VIDEO INTRODUCTION

https://www.youtube.com/watch?v=cX_Wso-6qq8

DESCRIPTION

Welcome to unit 1 of the Green Vineyards Course.

This unit starts with the very basics about climate change.

In level 1, you will get an introduction to

- Basics about climate change and the development of temperature and precipitation
- Impact of climate change to the wine sector

In level 2 we connect the climate change with human activities:

- Contribution of human activities to climate change
- Necessity and possibilities of mitigation of climate change

Get ready to embark on this sustainable journey. A journey of responsibility, innovation, and above all, a celebration of our shared commitment to a sustainable future.

Let's start with this Unit level 1.

LEVEL 1 - CORE LEARNING

INTRODUCTION

Climate change offers opportunities for viticulture in Europe. However, weather extremes and the poor predictability of weather events in particular also pose serious threats.

Mild winters, warm springs and hot summers accelerate the phenological development of the vine. In many wine-growing regions, the average harvest time for wine is about 14 days earlier than 50 years ago. Higher must weights can be achieved, and in regions where it used to be too cold, red wines are now fully ripening and viticulture in general is progressing.

On the other hand, mild temperatures also lead to earlier budding of the vines, which increases the risk of damage by late frost events. There is also an increased risk of severe drought events while at the same time heavy precipitation events will occur more frequently: These can trigger soil sloughing and erosion. Drier summers provide favourable conditions for drought-loving pathogens such as powdery mildew, red blight and esca pathogens. Higher temperatures in summer can lead to a higher risk of grape rot and the grape berry moth has been regularly producing three instead of two generations for some years. Due to the earlier grape ripening at higher temperatures, vinegar bacteria in particular can also become a problem. The harvest dates of early and late varieties are converging and increasing work peaks. Because the changes in climate and their effects are so massive, we are also talking about a climate crisis.

IMPACT OF CLIMATE CHANGE TO THE WINE SECTOR

Increase in extreme weather events

The higher average temperature causes an increase in the water content in the atmosphere. With each degree more, the air can absorb 7% more moisture. This means that the phase in which the air absorbs water before it rains off in clouds can become longer. The duration of precipitation-free periods has already increased, especially in summer. Less precipitation together with increased evaporation due to increased air temperatures imply that dry phases/droughts will occur more frequently and for longer periods (**¡Error! No se encuentra el origen de la referencia.**).

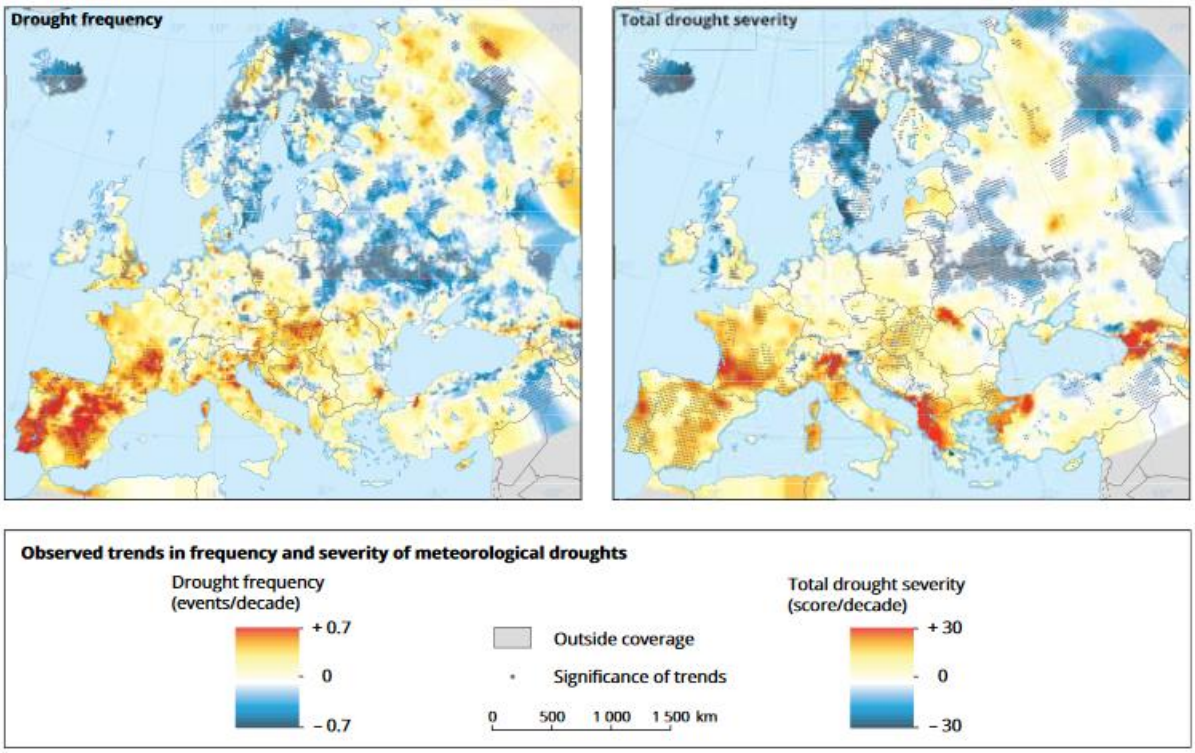

Figure 1: Observed trends in frequency and severity of meteorological droughts (EEA, 2017)

CHANGE IN PRECIPITATION PATTERN

In contrast to temperature development, changes in precipitation are more difficult to forecast. There are significant spatial and temporal differences in precipitation across Europe. Some precipitation events are extremely small-scale. While there is heavy rainfall in one place, it remains dry a few hundred meters further on. Overall, the average rainfall has decreased in summer while it has become significantly wetter in winter since the beginning of weather recording in 1881.

INCREASE IN HEAVY PRECIPITATION EVENTS

Due to the relatively higher amount of water vapor held in warmer air, the amount of water raining down in a precipitation event increase. This can lead to more frequent and increasingly heavy precipitation events. This effect will be relatively stronger in winter than in summer because the average temperature rises more in winter than in summer.

During heavy rainfall, large amounts of precipitation fall in a short time. Often, the water cannot be absorbed by the soil and accumulates or runs off the surface, which can lead to flooding and erosion damage. This effect is particularly high on uncovered, parched soils.

Hail

In particularly high rain clouds, the so-called cumulonimbus clouds, which can reach heights of up to 15 km, hail is formed in addition to rain and thunderstorms. In the process, strong updrafts pull raindrops into high, cold layers of air, where they freeze and fall back down again. In the process, more water droplets adhere to the hailstone, which grows as a result. The hailstone is again transported upwards with the updraft and continues to grow. Hailstones can grow to a diameter of more than 10 cm.

Hail events can lead to problems and crop losses by directly hitting and damaging the plants and fruits, but it can also lead to indirect damage through pest infestation of the damaged plants and fruits.

Increase in temperature and solar radiation

The average temperature in the growing season influences the ripeness of the grapes in addition to the growth of the vines. Higher temperatures lead to a faster attainment of the temperature sum necessary for the ripening of a grape variety. As a result, the grapes ripen earlier, i.e. the sugar content, which is responsible for the later alcohol content, is reached earlier. However, the grapes have not yet developed their full aromatic ripeness and the acidity is too much reduced. The typical taste of a variety can often no longer be achieved. Heat is also often accompanied by low humidity, and to avoid water stress, the stomata in the leaves close. The plant reduces photosynthesis and thus the production and storage of sugar.

Read more on earlier maturity due to climate change under complementary resources.

High temperatures and intense sunlight can also directly affect grape growing and cause damage to the vines and grape berries. The berries can discolour and dry out. This effect is strongest on vines with freshly defoliated grape regions.

Impact on soil organisms

Soil organic matter includes all living and dead plant and animal matter in the soil as well as their transformation products. The decomposed organic fraction in the soil constitutes humus. Humus is in constant build-up, transformation and decomposition due to the activity of soil organisms. The sources of organic matter are crop residues, animal manure, green manure, compost and other organic matter. Among other things, increased temperatures lead to a faster decomposition of organic carbon and a decrease in humus content. It is therefore necessary to counteract this process by promoting the biomass in the soil.

BASIC RESOURCES

- Intergovernmental Panel on Climate Change (IPCC) - Climate Change 2021: The Physical Science Basis
  https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/

- Change in precipitation pattern
  https://climate.copernicus.eu/monthly-summaries-precipitation-relative-humidity-and-soil-moisture

LEVEL 2 - LEARNING IN DEPTH

BASICS ABOUT CLIMATE CHANGE

Greenhouse effect and temperature development.

Climate is described in the same terms as weather: temperature, precipitation, radiation and wind. Weather results from solar radiation and the different heating of the Earth's surface elements (water, forest, mountains...), which in turn influences wind, temperature, evaporation and precipitation. However, while weather describes the short-term state of the atmosphere at a certain place at a certain time, climate is the description of the typical weather conditions in a region over a longer period of time. Usually, 30 years is assumed here. Like weather, climate is influenced on the one hand by local geographical conditions, which affect warming, precipitation and wind, and on the other hand by the interplay with other systems such as global air and water currents.

The difference between weather and climate is enormous. If the temperature drops by 5°C from 20 to 15°C on one day, for example, you take a jacket out of the wardrobe. If the climate drops by 5°C, we will experience the next glacial period. Northern Europe would then be covered in snow and ice.

How is the greenhouse effect created?

The greenhouse effect describes how greenhouse gases (GHG) in a planet's atmosphere partly absorb and redirect heat that is radiated from the planet's surface and thereby trap it in the atmosphere. This effect is comparable to that of a glass house as it retains the heat generated by sunrays and therefore warms up the atmosphere.

Most of the atmosphere consists of nitrogen (N_2), followed by oxygen (O_2) (Figure 2). However, these gases have no influence on the greenhouse effect. Greenhouse gases are gases with molecules of three or more atoms, such as water vapor (H_2O), carbon dioxide (CO_2), ozone (O_3), nitrous oxide (N_2O) or methane (CH_4). Although these molecules allow short-wave solar radiation to pass through almost unhindered, they reflect or absorb long-wave thermal radiation, which is emitted by the Earth's surface and thus does not reach space, or only partially. Consequently, they contribute to the warming of the atmosphere. The gases mentioned are on the one hand naturally occurring gases that are responsible for the natural greenhouse effect but are also emitted in large scale by anthropogenic activities. Although these gases make up only a very small part of the atmospherical composition (0.04%) (Figure 2), they have a powerful effect: without the natural greenhouse effect, the Earth's surface would be -19°C cold and covered in ice. No life as we can imagine it would be possible (**¡Error! No se encuentra el origen de la referencia.3¡Error! No se encuentra el origen de la referencia.**).

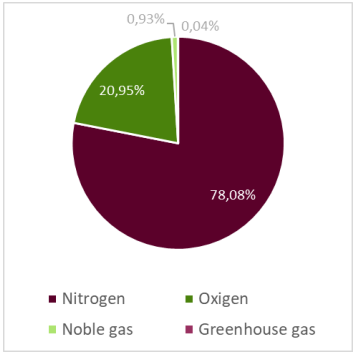

Figure 2: Composition of dry air in the Earth's atmosphere (Own illustration according to Nelles&Serrer, 2018)

The more greenhouse gases there are in the Earth's atmosphere, the stronger the greenhouse effect and the warmer it is on Earth.

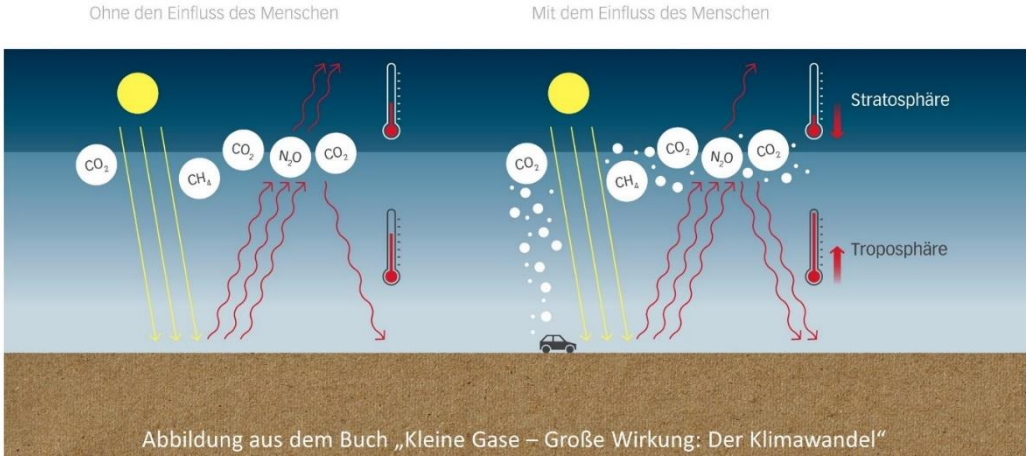

Figure 3: Natural (left) and man-made (right) greenhouse effect (Nelles&Serrer, 2018)

CONTRIBUTION OF HUMAN ACTIVITIES TO CLIMATE CHANGE

Change in the greenhouse effect due to industrialisation

The carbon cycle rules the exchange of carbon between Earth's reservoirs (biosphere, atmosphere, lithosphere and hydrosphere). It is an impressive system made of long-term stores, such as ocean floor sediments, fossil fuel reserves and rock material, and short-term stores, namely biomass and atmospheric carbon. The carbon cycle is perpetual and naturally about equilibrium. Plants absorb carbon dioxide (CO_2) from the atmosphere and use the carbon to construct biomass. Which in turn is degraded by humans, animals and microorganisms and thereby released back to the atmosphere, oceans and soil. Over millions of years, heat and pressure in the Earth's crust converted plant and animal material sedimented on the ocean floors into fossil raw materials such as oil, natural gas and coal which supposedly store the carbon over ages of time.

Since the beginning of the industrialisation, the combustion processes of fossil raw materials have increasingly released previously long-term stored carbon in the form of carbon dioxide (CO_2) into the atmosphere, throwing the carbon cycle out of balance. Human activities have also strongly increased the concentrations of the greenhouse gases nitrous oxide (N_2O) and methane (CH_4) mainly through agricultural practices. However, human activity has so far had the greatest impact on the concentration of carbon dioxide (CO_2), the concentration of which has increased since the beginning of the industrialisation 150 years ago (measured and reported in parts per million – ppm) before which it used to be about constant for 10,000 years.

Average temperatures are subject to certain fluctuations especially in shorter periods of time. Overall, however, it can be stated that the average temperature has been rising since the beginning of industrialisation and thus the intensive burning of fossil raw materials. The average temperature is already between 1.0 and 1.5 degrees (Kelvin) above the level of the pre-industrial era.

Past emissions of greenhouse gases will still have an effect in the future. This effect is amplified by current and continuing greenhouse gas emissions. The Intergovernmental Panel on Climate

Change (IPCC) describes five possible scenarios of how the temperature will change in the future - depending on the continued emission of greenhouse gases. In the SP1-1.9 scenario, man-made greenhouse gas emissions in total will cease by 2100, and CO_2 emissions even by 2050. In this scenario, the warming of the Earth's atmosphere will be lowest. In the SP5-8.5 scenario, with a further increase in GHG emissions, the atmosphere will warm much more. It is therefore important that we all reduce our emissions of greenhouse gases.

Mitigation of climate change

As explained in the previous chapters, the high concentration of greenhouse gases leads to an increase in the greenhouse effect, which promotes climate change. Before we look at possible adaptation measures in the following chapters, our efforts must first and foremost aim at reducing greenhouse gas emissions on our own farms.

In order to be able to save greenhouse gases one must be aware of where they are produced. Carbon dioxide (CO_2) again plays the main role here.

CO_2 occurs with:

- Company-related emissions
    - Direct greenhouse gas emissions (company fleet, heating, air conditioning, etc.)
    - Greenhouse gas emissions from purchased energy (electricity)
    - Indirect greenhouse gas emissions (staff travel, external service providers, third-party vehicles, water consumption, paper consumption, waste disposal, etc.)
- Product-related emissions
    - Viticulture (wire frames, plant protection products, fertilisers, cultivation, etc.)
    - Cellar management (storage containers, oenological treatment agents, cooling, etc.)
    - Filling (bottles, caps, labels, packaging)
    - Distribution (delivery)

Measures offering potential for savings are:

- Convert heating to non-fossil fuels (wood pellets, heat pump, etc.)
- Climate-neutral shipping of wine
- Purchase of green electricity
- Improving energy efficiency and promoting the operation of modern energy supply technologies such as geothermal energy, combined heat and power plants, solar and photovoltaic systems
- Reduction of fuel consumption and use of biofuels as well as promotion of electromobility
- Use of lightweight glass bottles (with a guideline value of 420 g)
- Extensive recycling and minimisation of the amount of residual waste
- Refrain from using mineral nitrogen fertilisers in order to avoid the formation of nitrous oxide
- Safeguarding biodiversity (plants extract carbon dioxide from the air and store the carbon in biomass. This carbon can be stored in the soil via microbial decomposition).
- Regional procurement to avoid emissions from logistics
- Use of climate-neutral transport at home and promotion of climate-neutral transport abroad

We have prepared more information on this in UNIT 6 Energy Efficiency Management and UNIT 7 Reduction of Greenhouse Gas Emissions.

COMPLEMENTARY RESOURCES

- Drought in vineyards
  https://www.oiv.int/press/severe-drought-and-extreme-heat-pose-new-threat-wine-production

- Impact of climate change on grape berry ripening
  https://www.frontiersin.org/articles/10.3389/fpls.2022.1094633/full

- Sunburn on wine grapes
  https://www.researchgate.net/publication/348331269_Sunburn_in_Grapes_A_Review

- Effects on soil organisms
  https://link.springer.com/chapter/10.1007/978-981-16-7759-5_8

- Institute of Atmospheric Physics
  https://www.dlr.de/pa/en/desktopdefault.aspx/tabid-2342/6725_read-52424/6725_page-11/

- Mitigation - Reducing GHG Emissions - Reaching Net Zero in the Wine Sector
  https://www.iwcawine.org/ghg-emissions

LEVEL 3

ADDITIONAL RESOURCES

- Hail Video: https://www.youtube.com/watch?v=GvyvQs9uYmU
- Climate, Grapes, and Wine I Gregory Jones, Ph. D. I TEDxRoseburg https://www.youtube.com/watch?v=aRwVFGjlOwU
- Continuous decrease in soil organic matter despite increased plant productivity in an 80-years-old phosphorus-addition experiment; Marie Spohn, Sabina Braun, Carlos A. Sierra https://www.nature.com/articles/s43247-023-00915-1
- Climate change, impacts and vulnerability in Europe 2016 https://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016
- The Impact of Climate Change on Viticulture and Wine Quality https://www.researchgate.net/publication/303979811_The_Impact_of_Climate_Change_on_Viticulture_and_Wine_Quality
- Keep Soil alive – protect soil biodiversity; foa.org https://www.fao.org/world-soil-day/about-wsd/campaign-materials/en/

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Helmholtz Centre for Environmental Research 2023: https://www.ufz.de/index.php?de=37937

Geisenheim University of Applied Sciences, 2023: http://rebschutz.hs-geisenheim.de/schadbilder-wein/schadbilder.php?Auswahl=Abiotisch

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SELF-ASSESSMENT

(Introduce 5-10 questions) (Only one answer is correct)

1. What is weather?
   a. Short-term state of the atmosphere at a particular place at a given time
   b. Fixed events from the 100-year calendar for a region
   c. Predominant character of the weather pattern over several days in an area/location
   d. Temperature change at a given location.

2. What is Climate?
   a. Weather events that occur repeatedly in a given region in a year.
   b. Typical weather conditions in a region over a period of usually 30 years.
   c.
   d. Variation of weather in a given region at a given time.

3. What do we mean by climate change?
   a. Normal change in the weather occurring at a specific point in time
   b. Global deviation of the earth's climate due to natural and anthropogenic causes
   c. Warmer air temperatures on Earth due to increased solar activity
   d. Small temperature increase in the distant future due to greenhouse gas emissions.

4. Can we influence the severity of climate change?
   a. No, the climate is changing due to changes in solar activity. Humans cannot change the climate.
   b. Yes, by reducing emissions of greenhouse gases such as CO_2, NH_4 and other greenhouse gases.
   c. Yes, by mankind reducing emissions of greenhouse gases such as N_2 and O_2.
   d. No, climate change can no longer be influenced.

5. What are no predictions due to climate change for most parts of Europe?
   a. Increase in extreme weather events
   b. Change in precipitation pattern
   c. Increase in heavy precipitation events
   d. Increase in plant-available water in the soil

UNIT 2 - CLIMATE CHANGE ADAPTATION

GREEN VINEYARDS PROJECT

2021-1-ES01-KA220-VET-33311

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Method for evaluation of course (by students, peer review etc.)	Peer review from partners Evaluation questionnaire by learners

VIDEO INTRODUCTION

https://www.youtube.com/watch?v=yIEdaql4QHI

DESCRIPTION

Welcome to unit 2 of the Green Vineyards Course.

This unit is about climate change adaptation in viticulture.

In level 1, you will

- Get an idea of how to reduce the vineyard's vulnerability.
- Get a brief overview of adaptation measures
- And implementation of adaptation measures.

In level 2 of this unit, you will have the opportunity to

- Learn more about sustainability of adaptation measures

Get ready to embark on this sustainable journey. A journey of responsibility, innovation, and above all, a celebration of our shared commitment to a sustainable future.

Let's start with this unit 2.

LEVEL 1 - CORE LEARNING

INTRODUCTION

Climate crisis is already affecting viticulture in Europe and will affect it even more in the future. It is important to recognise the challenge and take it seriously. Only then can the risks and challenges be recognised and adaptation measures implemented. The projections for the future development of the climate given in Unit 1 “Climate Change Awareness” are not predictions. How exactly the climate will behave in the future is not yet known. The predictions for weather made in the past for the time that has now passed have been confirmed or exceeded in severity by observations of actual climatic events. It is not possible to determine in advance exactly when weather extremes such as heavy precipitation, hail and droughts, but also years with optimal precipitation distribution and good growing and ripening conditions will occur. Projections for the future can only show a trend of how the climate may develop under certain conditions in a certain region. It is therefore important to take the path of adaptation in order to reduce the farm's vulnerability to climate change impacts such as extreme weather events.

IDENTIFYING SPECIFIC CLIMATE CHANGE SCENARIOS

An important aspect of adapting to climate change is to develop a sense of what exactly the challenges are. Maybe there are existing national, regional, territorial, sector, appellation or production area climate change scenarios.

The free online application CANARI can play a crucial role here. CANARI allows agricultural stakeholders to quickly, directly and easily create customised climate projections and calculate agroclimatic indicators adapted to different agricultural sectors and crops. Agroclimatic indicators show the development of "climate pressure" by comparing a reference period with a future period. The application is an independent tool based on the two RCP scenarios (for Representative Concentration Pathway), RCP4.5 (medium scenario) and scenario 8.5 (pessimistic scenario), which were defined in the IPCC report (IPCC Report 5). https://canari-europe.com/

Diagnosis of the vineyard's vulnerability

What are the main vulnerabilities of your farm? By spatialising the sensitivities and exposures (variability - phenology, yields, labour and need - turnover), the increase in alcoholic degrees, climatological variability (rain, temperature) and climatic accidents (frost, hail, flooding, drought, storm, floods, inundation, etc.), it is possible to identify the main threats to the vineyards in different locations.

Reducing the vineyard's vulnerability

Adaptation to the consequences of climate change is primarily about reducing vulnerability to weather extremes. We talk about increasing the **resilience**, i.e. the resistance of the farm. This can be achieved by increasing the resilience of the vines and the vineyards. However, the resilience of the farm can also be increased by implementing adaptation measures in the wine cellar or by

reducing dependence on the success of wine production through additional income opportunities such as wine tastings, farm holidays or guided tours of the vineyard.

An important way to reduce vulnerability is **diversification**. Diversity can be achieved, for example, by using different grape varieties (early and late ripening). Since the phenological development of different grape varieties does not take place at the same time, the different varieties also go through the sensitive development stages at different times. Critical phases are, for example, the budding of the vines, when the young shoots are susceptible to the risk of late frost, the flowering stage, when the shoots react sensitively to cool and damp weather, and the fruit development stage, when young vines in particular react to excessive heat and drought with premature ripening. Late frost events can, for example, hit one variety right at the start of budding and lead to high damage, while a variety that buds later is spared. Diversity and thus a lower risk from weather extremes can also be achieved by growing vines in different vineyard locations.

In vineyards, the **soil** plays a central role in adapting to climate change. In case of heavy precipitation events, the soil is required to absorb water quickly and thus reduce the risk of crusting and sealing and the risk of erosion. A well-structured and -textured soil with high soil fertility can store water for later dry phases. Measures to promote soil structure and fertility are presented in Unit 4 Soil management focused to climate change. In this unit “Climate Change Adaptation”, some adaptation measures are presented that are otherwise not dealt with further.

Heat stress/sunburn

As stated in Unit 1, the air temperature is increasing. High temperatures and strong sunlight increase the risk of sunburn. Shade protects the grapes from radiation. This can be achieved by:

- Higher planting density
- Hail nets, foil roofs
- Dense foliage/reduced summer pruning

-> Reduced summer pruning on the sunny side of the vines protects the fruit from sunburn

- Early defoliation for better hardening
- Vine training systems in which the foliage walls provide shade like a canopy
- Application of kaolinite against sunburn (**¡Error! No se encuentra el origen de la referencia.**)

Figure 1: The clay mineral kaolin protects the grapes from sunburn and also from the cherry vinegar fly Drosophila suzukii (Petgen, M., DLR Rheinpfalz, 2017).

Rising temperatures

Rising temperatures lead to the heat summation necessary for the ripening of a particular variety being reached more quickly. This can lead to earlier ripening of the grapes and reaching higher sugar contents and thus higher must weights. For some regions in Europe, this offers opportunities to expand viticulture. However, earlier ripening can also mean that characteristic aromas and acid notes of a wine are not yet fully developed, while the grapes are already ripe for harvesting. Among other things, the adaptation measures below are suitable for counteracting rising temperatures and early ripening.

- Year-round ground cover (vegetation, mulch)
  -> Evaporation protection, positive microclimate, protection of soil life from overheating, humus build-up
- Natural plant structures
  -> Hedges and trees create a microclimate and cool through shading and transpiration
- Foliage wall design
  -> Reduction of the leaf/fruit ratio due to defoliation leads to less assimilation area and thus less sugar storage
- Cooling the grape harvest
  -> Cooling the grape harvest during very high temperatures reduces the risk of faulty fermentation
- Cultivation of new, more heat-tolerant or more heat-loving varieties
- Change towards late maturing varieties

Dryness

High temperatures increase the evaporation of soil moisture and of moisture via the plants (transpiration). Plants can cool themselves by means of transpiration. Collectively, this is called evapo-transpiration. In order to prevent water shortages in the vines, it is important to reduce evaporation and unproductive transpiration. Here, some measures are listed that are suitable for improving the water balance in the vineyard (GeNiAL, 2022).

- Root management for new plants
  -> Limit lateral root growth and guide roots into the depth; pathfinders for roots are earthworm tubes or old root canals of companion plants -> Intercrop before new planting (biological deep loosening)
- Carry out break-out work on the cane in a timely manner
  -> Plants that are lagging behind in growth and have many shoots should be relieved in particular

- Rolling of diverse greening mixture (interrupted evapotranspiration, water-saving mulch layer, protection of beneficial insects)
- Shading (hail protection nets, foil roofs, agri-photovoltaics)
- Extend irrigation possibility
  -> Irrigation decision supported by e.g. tensiometric probes to determine water demand
- Efficient irrigation - economical (drip) irrigation
- Windbreak hedges
- Terracing or laying out the rows of vines across the slope to reduce water run-off and increase infiltration in the vineyard so that the water is then available to the vines
- Laying keylines across the slope to create infiltration opportunities for water and reduce the risk of erosion (see complementary resources)

Heavy precipitation and storms

The risk of heavy precipitation and storms is increasing. Depending on the severity of the event, entire vineyards can be destroyed. However, winegrowers have the chance to reduce their vulnerability to a certain extent (GeNiAL, 2022).

- Improvement of soil structure / humus build-up through measures such as diverse tramline planting, mulch or cover of the rows, compost, adapted fertilisation incl. liming -> improvement of infiltration performance
- Mulch material (straw) to reduce erosion in the tramlines
- Alignment of the plant in the main wind direction (less wind attack surface, faster drying -> reduce fungal infestation)
- Stop irrigation early (if foreseeable)
- Hail nets, foil roofs or agri-photovoltaics
- Planting of woody plants/hedges as windbreaks
- Stabilise the installation (increase the stability of the installations, e.g. use flatter bracing angles, concrete masts/earth anchors, thicker guy wires)
- Terracing or laying out the rows of vines across the slope to reduce water run-off.
- Creation of keylines across the slope to create infiltration opportunities for water and reduce the risk of erosion

Piwis - Fungus-resistant vines

Muscat Bleu, Cabertin, Pinotin, Sauvignac and Carbernet Blanc: the grape varieties sound somewhat familiar, but also unfamiliar. The varieties listed are grape varieties that are particularly resistant to fungal diseases and thus allow a significant reduction in the use of plant protection products. In terms of disease pressure, Piwi varieties are sensible adaptation measures to achieve stable yields and at the same time reduce the use of plant protection products. This no longer applies only to

northern wine-growing regions such as Germany. Winemakers in Spain, France and Italy have also recognised the potential and necessity of robust grape varieties.

- High resistance to fungal diseases
- Resistant to oidium (Erysiphe necator, powdery mildew)
- Significant reduction in the use of plant protection products
- Emergence through crossing
- Point of criticism: wine buyers locked into varieties
- However: "Varietal loyalty" softens too
- Getting to know the varieties via Cuvée
- Approach via sparkling wine or semi-sparkling wine
- Communication benefit: Saving on spraying agents (10% piwi means 30% saving on PPPs).

BASIC RESOURCES

Identifying the regional specific scenarios and threats through changing climate

- https://canari-europe.com/

Sustainability of the measures

- https://agriadapt.eu/region-continental/

Implementation of adaptation measures

- https://www.researchgate.net/publication/241746568_Conceptual_Framework_for_the_Transition_from_Conventional_to_Sustainable_Agriculture
- www.agriadapt.eu

Magazine article:

- *https://thewire.in/culture/wine-and-climate-change-8000-years-of-adaptation*
- *https://www.reuters.com/business/cop/spains-la-rioja-old-vines-could-future-proof-wine-against-climate-change-2022-11-03/*

Video: Climate resilience in the UK wine sector

- https://www.lse.ac.uk/granthaminstitute/resilient-wine/
- https://www.cornell.edu/video/six-mile-creek-vineyard-climate-smart-farming

Project & video

- https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-results-platform/23464
- https://youtu.be/hHoz68th09M?si=H3dist6o-Z6D1kPW

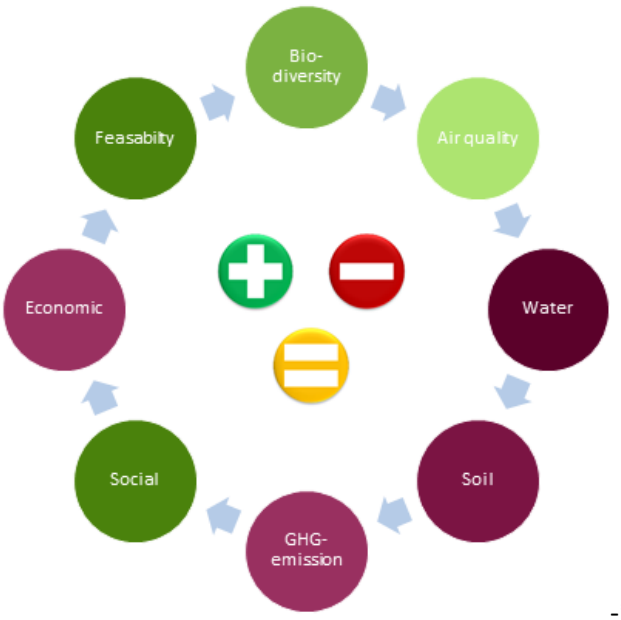
LEVEL 2 - LEARNING IN DEPTH

CLIMATE CHANGE ADAPTATION STRATEGIES

Sustainability of adaptation measures

The main objective is to help European winegrowing enterprises to be better prepared for climate crisis by increasing their resilience and thus reducing their vulnerability. The different measures can have different impacts (negative, neutral, positive) on the environment. In addition, the implementation conditions of the measures also have socio-economic impacts (negative, neutral, positive) on the winegrower. Some measures are cost-intensive, while others involve little additional cost or may even bring savings.

Each adaptation measure can be assessed in terms of its sustainability. In the EU-LIFE project AgriAdapt, eight different criteria were selected, for each of which targets and explanations were defined. The measures collected in the AgriAdapt project for arable farming, animal husbandry and permanent crops were assessed in terms of their respective impacts on different sustainability areas as well as technical feasibility (Figure 2). For example, irrigation of crops can have positive impacts on soil quality and biodiversity, in addition to impacts on quality and quantity of yield, but can reduce the amount of water available. Farm managers need to think about the respective effects of their measures and actions and weigh positive and negative impacts.



-*

Figure 2: Effects of adaptation measures on climate change (AgriAdapt, 2019)

Implementation of adaptation measures (efficiency, substitution and redesign)

Adaptation measures can be divided into three different categories of implementation. A grid is used to describe the transformation from intensive conventional to sustainable agriculture. Measures are categorized as efficiency, substitution and redesign (Hill et McRae, 1996). Simplified, efficiency measures can be implemented in the short term, while redesign requires more time and/or money.

This classification should help the farmer to understand the complexity of the measures and to plan sufficient time for their implementation (which are the different steps to adapt to climate change at the right time?).

Efficiency

In this category, the basic operation and cultivation are maintained. Modifications aim to optimize (especially rare and expensive) inputs to improve the current operational process (e.g. delaying pruning, changing vinification, using yeast mixtures, regional wild plants for greening of driving lanes ...).

Substitution

The aim is to partially exchange components of the operating system without changing it in its entirety. The changes are larger than those in the efficiency category and thus more costly to introduce (e.g. roof or vase training of vines versus trellis, cultivation of grape varieties better suited to warmer climates).

Redesign

The aim is to rethink the whole farm process with a view to adaptation to climatic constraints (e.g. Vitiforest, changing the direction of vine rows for having less radiation in the afternoon which is the most critical period, geographically displacing vineyards beyond their traditional boundaries).

COMPLEMENTARY RESOURCES

Technical documents

- Thünen Report 44 Current research in horticultural economics; sustainability and regionality - opportunities and challenges for horticulture https://literatur.thuenen.de/digbib_extern/dn057661.pdf

Websites

- Agriadapt. Sustainable adaptation measures https://agriadapt.eu/region-continental/

- LVWO Weinsberg. *Sunburn a one-time special event?* Retrieved September 23, 2023, from https://lvwo.landwirtschaft-bw.de/pb/,Lde/Startseite/Fachinformationen/Sonnenbrand+a+one+time+special_event_?LISTPAGE=669634
- Damage patterns in viticulture of the Institute of Phytomedicine at Geisenheim University Retrieved September 23, 2023, from https://www.hs-geisenheim.de/praxis/praxiswissen/rebschutzwetter/
- Frost damage in viticulture
  - Retrieved September 23, 2023, from https://www.lwg.bayern.de/weinbau/rebe_weinberg/143494/index.php
  - Retrieved December 18, 2023, from https://extension.umd.edu/resource/grapevine-frostfreeze-damage-i-background-and-prevention/
- Keyline Design https://www.permaculturenews.org/2013/02/22/before-permaculture-keyline-planning-and-cultivation/
- Fungus-resistant grape varieties
  https://www.sciencedirect.com/science/article/abs/pii/S0304423816301224
  https://piwi-international.org/en/
  https://www.weinbau-der-zukunft.com/piwis-in-italien/
  https://www.swrfernsehen.de/landesschau-rp/gutzuwissen/piwis-pilzwiderstandsfaehige-rebsorten-100.html

Videos

- Viticulture in climate change TV report on SWR (approx. 30 min) Retrieved September 23, 2023, from https://www.hr-fernsehen.de/sendungen-a-z/hessenreporter/sendungen/weinbau-im-klimawandel,video-119942.html

LEVEL 3 - ADDITIONAL RESOURCES

In essence, climate change adaptation is about reducing the vulnerability of individual farms to the impacts of climate change, such as drought, heavy precipitation, late frost events and others. Two very central elements here are risk reduction through diversification and improving soil quality. Soil is important since it is the basis of wine production being the ground for vines, nutrient supplier, water reservoir, buffer for diverse ingredients, habitat for soil organisms and carbon reservoir. On the other hand, soil health and thereby fertility is threatened by heavy precipitation and heat which can lead to drying out, crusting, sealing and erosion, which will increase due to climate change. We will go into this in more depth in the next level.

Websites

- Viticulture in Europe
  https://www.life-vineadapt.eu/en/aktuelles
- Huglin Index
  https://www.dwd.de/EN/ourservices/germanclimateatlas/explanations/elements/_functions/faqkarussel/huglin.html
- Perspectives of climate change until 2050 for viticulture in Germany (Climate 2050)
  https://www.pik-potsdam.de/en/output/publications/pikreports/.files/pr106.pdf/@@download/file/pr106.pdf
- Water scarcity, abandoning glyphosate, increasing (soil) biodiversity (BR)
  https://www.youtube.com/watch?v=-32uxT2MnkA
- France's Winegrowers - Tradition Meets Passion (GEO)
  https://www.youtube.com/watch?v=pQaBkRIgRk0
- With permaculture against climate change (delinat)
  https://www.weinbau-der-zukunft.com/permakultur-als-antwort-auf-den-klimawandel/
- Leaf wall management can reduce alcohol content:
  https://magazin.wein.plus/news/laubmanagement-kann-alkoholgehalt-in-weinen-senken-obere-blaetter-bilden-den-meisten-zucker?utm_campaign=Newsletter&utm_source=Newsletter_2023_37&utm_medium=DE
- Winesorar, agrovoltaic pilot project
  https://www.youtube.com/watch?v=uhS4n2EO7q0

REFERENCES

- GeNiAL, 2022
  https://genial-klima.de/module/weinbau/
- Hill, S. and MacRae, Roderick John., 1996. Journal of Sustainable Agriculture. Conceptual Framework for the Transition from Conventional to Sustainable Agriculture, 7(1), pp. 81-87.
- Petgen, Dr Matthias, DLR Rheinpfalz, 1997.
  https://vitipendium.de/Datei:Rebst%C3%B6ckeKaolin.JPG

SELF-ASSESSMENT

(Introduce 5-10 questions) (Only one answer is correct)

1. What are the relevant first steps to adapt the vineyard to climate crisis?
    a) arrange the rows of vines across the slope to reduce the risk of erosion in the event of heavy rainfall
    b) Identify specific climate change scenarios, diagnose the vineyard´s vulnerability and reduce it
    c) Higher planting density against water shortage
    d) Implementing windbreak hedges

2. How can winegrowing enterprises be better prepared for climate crisis?
    a) by reducing the resilience of the farm and thus increasing its vulnerability
    b) by increasing the vulnerability of the farm and thus reducing its resilience
    c) by increasing the resilience of the farm and thus reducing its vulnerability
    d) by reducing the vulnerability of the farm and thus increasing its resilience

3. Which measure does not help against heat stress and sunburn on grapes and stems?
    a) stop irrigation early
    b) higher planting density
    c) hail nets and foil roof
    d) dense foliage/reduced summer prunning

4. What are the central elements through which an individual farm can reduce its vulnerability?
    a) risk reduction through diversity and improving soil quality
    b) risk reduction through reducing greenhouse gas emission
    c) risk reduction through improving soil quality
    d) risk reduction through diversity and waste management

5. In which aspect a ground cover in viticulture can not help?
    a. Reduce evaporation and retain moisture in the soil
    b. Reduce erosion
    c. Protect soil life from heat
    d. Sunburn of grapes and stems

UNIT 3 - CLIMATE-ADAPTIVE WATER MANAGEMENT

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module</td><td colspan="3">Environmental management focused on climate change: Water, soil, biodiversity</td></tr>
<tr><td>Type</td><td colspan="3">Asynchronous online training</td></tr>
<tr><td>Workload for learner</td><td colspan="3">7 hours (estimated workload for completion of level 2)</td></tr>
<tr><td>Trainer</td><td colspan="3">Prof. Fabio Santucci, Ms Laura Rondoni, Ms Alessandra Antognelli, Ms Carine Herbin</td></tr>
<tr><td>Institution</td><td colspan="3">CESAR, IFV</td></tr>
<tr><td>Content/short description; duration</td><td colspan="3">Short description:

This module is designed to directly address the needs of wine workers and professionals in the wine industry, focusing on practical skills and applications to ensure the resilience and success of wineries amid today's environmental challenges. Learners will engage with real-life case studies from the wine industry, gaining insights into the European regulatory framework, innovative water conservation techniques, soil preservation strategies, and the importance of biodiversity in agroecology. Built around practical scenarios, the module offers a comprehensive learning experience that combines theory and application. Through it, learners will gain an in-depth understanding of water and soil management, agroclimatic mapping, hazard prevention, and biodiversity. Amid fluctuating environmental conditions, labour shortages, advances in technology, and the need for compliance with sustainability standards, wineries are called upon to navigate complex issues. This module empowers learners with the tools to face these challenges while preserving the uniqueness of their terroir, style, and variety. The applied knowledge and competencies acquired during the course will support them in making informed decisions that ensure the continued success of their establishments despite environmental, social, and economic challenges.</td></tr>
<tr><td></td><td>Unit</td><td>Content</td><td>Duration</td></tr>
<tr><td></td><td rowspan="4">Climate-adaptive water management</td><td>EU Regulatory framework</td><td rowspan="5">2.5 h</td></tr>
<tr><td></td><td>Agroclimatic mapping of wine-growing terroirs</td></tr>
<tr><td></td><td>Water needs in wine growing</td></tr>
<tr><td></td><td>Sustainable water consumption and conservation</td></tr>
<tr><td></td><td>Preservation of water quality and soil integrity</td></tr>
<tr><td></td><td rowspan="2">Soil management in vineyards</td><td>Soil characteristics and vine nutritional requirements</td><td rowspan="2">2.5 h</td></tr>
<tr><td></td><td>Soil conservation</td></tr>
</table>

		Soil climate adaptation	
		Enhancing carbon sequestration and terroir protection	
	Biodiversity and agroecology	Understanding biodiversity and EU Strategies	2.0 h
		Preservation of biodiversity	
		Promotion of biodiversity	
		Sustainable plant protection and biocontrol	
Learning Outcomes	By the end of this course, learners will be able to: ● Comprehend key EU strategies and techniques for climate-adaptive soil management, including soil fertility control, compaction prevention, erosion mitigation, contamination reduction, salinisation risk management, terroir protection, and CO2 sequestration enhancement. ● Understand the different impacts of sustainable water management practices in the context of winegrowing, focusing on agroclimatic mapping, hazard prevention, insurance, water consumption reduction, soil sealing limitation, and water quality preservation. ● Examine the role of biodiversity in sustainable vineyard management, including the adoption of plant materials suited for agroecological challenges, reduction of chemical use, and implementation of biocontrol methods. ● Compare case studies and real-world examples to develop comprehensive plans for soil, water, and biodiversity management in vineyards, considering both short-term and long-term sustainability goals. ● Reflect on personal values and their alignment with sustainability values in the wine sector, employing critical thinking skills to challenge conventional practices and propose innovative, environmentally conscious solutions.		
Learning materials	● Lectures (PPT) ● Case studies ● Videos ● Further readings		
Language/s of learning materials	· English (all materials of level 1 and 2 + some other materials of level 3) · Spanish, French, Italian, German, and Macedonian (all materials of level 1 + some other materials of level 3)		

Method/s for teaching and learnings	Each Unit consists of three online parts: 1. Level 1 (CORE): is the core learning, available in all languages (En + partner country languages). It includes introductory texts, videos. All learners will watch/read/study all the provided resources. It has to be completed in order to have access to the self-assessment quiz 2. Level 2 (RELEVANT). It includes presentation, videos, case study, problem-based learning method, project-based learning methods and assignments. 3. Level 3 (OPTIONAL) is optional and includes additional resources in different languages as well as optional tasks and experiential activities that can be completed autonomously.
Method/s of assessment	Self-assessment quiz with 5-10 questions for each Unit Assignment (optional)
Method for evaluation of course	Peer review from partners Evaluation questionnaire by participants

VIDEO INTRODUCTION

https://www.youtube.com/watch?v=mTDZ2GRs_78

TRANSCRIPTION

Welcome to unit 3 of the Green Vineyards Course. This unit focuses on CLIMATE-ADAPTIVE WATER MANAGEMENT that covers several aspects of a very important subject: the water needs of the vineyards and how to use properly the water in the fields and winery.

In Level 1, you will learn about:

- general policy and regulation of the European Union, concerning both quality and quantity of water.
- key concepts in agroclimatology
- tools and technologies that can be used for mapping the needs and the availability of water
- the water needs of the vine throughout the growing cycle.

In Level 2, you will go deeper in analyzing techniques for water conservation, for the monitoring of water use, the risks and impacts of water pollution in the vineyards.

In Level 3 you will find the links to websites and publications available on line, so that you can read and see the most updated information about this issue: how to optimize the use of water in the vineyards.

LEVEL 1 – CORE LEARNING

SUSTAINABLE WATER CONSUMPTION AND CONSERVATION - TECHNIQUES FOR WATER CONSERVATION

Rainwater harvesting

Rainwater harvesting (RWH) is defined as the management, control, and use of rainwater in situ or its storage for future use. RWH comprises all of the methods by which rainwater and run-off are managed effectively for different uses. RWH implies harvesting, storing, and conserving rainwater (or the run-off derived from a catchment area of a reservoir) directly, in a farmed area that is generally smaller than the size of the catchment area. The most widespread use is that of supplementary irrigation, complementing rainfall during periods of water scarcity or stress during the growth stages of plants. The principal objective of RWH as supplementary irrigation is to collect run-off from outlying areas or from areas where it is not used, store it, and make it available where and when there is a scarcity of water.

Irrigation management

Proper irrigation techniques can help optimize grape growth, control vine stress and manage water resources efficiently.

Water source quality: ensure a reliable and clean water source to prevent issues with water quality affecting health and wine quality.

Soil moisture monitoring: use soil moisture sensor to determine when and how much to irrigate.

Vine growth stage: adjust irrigation based on the grapevine's growth stage (e.g. budbreak, flowering, veraison) to find out the specific water requirements.

Drip irrigation: drip irrigation system is commonly used in vineyard for precise water delivery to the root zone.

Canopy management: prune and training grapevines to optimize canopy structure, which can affect leaf area development and consequently water use efficiency.

Irrigation scheduling: develop an irrigation schedule based on weather forecasts, soil moisture, and vineyard-specific factors.

Regulatory considerations: be aware of local water regulations and guidelines for sustainable water use in agriculture.

Research and Technology: stay updated on the latest research and technologies relates to vineyard irrigation management.

The irrigation management may vary depending on the grape variety, region, climate and oenological goals. It is essential for viticulturist to adapt their irrigation management strategies accordingly while considering sustainable practices and environmental impacts.

Monitoring and managing water use

The scarcity of the water resource usable by plants in summer is often linked to the increased evapotranspiration caused by rising air temperatures and the poor water retention capacity of soils, often caused by chronic organic matter deficiency. In this context, the hillsides, especially those facing south, south-east and south-west, benefit from high thermal and radiative availabilities and therefore show significant increases in effective evapotranspiration, with a negative impact on yields and grape composition. In black grape varieties, summer stresses, if short-lived, can exert positive effects on grape composition with interesting increases in anthocyanins and tannins. Vice versa, if they are long lasting, they produce intense and lasting losses of photosynthesis in the canopy, followed by yield reductions, degradations of the grape composition and poor replenishment of nutritional reserves (Figure 1).

Figure 1. Water stress damage on Marselan bunches. Foto di A. Palliotti

With a view to optimize available water, two irrigation techniques are attracting great interest:

1) **The controlled water deficit (CWD)** provides for irrigation to be carried out with water supplies reduced in relation to specific needs, especially at certain phenological stages, so as not to alter the yields and composition of the grapes, but with considerable water savings. The aim of the CWD is to synchronize irrigation according to the plant's needs at times when stress threatens.
2) **Deep root irrigation (DRI)** is a new irrigation system that has recently been patented in the USA and is currently undergoing validation. It is based on the use of emitters consisting of a porous plastic bulb of variable length (for vines, the optimum length is 30 cm), which is inserted into the soil close to the root system. This means that a much larger volume is reached than with standard drippers (Figure 2). The advantages of this new device seem to be:
    a. Greater homogeneity and depth of soil wetting;
    b. Rliminate evaporative losses;
    c. Delivering water directly to root system;
    d. Reduced competition for water from weeds;

e. Easy to check and monitor;
f. Water savings of over 40% compared to traditional drippers.

a

b

Figure 2. DRI inserted into the soil (a) and DRI out of soil (b).

In addition, the construction of artificial rainwater collection and storage reservoirs near vineyards in hilly areas is functional for emergency irrigation during the summer.

PRESERVATION IN WATER QUALITY AND SOIL INTEGRITY

Risks and impacts of water pollution in vineyards

Agriculture is the largest source of pesticides and nitrate pollution in fresh European waters. This pollution is mainly caused by the use of fertilizers, pesticides and other agricultural practices that can lead to run-off of these chemicals into rivers, lakes and groundwater. Nitrate pollution in particular can be harmful, as it can contaminate drinking water sources and pose health risks to humans and aquatic ecosystems.

Water pollution in vineyards can have a significant negative impact on both environment and quality of grapes and wine production and some of the main risks and impacts are:

1. **Soil contamination**: water pollution can lead to contamination of vineyard soils. It occurs when pesticides, herbicides and fertilizers used in vineyard management enter the soil through run-off or leaching.
2. **Contamination of surface water**: run-off from vineyards, especially after heavy rainfall, can carry pollutants such as pesticides and sediment into nearby streams, rivers or lakes.
3. **Contamination of groundwater**: chemicals used in vineyards can leach into groundwater, potentially contaminating groundwater sources. Nitrate contamination in particular is a common problem in regions where intensive vineyard farming is practiced.

4. **Impact on biodiversity and wildlife**: water pollution can have a negative impact on local biodiversity and wildlife. Pesticides and other pollutants can be toxic to aquatic organisms and terrestrial fauna, with adverse effects on the overall health and balance of ecosystems.
5. **Vine health and wine quality**: water pollution can have a direct impact on vines. The use of contaminated water for irrigation can introduce harmful contaminants into the vines, such as heavy metals, pesticides or excess salts, potentially stunting their growth and compromising the quality of the grapes produced. Moreover, it could cause a residue accumulation such as pesticides, in grape skin. These residues may persist and be present in the final wine.

In summary, water pollution can have direct and indirect effects on vine health and wine quality. Ensuring the use of clean, uncontaminated water sources for vineyard irrigation is essential to maintain the quality and integrity of wine production. In addition, careful monitoring and management of vineyard practices in accordance with environmental guidelines can help reduce the risks associated with water pollution in vineyards.

Soil management practices for preserving water quality

Preserving water quality in viticulture through effective soil management is a critical aspect of sustainable grape production.

Here are some soil management practices supported by references for preserving water quality in viticulture.

- **Cover Cropping**: planting cover crops can reduce erosion and nutrient runoff. Cover crops can also improve soil structure and organic matter content.
- **Mulching**: applying organic mulch around grapevines helps retain soil moisture, reduce weed competition, and mitigate erosion.
- **Reduced Tillage**: reduced tillage or no-till practices can preserve soil structure and reduce erosion.
- **Proper irrigation management**: efficient irrigation practices can reduce water wastage and minimize runoff.
- **Implementing buffer zones**: buffer zones of native vegetation or cover crops can filter out contaminants from runoff.
- **Slope stabilization**: implementing erosion control measures on slopes can prevent soil erosion and sediment runoff.
- **Compost and organic matter addition**: increasing in use of compost and organic matter can improve soil structure, water-holding capacity, and nutrient retention.
- **Regular monitoring and record-keeping**: maintaining records and monitoring water quality ensures that practices are effectively preserving water quality.

These practices, supported by scientific research and publications, can help viticulturists to protect water quality, reduce environmental impacts and promote sustainable grape production.

BASIC RESOURCES

Website

- Hayes P., Graça A., De la Fuente M., Bois B., Andrag A., Savage C., Corbett-Milward J., Koundouras S., *Sustainable use of water in winegrape vineyards*. International Organisation of Vine and Wine. Retrieved May, 2021 from https://www.oiv.int/public/medias/7949/2021-oiv-collective-expertise-document-sustainable-use-of-wa.pdf;
- *Precision agriculture & sons: what is precision viticulture*, Wine 2 Wine Business Forum, Retrieved 27 September, 2019 from https://wine2wine.net/agricoltura-di-precisione-sons-cose-la-viticultura-di-precisione/?lang=en;
- Finco A., Bentivoglio D., Chiaraluce G., Alberi M., Chiarelli E., Maino A., Mantovani F., Montuschi M., Raptis K. G. C., Semenza F., Strati V., Vurro F., Marchetti E., Bettelli M., Janni M., Anceschi E., Sportolaro C., Bucci G., *Combining Precision Viticulture Technologies and Economic Indices to Sustainable Water Use Management*, MDPI, Retrieved 6 May, 2022 from https://www.fe.infn.it/radioactivity/materials/papers/finco2022.pdf.

Case Study

- Precision viticulture, The use of sensors to inform decisions on the use of water and fertiliser and to optimise timings in the growing and harvesting of grapes**,** Preparatory Action on Smart Rural Areas in the 21st Century, Date of project 01/2018-12/2020, from https://www.smartrural21.eu/smart-solution/precision-viticulture/#.

LEVEL 2 LEARNING IN DEPTH

AGROCLIMATIC MAPPING OF WINE-GROWING TERROIRS

Key concept in agroclimatology

The agrometeorology is the study of the relationships between meteorological variables and the various components of the agroecosystem, it has assumed an increasingly important role in agricultural planning and management, thus also in viticulture (IPCC, 2021).

The viticulture sector is one of the most exposed and vulnerable and the previous agro-meteorological information (climate analyses), current (monitoring), short and long-term future (forecasts and agro-meteorological scenarios) constitute a valid aid in the development of sustainable and resilient agro-systems to climate change.

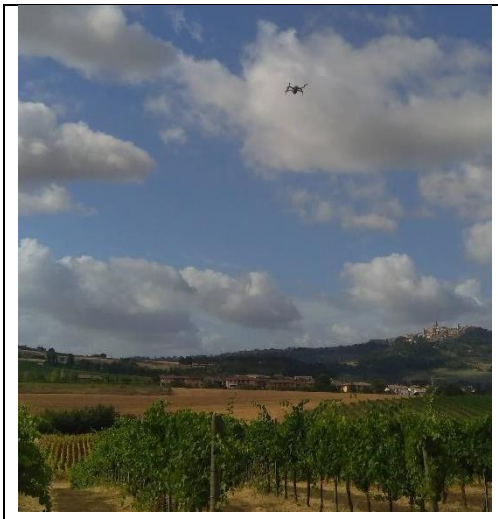
In fact, agro-meteo-climatic analyses, in addition to orienting crop choices and planning agricultural interventions, can also support the agricultural sector in responding to specific agricultural and environmental policy guidelines. These are guidelines that aim at a sustainable use of the tools of production, reducing the negative impact on agro-ecosystems, through the development of innovative technical assistance services (including agro-meteorological services), generating benefits:

TOOLS AND TECHNOLOGIES FOR MAPPING

Tools and techniques to monitor and map the environment are now very well developed and widely used in practice. Precision Viticulture (PV) is now a very well-developed approach to vineyard monitoring, mapping and management, and one that has been successfully demonstrated through many studies and practical applications leading to greatly improved efficiency and effectiveness in the day-to-day operation of the vineyard and, ultimately, improved fruit quantity, quality and wine production.

PV techniques are used to improve the efficient use of inputs (e.g., fertilizers and chemicals), yield forecasting, selective harvesting of grape quality, and agree with the real needs (e.g., nutrients and water) of each plot within the vineyard. Remote and proximal sensors become reliable instruments to disentangle vineyard overall status, and give recommendations to improve management efficiency.

Remote sensing techniques rapidly provide a description of grapevine shape, size, and vigor and allow assessment of the variability within the vineyard. This is image acquisition at a distance with different scales of resolution, able to describe the vineyard by detecting and recording sunlight reflected from the surface of objects on the ground. The three platforms mainly used in remote sensing are satellites, aircraft, and unmanned aerial vehicles (UAVs) (Figures 3 and 4).



a

b

Figure 3. UAV platform, commonly known as a drone, equipped with a multisentor system during the acquisition of thermal and multispectral data (a) photo by CESAR

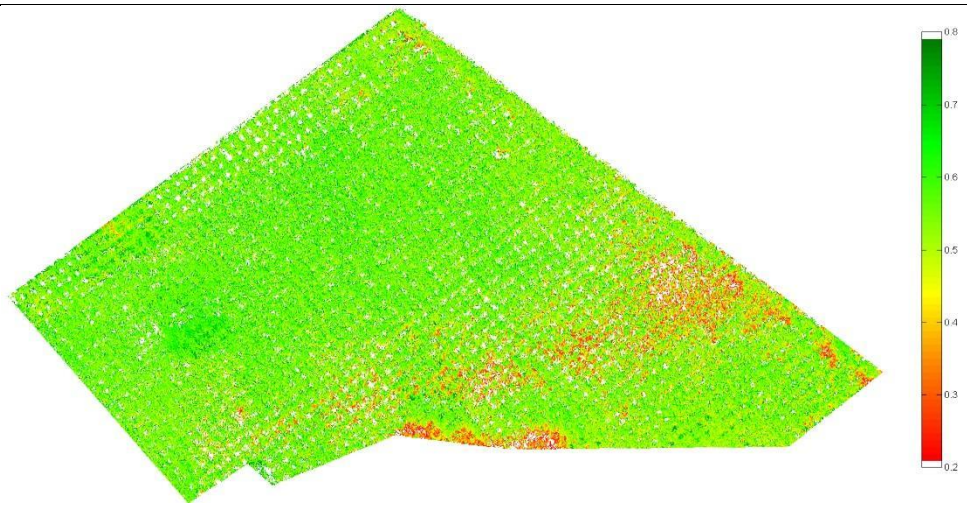


Figure 4. Multispectral image for the development of descriptive thematic maps of vigor.

Proximal sensing applications provide many tools available for continuous measurements related to soil, crop, yield and quality carried by moving vehicles, or instruments for precise ground observations made by an operator.

Many systems and tools have been developed for soil monitoring (e.g. mobile platform equipped with soil electromagnetic sensors and GPS for continuous measures), crop monitoring (high-resolution screening of the canopy side across the row coupled with a GPS system for data georeferencing) and yield and quality monitoring (e. g. varieties of systems based on direct and/or

nondestructive measurement of parameters related to grape quality and optical sensor with georeferenced noncontact measurements both on target leaves and grapes) (Figure 5).


a


b

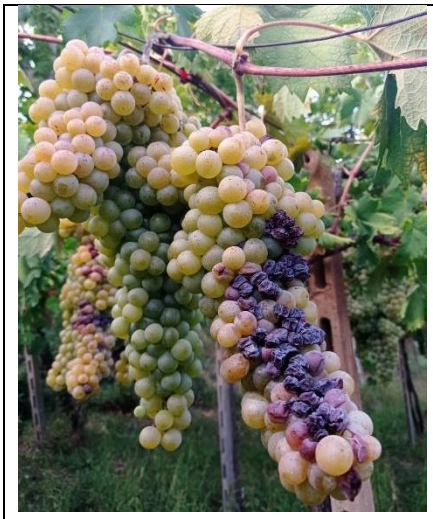
Figure 5. (a) & (b) An electric traction, self-driving prototype designed to move inside of vineyards through satellite systems advanced (GPS, RTK and IMU technology). It is equipped with a multispectral camera to capture the spectral signature for characterizing the vineyard health. The collected data is used to obtain vigor maps calculated using the NDVI index.

Foto by CESAR

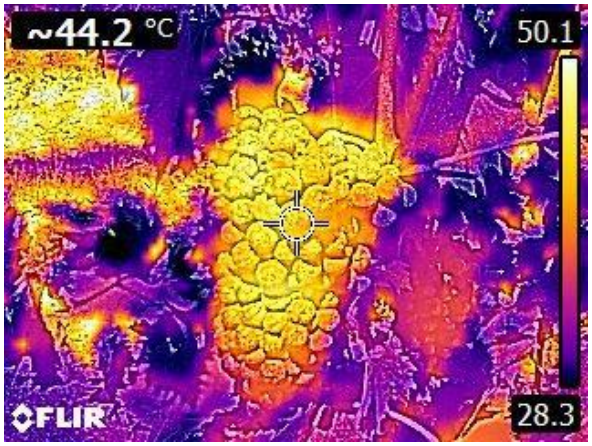
Impact of climate variations on winegrowing

Expected climatic changes, such as the increase in the frequency of extreme meteorological and hydrological phenomena, will alter the usual conditions of vine growing and the trend of an increasing temperature observed during the last decades is expected to continue in the coming decades. Viticultural climatic indices were assessed for the evaluation of the meteorological variations in the requirements of grapevine cultivars for wine production. Climate change would significantly affect the viability of vine cultivation, varying the production and quality of the wine with different incidence depending on the region. Future climate scenarios predict that Northern European regions will become areas suitable for viticulture, while Southern regions would be too hot. Several studies have identified air temperature as a key factor in the composition, colour and aroma acquisition of berries and the anthocyanin-sugar balance in all varieties. High temperatures can cause problems in colour and tannin structure. On the other hand, excessive cold temperatures can inhibit the formation of sugar and anthocyanins due to a delayed development of the berries, which reduces the quality of the wine. These evidences imply significant impacts on the flavor and composition of the grapes, which results in unbalanced wines. Finally, air temperature higher than

42-43 °C can produce sun-burn damage and make these clusters not suitable for winemaking (Figure 6).



a



b

Figure 6. (a) Montonico dehydrated and dried bunches affected by sunburn damage.

Photo by CESAR

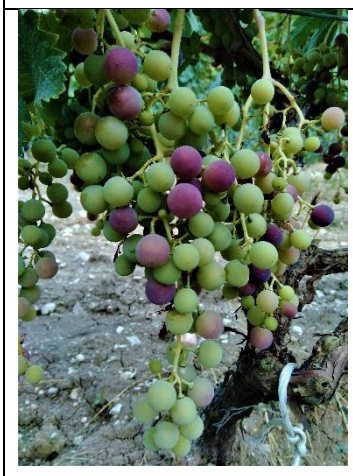
(b) Bunch image from thermal imaging camera.

Photo by CESAR

Water needs of the vine throughout the winegrowing cycle

Generally, grapevines require different amounts of water at different stages of their growth cycle. Here is an overview of the water needs throughout the winegrowing cycle (Figure 7):

1. **Dormant season DS** (Winter): during the DS, grapevines require minimal water. This is the period when the vines are not actively growing and are typically pruned.
2. **Bud break to bloom** (Spring): as the vines awaken from dormancy and start to grow new shoots and leaves, they require more water.
3. **Fruit set to veraison** (Summer): this is a critical period for water management. Grapevines need consistent and sufficient moisture to support the growth of the grape berries.
4. **Veraison to harvest** (Late Summer to Fall): during ripening, grapevines require less water compared to earlier growth stages. In fact, some level of water stress can be beneficial for enhancing fruit quality by concentrating phenols and flavors in the grapes. However, excessive water stress can lead to shriveled berries and imbalanced ripening.
5. **Post-harvest to leaf fall** (Late Fall): after harvest, grapevines begin to prepare for dormancy again. Water requirements decrease as the vines senesce and lose their leaves.

	a. Dormant season
	b. Bud break to bloom
	c. Fruit set to veraison
	d. Veraison to harvest

e. Post-harvest to leaf fall

Figure 7. Different stages of the vine growth cycle.

References

- DIRECTIVE 2008/105/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council: https://eur-lex.europa.eu/eli/dir/2008/105/2013-09-13;
- Palliotti, A., Giordano, L., & Di Lena, B. (2022). Tutelate l'efficienza del vigneto in estate con il deficit idrico controllato. VVQ, Vigne Vini & Qualità, 3 : 2630.

COMPLEMENTARY RESOURCES

Website

- Hayes P., Graça A., De la Fuente M., Bois B., Andrag A., Savage C., Corbett-Milward J., Koundouras S., *Sustainable use of water in winegrape vineyards*. International Organisation of Vine and Wine. Retrieved May, 2021 from https://www.oiv.int/public/medias/7949/2021-oiv-collective-expertise-document-sustainable-use-of-wa.pdf;
- https://www.sciencedirect.com/topics/earth-and-planetary-sciences/potable-water

Case Study

- Precision viticulture, The use of sensors to inform decisions on the use of water and fertiliser and to optimise timings in the growing and harvesting of grapes**,** Preparatory Action on Smart Rural Areas in the 21st Century, Date of project 01/2018-12/2020, from https://www.smartrural21.eu/smart-solution/precision-viticulture/#.

LEVEL 3 – ADDITIONAL RESOURCES

EU REGULATORY FRAMEWORK

Wine Production in the Common Agricultural Policy (CAP)

The Common Agricultural Policy (CAP), also referred to as Regulation (EU) 2021/2115, has long been regarded as the cornerstone of European integration. Its gradual expansion of original objectives has led to a comprehensive legislative framework. Within this context, wine policy has undergone significant reform, reflecting the unique nature of wine production, where the value of grapes is closely tied to processing opportunities. So, since the beginning of the CAP, everything related to the wine sector (viticulture rules, wine production, types of wine, labelling and market instruments) has followed its own track, which, however, always had a close link to the reference regulations of the CAP. Consequently, wine policy immediately differed from other sectors, becoming a distinctive feature within the CAP framework.

Environmental focus in the reform post-2020

The new CAP includes several measures to support sustainable wine production and reduce the environmental impact of the sector. For example, the new eco-schemes will provide financial support to farmers who adopt environmentally friendly practices, such as reducing pesticide use, promoting biodiversity, and improving soil health. Additionally, the new CAP includes measures to support organic farming and agroforestry, providing a range of tools and incentives for wine actors to reduce their environmental impact and contribute to the EU's climate and environmental goals.

EU WATER FRAMEWORK DIRECTIVE (WFD) AND ITS RELEVANCE TO WINE PRODUCTION

Introduction to the EU Water Framework Directive (WFD)

The EU Water Framework Directive (WFD), officially known as Directive 2000/60/EC, is a vital piece of legislation that aims to protect water resources and ensure good ecological status to water basins and promote sustainable water use. The WFD also aims to reduce pollution from various sources, including agriculture, industry, and urban areas, and to ensure that there is enough water to support human needs as well as wildlife.

The WFD is supported by two directives that focus on the quality and quantity of groundwater and surface water. They provide additional guidance and requirements for achieving the objectives of the WFD.

Linking WFD with wine production in CAP

Wine production, as part of the agricultural sector, plays a significant role in water management. The Common Agricultural Policy (CAP) and the WFD intersect in several key areas. Both CAP and WFD emphasise the sustainable use of water resources, and wine production must adhere to regulations that promote water conservation and prevent pollution. Furthermore, the WFD promotes an integrated approach to water management, considering the entire water cycle. This approach is mirrored in CAP's wine policy, which encompasses the entire supply chain from grape cultivation to commercialisation.

ADDITIONAL RESOURCES

Website

- DIRECTIVE 2008/105/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council: https://eur-lex.europa.eu/eli/dir/2008/105/2013-09-13;
- *The 2020 resolution on the implementation of the EU water legislation*, FAO: https://www.fao.org/faolex/results/details/en/c/LEX-FAOC201243/;
- *Drought Resilience Improvement in Vineyard Ecosystems*: https://www.drive-life.it/en/;
- *Smart vineyard: management and decision making support for wine producers*, European Commission: https://ati.ec.europa.eu/sites/default/files/2020-06/Smart%20vineyard-%20management%20and%20decision-making%20support%20for%20wine%20producers%20%28v1%29.pdf;

Video

- *Using water sustainably through science*: https://www.youtube.com/watch?v=q1eGnf-XUOw;

SELF-ASSESSMENT

1. What are the “eco-schemes”?
   a) Types of financial support for producers who apply some environmentally friendly practices.
   b) Rules established to control the ecological impact of new plantations.
   c) Technical guidelines for the modernization of farm buildings
   d) Financial support for increase agricultural production

2. Which one of the following statements is correct?
   a) Organic agriculture will receive financial support in the next years
   b) Organic agriculture will not receive any financial support, that is addressed to post-gate processing firms
   c) Only the organic grape and wine production will receive financial support
   d) Only the not-organic grape and wine production will receive financial support

3. In which year was established the Water Directive?
   a) 2000
   b) 2010
   c) 2020
   d) 2002

4. Which one of the following statements is correct?
   a) The water needs of grapes are the same for all varieties
   b) Future climate scenarios predict that Northern European regions will become areas suitable for viticulture
   c) The water needs depend on the colour of the soli
   d) The water needs depend on the colour of the skin

5. Which one of the following statements is correct?
   a) The climate change is not affecting grapes
   b) The climate change affecting only the red grapes
   c) The climate change is affecting all varieties
   d) The climate change is affecting only some grape’s variety

UNIT 4 - SOIL MANAGEMENT IN VINEYARDS

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module</td><td colspan="3">Environmental management focused on climate change: Water, soil, biodiversity</td></tr>
<tr><td>Type</td><td colspan="3">Asynchronous online training</td></tr>
<tr><td>Workload for learner</td><td colspan="3">7 hours (estimated workload for completion of level 2)</td></tr>
<tr><td>Trainer</td><td colspan="3">Prof. Fabio Santucci, Ms Laura Rondoni, Ms Alessandra Antognelli, Ms Carine Herbin</td></tr>
<tr><td>Institution</td><td colspan="3">CESAR, IFV</td></tr>
<tr><td>Content/short description; duration</td><td colspan="3">Short description:

This module is designed to directly address the needs of wine workers and professionals in the wine industry, focusing on practical skills and applications to ensure the resilience and success of wineries amid today's environmental challenges. Learners will engage with real-life case studies from the wine industry, gaining insights into the European regulatory framework, innovative water conservation techniques, soil preservation strategies, and the importance of biodiversity in agroecology. Built around practical scenarios, the module offers a comprehensive learning experience that combines theory and application. Through it, learners will gain an in-depth understanding of water and soil management, agroclimatic mapping, hazard prevention, and biodiversity. Amid fluctuating environmental conditions, labour shortages, advances in technology, and the need for compliance with sustainability standards, wineries are called upon to navigate complex issues. This module empowers learners with the tools to face these challenges while preserving the uniqueness of their terroir, style, and variety. The applied knowledge and competencies acquired during the course will support them in making informed decisions that ensure the continued success of their establishments despite environmental, social, and economic challenges.</td></tr>
<tr><td></td><td>Unit</td><td>Content</td><td>Duration</td></tr>
<tr><td></td><td rowspan="5">Climate-adaptive water management</td><td>EU Regulatory framework</td><td rowspan="5">2.5 h</td></tr>
<tr><td></td><td>Agroclimatic mapping of wine-growing terroirs</td></tr>
<tr><td></td><td>Water needs in wine growing</td></tr>
<tr><td></td><td>Sustainable water consumption and conservation</td></tr>
<tr><td></td><td>Preservation of water quality and soil integrity</td></tr>
<tr><td></td><td></td><td>Soil characteristics and vine nutritional requirements</td><td>2.5 h</td></tr>
</table>

	Soil management in vineyards	Soil conservation	
		Soil climate adaptation	
		Enhancing carbon sequestration and terroir protection	
	Biodiversity and agroecology	Understanding biodiversity and EU Strategies	2.0 h
		Preservation of biodiversity	
		Promotion of biodiversity	
		Sustainable plant protection and biocontrol	
Learning Outcomes	By the end of this course, learners will be able to: ● Comprehend key EU strategies and techniques for climate-adaptive soil management, including soil fertility control, compaction prevention, erosion mitigation, contamination reduction, salinisation risk management, terroir protection, and CO2 sequestration enhancement. ● Understand the different impacts of sustainable water management practices in the context of winegrowing, focusing on agroclimatic mapping, hazard prevention, insurance, water consumption reduction, soil sealing limitation, and water quality preservation. ● Examine the role of biodiversity in sustainable vineyard management, including the adoption of plant materials suited for agroecological challenges, reduction of chemical use, and implementation of biocontrol methods. ● Compare case studies and real-world examples to develop comprehensive plans for soil, water, and biodiversity management in vineyards, considering both short-term and long-term sustainability goals. ● Reflect on personal values and their alignment with sustainability values in the wine sector, employing critical thinking skills to challenge conventional practices and propose innovative, environmentally conscious solutions.		
Learning materials	● Lectures (PPT) ● Case studies ● Videos ● Further readings		
Language/s of learning materials	· English (all materials of level 1 and 2 + some other materials of level 3) · Spanish, French, Italian, German, and Macedonian (all materials of level 1 + some other materials of level 3)		

Method/s for teaching and learnings	Each Unit consists of three online parts: 1. Level 1 (CORE): is the core learning, available in all languages (En + partner country languages). It includes introductory texts, videos. All learners will watch/read/study all the provided resources. It has to be completed in order to have access to the self-assessment quiz 2. Level 2 (RELEVANT). It includes presentation, videos, case study, problem-based learning method, project-based learning methods and assignments. 3. Level 3 (OPTIONAL) is optional and includes additional resources in different languages as well as optional tasks and experiential activities that can be completed autonomously.
Method/s of assessment	Self-assessment quiz with 5-10 questions for each Unit Assignment (optional)
Method for evaluation of course	Peer review from partners Evaluation questionnaire by participants

VIDEO INTRODUCTION

https://youtu.be/LZUeeESN5NU

TRANSCRIPTION

Welcome to unit 4 of the Green Vineyards Course. The characteristics of the different soils impact on vine development and grape ripening, through soil temperature, water and mineral supply. It is important to know how to optimize the relationship between soils and vines.

In level 1, you will learn about:

- Soil characteristics and vine nutritional requirements
- Types of soils in winegrowing regions and nutrient uptake by vines, talking about different strategies of fertilization
- Techniques for soil conservation.

In level 2, you will analyze the challenges presented by climate change, and what to do for structural adaptation, like for example the selection of new rootstock and varieties, and the design of new vineyards. Also, you will learn about the role of vineyards for the mitigation of climate change thanks to carbon sequestration.

Level 3 provides the links to websites and publications, so you can read and see the most updated information about this issue.

LEVEL 1 – CORE LEARNING

SOIL CLIMATE ADAPTATION

Enhancing carbon sequestration and terroir protection

Vineyards, typically associated with the art of winemaking, hold a remarkable yet often overlooked secret: they play a significant role in carbon sequestration. Carbon sequestration refers to the process of capturing and storing carbon dioxide (CO_2) from the atmosphere.

How a vineyard, a place known for growing grapes and producing wine, can help fight climate change?

Role of vineyards in carbon sequestration

The permanent biomass of grapevines typically represents a smaller carbon stock compared to other woody crops like olive groves and citrus orchards. Nevertheless, grapevines still contribute significantly to carbon storage.

Following winter pruning, the annual debris, such as pruned canes and leaves, are typically left on the vineyard ground, where they can accumulate as litter. Over time, this litter can contribute to an increase in soil organic carbon. Notably, adopting conservative vineyard management practices, such as retaining pruning residues, implementing no-tillage, and incorporating inter-row cover crops, has been shown to enhance the carbon sequestration capacity of vineyards.

To maximize carbon storage in vineyards and woody crops in general, cultivation of inter-row soil should be limited. Besides carbon sequestration, cover crops offer various ecosystem services in vineyards, including soil protection, biodiversity support, improved water infiltration, weed control, and regulation of pests and diseases. Concerns about water and nitrogen competition between cover crops and grapevines in Mediterranean regions are often raised. However, research indicates that nitrogen accumulation in grapevines can be reduced, limiting excessive vegetative growth. Water competition between grapevines and cover crops is generally low due to differences in root system morphology, with grapevine roots exploring deeper soil layers. This minimizes competition for water stored in inaccessible deep layers and allows for coexistence without significant competition. Additionally, the limited root system of cover crops can lead to rapid drying during summer droughts, eliminating competition with grapevines.

TECHNIQUES FOR ENHANCING CARBON STORAGE IN VINEYARD SOILS

Cover Cropping

Cover cropping is one effective technique for enhancing carbon storage involves planting other crops, like clover or legumes, between vineyards rows. These cover crops help improve soil health by

adding organic matter, nutrients and water availability. As these plants grow, they are able to capture CO_2 from the atmosphere and contribute to carbon sequestration.

Moreover, modified mulchers can fling the mulch material into the vine rows, where it can reduce evaporation and the risk of erosion, as well as helping to nourish soil life.

Compost Application

Composting is another valuable practice in enhancing carbon storage. By incorporating compost, organic material like food scraps and plant waste, into the soil, vineyard owners enrich it with nutrients and carbon. This not only improves the overall health of the grapevines but also significantly increases carbon storage capacity.

Understanding Terroir

Terroir is a French term encapsulating the unique combination of soil, climate, geography, and local traditions in a particular region, imparts distinctive qualities to wines. These characteristics are highly prized by winemakers and wine enthusiasts alike. Simultaneously, there is a growing imperative to sequester carbon to mitigate climate change. Balancing the preservation of terroir with carbon sequestration efforts presents a nuanced challenge and an exciting opportunity for vineyards.

The use of sustainable soil management practices is becoming common in wine growing regions around the world in response to an increased awareness of the value of soil health to maintain environmental quality, crop yield and grape quality.

Terroir is the soul of a wine and it defines its taste, aroma, and overall character. Every region boasts a distinct terroir, which reflects centuries of natural and cultural influences. For example, the limestone-rich soils of Burgundy, France, produce wines with different qualities than the volcanic soils of Mount Etna in Sicily, Italy.

Preserving terroir characteristics while engaging in carbon sequestration requires meticulous planning, thoughtful practices, and a profound understanding of the local ecosystem.

Here are some key considerations:

1. Careful Soil Management
2. Selective Cover Cropping
3. Precision Irrigation
4. Local Compost Usage
5. Biodiversity Conservation

Even the role of sustainable wine certifications, such as "organic" and "biodynamic," often incorporate practices that align with both carbon sequestration and terroir preservation. These certifications provide guidelines and frameworks that help vineyards navigate this intricate terrain (Figure 1).

a

b

Figure 1. (a) Preparation of manure horn for a soil biodynamic management; **(b)** example of selective cover cropping and biodiversity conservation.

A healthy soil is not merely characterized by specific properties; rather, these properties are intricately linked to the soil's ability to perform functions or provide ecosystem services that are beneficial to humanity.

We envision a healthy soil as one that (1) supports high crop yields and quality, (2) exhibits efficient water infiltration and water storage capabilities, (3) retains and efficiently recycles nutrients while supplying nutrients in alignment with crop requirements, (4) serves as a reservoir for carbon storage and contributes to the reduction of greenhouse gas emissions, and (5) fosters a thriving community of diverse microorganisms with high biological activity. Evaluating a soil's capacity to perform these critical soil functions can involve a range of soil health indicators encompassing chemical, physical, and biological aspects.

Nevertheless, it is worth noting that achieving a standardized approach for assessing soil health remains a challenging endeavor, as highlighted by previous research.

In the face of climate change, the preservation of terroir and the sequestration of carbon are not mutually exclusive goals. Vineyards have the potential to serve as models of harmonious coexistence between agricultural production and environmental stewardship. By employing sustainable practices, vineyards can enhance their role in carbon sequestration while continuing to produce wines that bear the unique signature of their terroir. In this way, they contribute not only to the preservation of tradition but also to the sustainable future of winemaking.

BASIC RESOURCES

Video

Water-holding capacity: HYDROGEL https://youtu.be/dP3vQjwlJaY

Documents

https://www.agvise.com/wp-content/uploads/2019/01/Caley-Gasch-Soil-Aggregate-Stability.pdf

LEVEL 2 – LEARNING IN DEPTH

SOIL CHARACTERISTICS AND VINE NUTRITIONAL REQUIREMENTS

Types of soils in winegrowing regions

Different soil types and their inherent characteristics can influence nutrient availability and affect grapevine growth and grape and wine quality.

Below are some the prominent soil types found in winegrowing regions (Figure 2).

Granitic Soils: found in regions like the Northern Rhône Valley in France and parts of Portugal's Douro Valley.

Limestone Soils: prevalent in Burgundy, Champagne, parts of Bordeaux (e.g., St-Émilion), and some regions in Italy (e.g., Chianti).

Clay Soils: clay soils can be found in various wine regions, including parts of Bordeaux (e.g., Pomerol) and Tuscany (e.g., Brunello di Montalcino).

Schist Soils: found in Portugal's Douro Valley and Spain's Priorat region.

Volcanic Soils: volcanic soils are common in regions like Sicily (e.g., Mount Etna), Santorini in Greece, and parts of Oregon (e.g., Willamette Valley).

Sandy Soils: sandy soils are found in regions like the Barossa Valley in Australia and parts of California (e.g., Santa Barbara County).

Alluvial Soils: common in regions near rivers and streams, such as Napa Valley in California and Bordeaux's Médoc region.

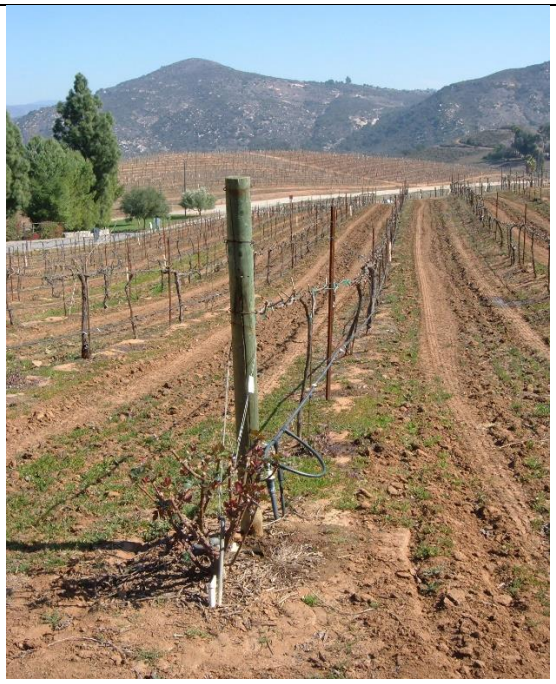
Slate Soils: predominant in Germany's Mosel and Rhine regions, as well as parts of Spain (e.g., Rías Baixas).

Loess Soils: found in regions like Austria's Wachau Valley and parts of Washington State.

Chalk Soils: chalky soils are prominent in Champagne, parts of the Loire Valley, and parts of England (e.g., Sussex).

These soil types contribute to the unique terroir of wine regions and influence grapevine growth, grape composition, and ultimately, the character of wines produced in those areas. Winemakers and viticulturists often consider soil type when selecting grape varieties and implementing vineyard management practices. One should avoid heavy clays, very shallow soils, poorly drained soils and those that contain high concentrations of salts of the alkali metals, boron, or other toxic substances.


a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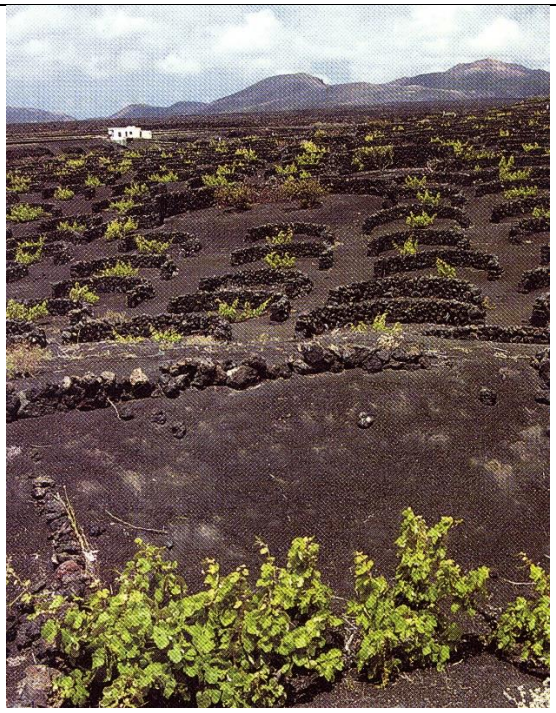
d

Figure 2. Some of the soil types found in winegrowing regions: (a) clay soil; (b) red soil; (c) alluvial soil; (d) volcanic soil (Photos by CESAR)

NUTRIENT MANAGEMENT

Vineyard managers monitor soil nutrient levels through soil testing and vine nutrient status through leaf tissue analysis to determine if nutrient deficiencies or excesses are present. Fertilization

practices are adjusted based on the specific nutrient requirements of grapevines at different growth stages to optimize vine health and grape quality.

Tailoring fertilization strategies to soil type and vine needs.

Tailoring fertilization strategies to soil type and vine needs is essential for optimizing grapevine health, grape quality, and sustainable vineyard management.

It is necessary to carry out a soil type assessment by conducting a thorough soil analysis to determine the nutrient content, pH, and other relevant soil characteristics.

Moreover, grapevines have different nutrient requirements during the year, with increased needs during active growth periods (spring and early summer) and it is essential to address the specific macronutrient (N, P, K) and micronutrient (Fe, Mn, Zn, Cu, B) requirements of grapevines. Different soils may have varying nutrient deficiencies or excesses; thus, it is necessary to develop customized fertilization plans based on each specific soil type and vineyard conditions.

Certainly, there are various products and materials that can enhance the soil water holding capacity (SWHC), also known as water retention capacity. These products work by increasing the available water content (AWC) in the soil.

By tailoring fertilization strategies to soil type and vine needs, vineyard managers can optimize nutrient use efficiency, minimize nutrient waste, and promote sustainable viticulture practices that benefit both the vines and the environment. Here are different terms or phrases that refer to similar concepts related to improving soil water retention:

WATER RETENTION CAPACITY	The ability of soil to retain water and make it available to plants. It is often expressed in terms of available water content (AWC).
ORGANIC CARBON	The carbon stored in organic matter in the soil. Increasing organic carbon content can improve soil structure and water retention
MOISTURE ABSORPTION	The ability of soil or other materials to absorb moisture, contributing to higher water content and retention
HYDRATION CAPACITY	The capability of soil or additives to hold water molecules, enhancing overall water retention.
SOIL HUMUS	Organic matter in the soil that consists of decayed plant or animal material. Enhancing soil humus content can improve water retention capacity
BIOCHAR	Charcoal-like material created by heating organic matter in a low-oxygen environment. It can increase water retention and improve soil structure
POROUS MATERIALS	Materials with empty spaces or pores, such as zeolites. It can absorb and retain water in the soil
HUMIC DERIVATIVES	Compounds derived from humus. It can enhance soil structure and water retention
SUPERABSORBENT POLYMERS	Polymers that can absorb and retain large amounts of water. When added to soil, they increase its water-holding capacity
AMENDED SOILS	Soils that have been improved or modified by adding substances like organic matter, biochar, or polymers. It enhances water retention
PARTICLE SIZE FRACTION	Refers to the distribution of particle sizes in the soil. Amending soils can modify particle size fractions, leading to better water retention.

Tab. 1-Terms and phrases related to improving soil water retention

Case study

In Italy, the Orsogna winery is an example of how to take action to keep the soil alive and fertile. The winery adopts the following practices:

- **Mature manure heaps**: The biodynamic heap (manure covered with straw) is prepared, and biodynamic compounds are placed inside it. Biodynamic compounds promote the maturation of

the heap's organic matter. So, in about six months it is transformed into a matrix with a colloidal consistency and a pleasant scent like undergrowth loam.

- **Green manure:** in autumn, a seeds mixture of native herbaceous plants (legumes, grasses, and cruciferous plants) is sown in the vineyard. They grow naturally until they reach their maximum development, then are buried in the ground, leaving some for biodiversity.
  Green manure is important for the agroecosystem because:
  - it forms stable humus that improves soil fertility;
  - it is food for soil bacteria that make nutrients available to plants;
  - it improves the physical structure of the soil and reduces runoff and erosion;
  - it is an ideal habitat for beneficial insects, especially pollinators;
  - it is food for sheep during grazing in the winter and spring periods.
- **Grazing:** in winter, about 2,000 sheep come from Maiella Mountains into the grass cover or cover crops vineyards. Sheep improve soil structure (reducing the use of operating machinery) and transforms plant biomass (grass) into organic manure.
- **Burying of pruning shoots, vines and vine shoots**: it helps and supports the soil without adding external elements.

LEVEL 3 – ADDITIONAL RESOURCES

SOIL CLIMATE ADAPTATION

Adapting vineyard management to climate change

Climate change is set to impose warmer and drier conditions upon vineyards, which have a profound impact on the quality and quantity of wine produced.

In wine regions, growers have historically fine-tuned their approaches to optimize both yield and wine quality, taking local climate patterns into account. However, in light of climate change, these practices must evolve.

To enhance vineyard resilience against drought, several measures can be taken:

- Drought-resistant plant material: selecting grapevine varieties that are more tolerant of water scarcity.
- Vineyard training systems: adopting training systems like goblet bush vines or wider row spacing for trellised vineyards to reduce water stress.
- Soil selection: opting for soils with greater water-holding capacity to help retain moisture during dry periods.

In summary, adapting to the changing climate in vineyards aims to improve resistance against erosion, increase of water retention and water holding capacity, reduce evaporation. This involves a combination of adjusting plant materials and viticultural techniques to maintain optimal harvest times, selecting drought-resistant plants, modifying training systems, and possibly considering irrigation while being mindful of environmental implications. …

Monitoring and adapting to changing soil conditions

A significant portion of vineyards is situated in regions characterized by seasonal drought, such as Mediterranean climates, where both soil and atmospheric water deficits, coupled with high air temperatures. Deficit irrigation has emerged as a viable strategy to enable crops to endure mild water stress, resulting in minimal or no yield reduction while potentially enhancing the quality of berries.

This process involves several crucial stages, including the regular conduct of soil tests to evaluate factors like nutrient levels, pH, organic matter content, and soil texture. The data obtained from these tests serves as the basis for making well-informed choices regarding nutrient management and the application of soil amendments.

The vineyard mapping allows to create detailed maps of the vineyard, including soil types, topography, and drainage patterns. This information helps in planning and adapting viticultural practices based on specific soil conditions.

Through the use of remote sensing technologies, such as drones and satellite imagery, to monitor vine health and soil moisture levels it is possible to provide real-time data for precision agriculture.

Vigilance in monitoring soil-borne diseases and pests that have the potential to impact the health of grapevines allows for effective disease and pest surveillance. Implement integrated pest management strategies to address these issues.

Water management involves the vigilant monitoring of soil moisture levels to fine-tune irrigation practices. This entails adapting irrigation schedules in response to soil conditions and weather forecasts to avoid both excessive and insufficient irrigation.

Protecting and promoting terroir characteristics while sequestering carbon

The growing recognition of soils as a finite and irreplaceable resource, coupled with their pivotal role in mitigating climate change, has triggered global initiatives to safeguard and enhance soil health. Current assessments suggest that a staggering 36 billion tons of soil are eroded each year, primarily due to the forces of water and wind. In addition to erosion, soils face a multitude of threats, including the depletion of soil organic matter (SOM), imbalances in soil nutrients, salinization, sodification, soil sealing, and land degradation, diminishment of soil biodiversity, contamination, acidification, compaction, and water saturation.

Soil conservation

Soil conservation and climate adaptation are closely linked strategies that aim to address the challenges posed by climate change, protect soil resources, and ensure sustainable land use practices.

Techniques for soil conservation

Vines exhibit resilience to drought conditions and flourish in nutrient-poor soils. Consequently, they are often grown in less fertile, marginal lands. Vines have the capacity to yield grapes for over a century, although productivity decreases after several decades, while the quality of wine may improve (Robinson, 2006). Due to their enduring lifespan, conventional methods that involve frequent soil tillage result in land deterioration due to the extensive stretches of exposed, barren soil over prolonged periods. Consequently, soil degradation has been frequently documented in regions dedicated to grape cultivation.

Soil conservation practices, such as contour farming, terracing, and the use of cover crops, help prevent soil erosion (Figure 3) caused by intense rainfall events and increased precipitation variability associated with climate change. Climate change can lead to altered precipitation patterns, including more frequent droughts and intense storms. Soil conservation practices, such as mulching,

reduced tillage, and the construction of rainwater harvesting systems, improve water retention and reduce runoff, helping to maintain soil moisture levels for crops during dry periods.

Healthy soils with high organic matter content are better at sequestering carbon. Practices that enhance soil health, like cover cropping, reduced tillage, and organic matter additions, contribute to carbon sequestration, which helps mitigate climate change by reducing atmospheric carbon dioxide levels.

As climate conditions change, farmers may need to adapt their crop choices. Soil conservation practices can support crop diversification and the selection of climate-resilient crop varieties to ensure food security in the face of shifting climate patterns.

Soil conservation methods play a vital role in mitigating nutrient runoff and improving the efficiency of nutrient utilization, guaranteeing the accessibility of crucial nutrients for crops. This becomes particularly significant in areas where the impact of climate change can disrupt nutrient cycling and the accessibility of these essential elements.

Agroforestry systems (Figure 4) and conservation agriculture practices, such as no-till farming and cover crops, aim increase organic matter concentration (to improve soil structure) and biodiversity.

So, other interesting strategies are for example the use of surface mulches, to minimize evaporation, that plays a significant role in the drying out of soil, especially un arid and semi-arid regions.

These practices enhance the soil's capacity to withstand climate-related stresses, including extreme temperatures and water scarcity.

Continuous monitoring of soil health, moisture levels, and nutrient content, combined with research on soil-climate interactions, provides valuable data for climate adaptation strategies. It helps farmers make informed decisions about soil management in changing conditions.

Soil conservation practices are critical for reducing soil degradation, including salinization, acidification, and desertification, which can be exacerbated by climate change impacts. Preserving soil quality ensures its long-term productivity.

Land use planning that incorporates soil conservation measures, such as maintaining buffer strips along water bodies, prevents soil erosion and protects water quality. This contributes to climate adaptation by reducing the vulnerability of ecosystems to climate-induced stressors.

Governments and agricultural organizations play a crucial role in promoting soil conservation and climate adaptation through policies, incentives, and educational programs that encourage sustainable land management practices.

In brief, soil conservation practices are essential for climate adaptation in agriculture. They help protect soil resources, enhance resilience to climate change impacts, and contribute to overall sustainability in the face of evolving environmental conditions. Adopting these practices is crucial for ensuring food security, conserving natural resources, and mitigating climate change.

Figure 3. Example of soil erosion.
Foto L. Giordano- CESAR

Figure 4. Agroforestry system with sheep and geese and vineyard
Foto A. Palliotti - CESAR

Nutrient uptake by vines

Vines, like all plants, require various nutrients for growth, development, and grape production.

MACRONUTRIENTS	ACTIVITY
Nitrogen (N)	vegetative growth, leaf production, and the formation of amino acids and proteins
Phosphorus (P)	energy transfer and root development
Potassium (K)	fruit development, disease resistance, and overall plant vigor
Calcium (Ca)	cell wall formation and stability
Magnesium (Mg)	component of chlorophyll and is critical for photosynthesis
Sulfur (S)	required for the synthesis of amino acids and proteins

Macronutrients differ in their mobility within the plant. Mobile nutrients, such as nitrogen and potassium, can move within the plant to support growth in new tissues. Immobile nutrients, like calcium and boron, remain in the tissues where they are initially absorbed.

MICRONUTRIENTS	ACTIVITY
Iron (Fe)	chlorophyll production and photosynthesis
Manganese (Mn)	photosynthesis and enzyme activation
Zinc (Zn)	enzyme function and auxin synthesis
Copper (Cu)	electron transport in photosynthesis and respiration
Boron (B)	cell elongation and pollen tube growth
Molybdenum (Mo)	cofactor for nitrate reductase, essential for nitrogen metabolism

With the fruit harvesting nutrients taken up by the plant don't return to the soil.

ADDITIONAL RESOURCES

Website

- European Soil Data Center https://esdac.jrc.ec.europa.eu/resource-type/datasets

Video

- Agricoltura e cambiamento climatico: https://www.youtube.com/watch?v=CCSeWrvTlms
- Il futuro della viticoltura riparte dal suolo: https://www.youtube.com/watch?v=HjuNL3IZpxk

Scientific articles/publications

- Mutiu Abolanle Busari, Surinder Singh Kukalb, Amanpreet Kaur, Rajan Bhatt, Ashura Ally Dulazi (2015), *Conservation tilllage impacts on soil,crop and the environment,* International Soil and Water Conservation Research, (https://www.sciencedirect.com/journal/international-soil-and-water-conservation-research)
- Eleonora Cataldo, Linda Salvi, Sofia Sbraci, Paolo Storchi and Giovan Battista Mattii (2020), *Sustainable Viticulture: Effects of Soil Management in Vitis vinifera*, Agronomy (https://www.mdpi.com/journal/agronomy)
- Caley Gash, Soil Aggregate Stability: Tillage, Rotations, and Cover Crop Effects, Power point presentation

SELF-ASSESSMENT

(Introduce 5-10 questions) (Only one answer is correct)

1. Which type of soils should be avoided when planting a new vineyard?
   a) Poorly drained soils
   b) Well drained soils
   c) Rocky and clay soils
   d) All soil types

2. In which part of Europe can Schist soils be found?
   a) Some regions of Portugal and Spain
   b) Southern Italy and Greece
   c) Southern France and Croatia
   d) Southern Germany, where they are called “Schiefer“

3. To which category does the Zinc belong?
   a) Mesonutrients
   b) Micronutrients
   c) Macronutrents
   d) none of the above

4. For which function is Calcium (Ca) required by the vines?
   a) Resistance against diseases
   b) Formation of the cell wall
   c) Improvement of photosynthesis
   d) Resistance against water shortage

5. For which purpose is the leaf analysis suggested in the vineyards?
   a) To determine the presence of viruses
   b) To quantify the presence of sugars
   c) To determine the status of nutrients
   d) To identify the presence of insects

UNIT 5 - BIODIVERSITY AND AGROECOLOGY

GREEN VINEYARDS PROJECT

2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module</td><td colspan="3">Environmental management focused on climate change: Water, soil, biodiversity</td></tr>
<tr><td>Type</td><td colspan="3">Asynchronous online training</td></tr>
<tr><td>Workload for learner</td><td colspan="3">7 hours (estimated workload for completion of level 2)</td></tr>
<tr><td>Trainer</td><td colspan="3">Prof. Fabio Santucci, Ms Laura Rondoni, Ms Alessandra Antognelli, Ms Carine Herbin</td></tr>
<tr><td>Institution</td><td colspan="3">CESAR, IFV</td></tr>
<tr><td>Content/short description; duration</td><td colspan="3">Short description:

This module is designed to directly address the needs of wine workers and professionals in the wine industry, focusing on practical skills and applications to ensure the resilience and success of wineries amid today's environmental challenges. Learners will engage with real-life case studies from the wine industry, gaining insights into the European regulatory framework, innovative water conservation techniques, soil preservation strategies, and the importance of biodiversity in agroecology. Built around practical scenarios, the module offers a comprehensive learning experience that combines theory and application. Through it, learners will gain an in-depth understanding of water and soil management, agroclimatic mapping, hazard prevention, and biodiversity. Amid fluctuating environmental conditions, labour shortages, advances in technology, and the need for compliance with sustainability standards, wineries are called upon to navigate complex issues. This module empowers learners with the tools to face these challenges while preserving the uniqueness of their terroir, style, and variety. The applied knowledge and competencies acquired during the course will support them in making informed decisions that ensure the continued success of their establishments despite environmental, social, and economic challenges.</td></tr>
<tr><td></td><td>Unit</td><td>Content</td><td>Duration</td></tr>
<tr><td></td><td rowspan="5">Climate-adaptive water management</td><td>EU Regulatory framework</td><td rowspan="5">2.5 h</td></tr>
<tr><td></td><td>Agroclimatic mapping of wine-growing terroirs</td></tr>
<tr><td></td><td>Water needs in wine growing</td></tr>
<tr><td></td><td>Sustainable water consumption and conservation</td></tr>
<tr><td></td><td>Preservation of water quality and soil integrity</td></tr>
<tr><td></td><td>Soil management in vineyards</td><td>Soil characteristics and vine nutritional requirements</td><td>2.5 h</td></tr>
</table>

		Soil conservation	
		Soil climate adaptation	
		Enhancing carbon sequestration and terroir protection	
	Biodiversity and agroecology	Understanding biodiversity and EU Strategies	2.0 h
		Preservation of biodiversity	
		Promotion of biodiversity	
		Sustainable plant protection and biocontrol	
Learning Outcomes	By the end of this course, learners will be able to: ● Comprehend key EU strategies and techniques for climate-adaptive soil management, including soil fertility control, compaction prevention, erosion mitigation, contamination reduction, salinisation risk management, terroir protection, and CO2 sequestration enhancement. ● Understand the different impacts of sustainable water management practices in the context of winegrowing, focusing on agroclimatic mapping, hazard prevention, insurance, water consumption reduction, soil sealing limitation, and water quality preservation. ● Examine the role of biodiversity in sustainable vineyard management, including the adoption of plant materials suited for agroecological challenges, reduction of chemical use, and implementation of biocontrol methods. ● Compare case studies and real-world examples to develop comprehensive plans for soil, water, and biodiversity management in vineyards, considering both short-term and long-term sustainability goals. ● Reflect on personal values and their alignment with sustainability values in the wine sector, employing critical thinking skills to challenge conventional practices and propose innovative, environmentally conscious solutions.		
Learning materials	● Lectures (PPT) ● Case studies ● Videos ● Further readings		

Language/s of learning materials	· English (all materials of level 1 and 2 + some other materials of level 3) · Spanish, French, Italian, German, and Macedonian (all materials of level 1 + some other materials of level 3)
Method/s for teaching and learnings	Each Unit consists of three online parts: 1. Level 1 (CORE): is the core learning, available in all languages (En + partner country languages). It includes introductory texts, videos. All learners will watch/read/study all the provided resources. It has to be completed in order to have access to the self-assessment quiz 2. Level 2 (RELEVANT). It includes presentation, videos, case study, problem-based learning method, project-based learning methods and assignments. 3. Level 3 (OPTIONAL) is optional and includes additional resources in different languages as well as optional tasks and experiential activities that can be completed autonomously.
Method/s of assessment	Self-assessment quiz with 5 questions for each Unit Assignment (optional)
Method for evaluation of course	Peer review from partners Evaluation questionnaire by participants

VIDEO INTRODUCTION

https://youtu.be/FAsvFsfKn2E

TRANSCRIPTION

Welcome to unit 5 of the Green Vineyards Course. This unit focuses on Biodiversity and agroecology that covers several aspects of protection and enhancement of biodiversity.

In level 1 of this unit, you will be able to learn about Importance of biodiversity in vineyards and European Strategies in promoting beneficial insects and controlling pests

In level 2 of this unit, you will go deeper in analyzing techniques for biodiversity preservation and promotion as well as methods for Sustainable plant protection and biocontrol, as the use of beneficial insects (ladybirds, lacewings), and microbial biopesticides

Finally, in Level 3 you will find the links to websites and publications available on line, so that you can, if you wish, read and see the most updated information about this issue: how to reduce the climate impact of vine growing through the Enache of biodiversity

Let's start with this unit level 1.

LEVEL 1 - CORE LEARNING

UNDERSTANDING BIODIVERSITY AND EU STRATEGIES

Importance of Biodiversity in vineyards

Biodiversity is represented by different types of microorganisms, insects and plants belonging to an habitat; so, it is a key component of sustainable agriculture, particularly in vineyards. In fact, biodiversity and agriculture are strongly interrelated: in the past agriculture significantly contribute to the increase of cultural landscape and species diversity. A biodiverse ecosystem can provide numerous benefits for both the environment and agricultural yield, for example reating a healthy and sustainable environment for grape cultivation. The European Union recognizes the importance of biodiversity in agriculture and has implemented several policies and legislation to promote it.

Implementation

There are several ways to implement biodiversity in vineyards. One approach is to use cover crops or native plants in the mid-rows, which can attract beneficial insects and improve soil health. Mulches can also be used in the vine rows to help retain moisture and suppress weeds. Hedgerows, which are lines of naturally growing trees or bushes, can diversify the landscape and provide a natural habitat for beneficial animals. Minimising mechanical cultivation can reduce soil compaction, improving soil drainage and aeration, allowing water infiltration and biological activity.

Another way to promote biodiversity is to use integrated pest management (IPM) strategies. This involves monitoring pest populations and using targeted interventions, such as releasing natural predators or using pheromone traps, to control pests while minimising the use of chemical pesticides. By implementing these practices, vineyards can create a more sustainable and biodiverse environment that benefits not only the grape yield but also the wider ecosystem.

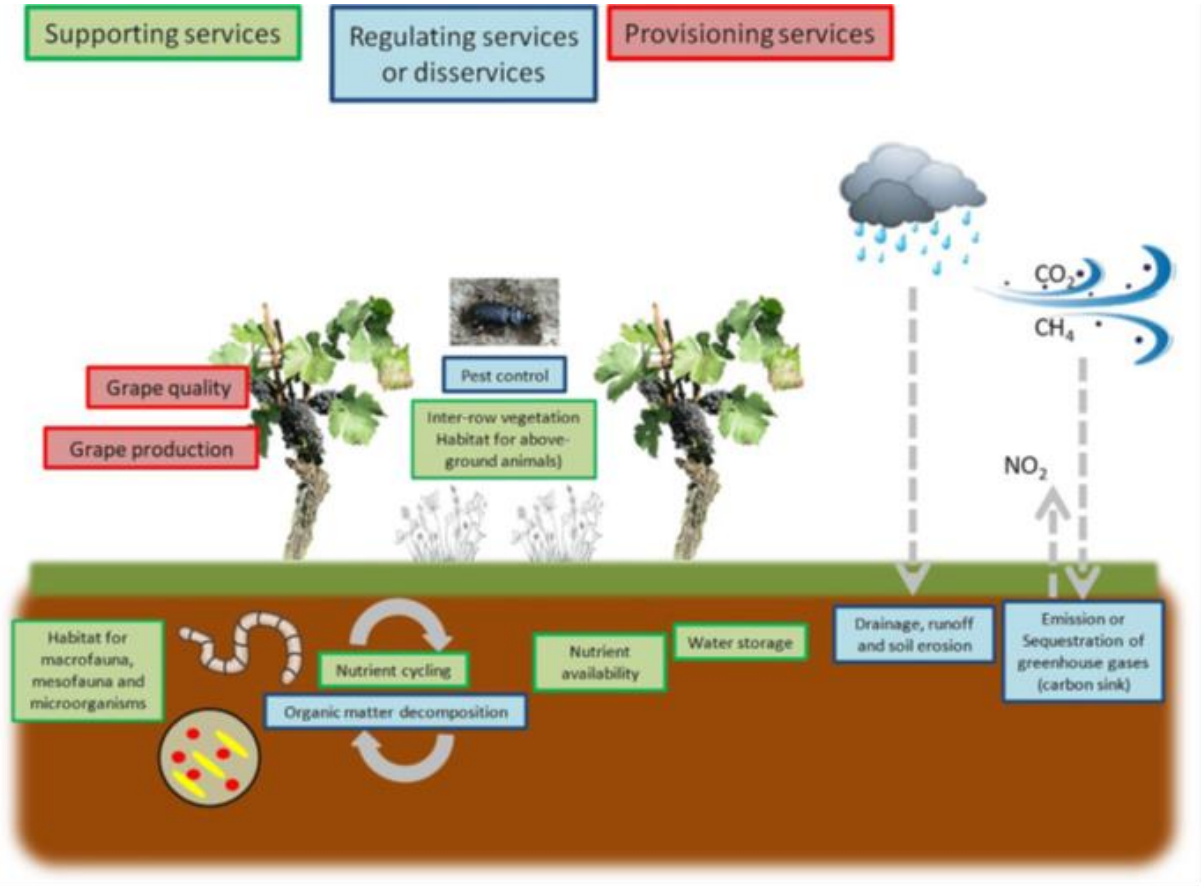

Figure 1. Ecosystem services provided by vineyard soils. Biodiversity is strongly linked to habitats availability in this agroecosystem: soil and plant cover above-ground. In turn, biodiversity strongly drives several regulating services (blue boxes), related to supporting services (green boxes), and influences some provisioning services (red boxes)- from "Vineyard Management and Its Impacts on Soil Biodiversity, Functions, and Ecosystem Services", Frontiers in Ecology and Evolution Review; 1 July 2022 | Volume 10 | Article 850272 (*www.frontiersin.org*).

PRESERVATION AND PROMOTION OF BIODIVERSITY

Biodiversity preservation

Biodiversity is the biological diversity between species, within species and between ecosystems. So, it is defined by European Environment Agency (EEA) as "the name given to the variety of ecosystems, species and genes in the world or in a particular habitat". Biodiversity represents a fundamental element for the ecosystem services, like for example pollination, climate regulation, flood protection, soil fertility and the production of food, fuel, fibre and medicines.

Today, intensive management, based specially on high mechanisation, chemical fertilisers and Plant Protection Products, has caused an alteration of biodiversity level in vineyards: a “clean” vineyard where species have no place to be. Therefore, we have a more degradation of soil structure, lesser fertility and more groundwater contamination.

Preservation and promotion of biodiversity are the key to minimizing these negative impacts, and to restoring a resilient ecosystem.

Promotion of biodiversity

Increasing use of intensive viticulture has contribued to the reduction of both the native flora and fauna of a specific habitat. This aspect has caused a biodiversity alteration, and ecosystem balance that regulate healthiness of vineyards was broken.

For example, actually we have lesser zoophagous[1] species in vineyard. Zoophagous represent important arthropods predators.

Introduction of “Oasis vineyards” are possible solution to promoting biodiversity; it consists in the interruption of vineyard homogeneity through different vine varieties or different species of plants within/around vineyards.

In the past, near vineyards border farmers cultivated forest or fruit tree species; it allowed to realize high relationships between different communities of microorganisms, generating an increase in biodiversity that has been lost over time due to the intensification of vineyards.

Natural hedges and groups of trees, placed around vine areas, contribute to increase a “refuge habitat”: specifical place where high balance of biodiversity generates great quantity and quality production. So, they offer other kinds of positive effects, such as shade, windbreaks and thus less soil erosion.

Other type of solution in oasis vineyards consists in the introduction of trees and hedges plants inside vineyards rows. It could be an interesting option to growing the heterogeneity of vineyards with selected species as not to demage vines.

Therefore, a development of numerous phytophagous arthropods[2] and thus related predators could be more likely in this context.

However, grassing vineyard remains a significant method to maintaining an high level of biodiversity in a specifical habitat, implementing predatory insects.

SUSTAINABLE PLANT PROTECTION AND BIOCONTROL

Understanding plant pests and diseases common in vineyards.

[1] Zoophagus: genus of zygomycete fungi that feeding on rotifers and nematodes.
[2] Insects that do damage to plants often because they feed on them.

In addition to weather-related adversity, such as hail, late frost, excess rain and prolonged drought during susceptible phenological stages, fungi and pests contribute to vine damage.

In vineyards, most frequent fungal diseases are:

- Oidium: desease (by Ascomycota) caused by long wet periods and absence of wind. We can recognize it through white dusts in leaves, inflorescences and grapes. So, grapes don't ripen and broke up.
- Downy Mildew: an important vine deseas (by Plasmopara viticola), it manifests as yellow spots on leaves. Grapes are dry because pathogen adsorbs all plant nutrient.
- Botrite: vine fungus (Botrytis cinerea) that affects shoots and grapes.

Between vineyard pests, we have:

- Golden Flavescence: phytoplasmosis transmitted by leafhopper (Scaphoideus Titanus) that settles in plant tissues, bloking the sap;
- Phylloxera: phytophagous insect (Rhyncota Homoptera) that affects roots of european species (vitis vinifera) and the aerial plant part of american species (vitis rupestris). It involves in plant death.

Sustainable plant protection techniques

Acting on ecosystem creating a biodiversity balance that makes it more difficult for pathogens to gain the upper hand, certainly represents a way to increase plants protection.

In order to avoid a chemical control, it's very important to have a good monitoring and prevention plan, which allows one to be able to anticipate possibile pathogen attacks and protect plant health, thus in line with european "Farm to Fork" program.

Following this line, organic farming is the main way to realize that, thanks to its aim to produce food using natural substances and processes. Indeed, organic farming approach tends to have a limited environmental impact as it encourages:

- The responsible use of energy and natural resources;
- Maintenance of biodiversity;
- Preservation of regional ecological balances;
- Enhancement of soil fertility;
- Maintenance of water quality.

Plant health status also contributes to make it more difficult plant-damaging pathogens work.

Alongside organic farming we find Integrated Pest Management (IPM), the general principals of which are covered in Annex III of European Directive, representing one of the tools for low-pesticide pests management. In fact, pesticides can be used in a reduced and controlled form if they are both economically and ecologically justified.

So, in both cases some techniques to be used may be:

- Use of cultivars suited for a given habitat: it allows for vines that are more resistant to the typical impacts of specific habitat;
- Use certified vines: they offer a higher assurance of the healthiness of the plants, therefore also a better behavior against acosystem-related adversities;
- Rational and consistent cultivation techniques: medium/low planting density (for new plantings),ecniche di coltivazione razionali e costanti: medio/bassa densità di impianto (per nuovi impianti), good pruning;
- Balanced fertilization;
- Good soil drainage;
- Regular cleaning of machinery and equipment used for different for various field operations: it's important to contain the spread of harmful organism through hygienic measures;
- Enhancement of beneficial organisms;
- Introducing plants between rows for making useful associations for the vineyard.

Biocontrol methods: use of beneficial insects and microbial biopesticides

Biocontrol methods involve the use of microorganisms such as fungi, bacteria, yeasts and even viruses (less frequently) to contain the development of pathogens in a given area.

Microorganisms must have at least one of these characteristics:

- Being competitors for nutrients with pathogens;
- Being competitors for space with pathogens;
- Having "antibiotic" or "parasitic" function: produce and spread toxic substances for pathogens that counteract their activity as phytopathogens;
- Induce the host plant to be more resistant to external impacts (fungi, bacteria, viruses).

Interesting in biocontrol is the use of "beneficial insects", which are able to comply with actions that are useful to the plant, and thus interact positively in a given habitat.

Among the various beneficial insects we have:

- Ladybirds: predatory beetle of aphids, mealybugs, mites and fungi. They are most abundant and active where pesticide products are used less frequently;
- Lacewings: predatory insects, of the order Neuroptera, widely used in biological control because the larvae feed on mealybugs and Drosophila larvae, while the adults also feed on honeydew (thus counteracting aphid and mealybugs).

BASIC RESOURCES

Websites:

- *Biodiversity strategy for 2023*, European Commission: https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en;

PDF Document:

- *Biodiversity Factsheet:* Document elaborated by the partners of the project "Partnership for Biodiversity Protection in Viticulture in Europe" Project-Nr.: 2015-1-DE02-KA202-002387

Scientific articles:

- Giffard B., Winter S., Guidoni S., Nicolai A., Castaldini M., Cluzeau D., Coll P., Cortet J., La Cadre E., d'Errico G., Forneck A., Gagnarli E., Griesser M., Guernion M., Lagomarsino A., Landi S., La Bissonnais Y., Mania E., Mocali S., Preda C., Priori S., Reineke A., Rusch A., Schroers H.J., Simoni S., Steiner M., Temneanu E., Bacher S., Costantini E.A.C., Zaller J., Leyer I. (2022), *Vineyard Management and Its Impacts on Soil Biodiversity, Functions, and Ecosystem Services*, Frontiers: https://www.frontiersin.org/articles/10.3389/fevo.2022.850272/full;

LEVEL 2- LEARNING IN DEPTH

EU BIODIVERSITY STRATEGY FOR 2030, AND OTHER EU INITIATIVES FOR BIODIVERSITY

EU Biodiversity Strategy for 2030

The EU Biodiversity Strategy for 2030 (COM/2020/380 final) is a comprehensive, ambitious, and long-term plan to protect nature and reverse the degradation of ecosystems. The strategy has several objectives, including establishing a larger EU-wide network of protected areas on land and at sea, launching an EU nature restoration plan, introducing measures to enable the necessary transformative change, and introducing measures to tackle the global biodiversity challenge. The strategy also aims to build our societies' resilience to future threats such as the impacts of climate change, forest fires, food insecurity, and disease outbreaks – including by protecting wildlife and fighting illegal wildlife trade.

Other EU initiatives

One of the key tenets of the strategy that vineyard managers must heed is the Farm to Fork Strategy (COM/2020/381 final). This initiative, central to the EU Biodiversity Strategy, targets a reduction of 50% in the use of chemical pesticides and fertilisers by the year 2030. While this might seem like a daunting target, it aligns well with the goals of sustainable vineyard management, which already seeks to minimise chemical inputs.

Moreover, vineyard managers may find another avenue for sustainable practices through the newly adopted Nature Restoration Law (COM/2022/304 final). The Nature Restoration Law has been adopted in June 2023, and it is the first EU legal biodiversity framework. This law aims to restore degraded ecosystems, improve the resilience of ecosystems, and enhance the provision of ecosystem services. It sets legally binding targets for the restoration of ecosystems, including forests, wetlands, peatlands, grasslands, and marine ecosystems.

The Nature Restoration Law is relevant for biodiversity because it aims to address the root causes of biodiversity loss, such as habitat destruction and degradation. By restoring degraded ecosystems and improving their resilience, the law aims to create more favourable conditions for the conservation of biodiversity. This is particularly important in the context of climate change, as healthy and resilient ecosystems are better able to adapt to changing environmental conditions.

For vineyard managers, the Nature Restoration Law presents both challenges and opportunities. On the one hand, vineyards may need to adapt their practices to comply with the law's requirements for ecosystem restoration. On the other hand, vineyards that implement sustainable practices and contribute to ecosystem restoration may be eligible for financial incentives and may gain a competitive advantage in the marketplace.

Fig 2 -3- Rose plants at the beginning of the row for early pathogen control – Own image/Canva

The case study.

The proposed case study, named T.I.GE.S.VI (EIP-AGRI European Innovation Partnership), was carried out with the aim of identifying better and innovative soil and topsoil management in order to increase soil biological fertility, organic matter content and, thus, foster plant and animal biodiversity.

Two techniques for inter-row management were studied, frequent mowing of the vegetation and green manure, with an innovative and more sustainable management consisting of mowing the area in alternating shifts between one inter-row and the next, so as to always keep the plants in bloom in the vineyard.

The project, carried out in two different locations so as to make the method as suitable as possible for several contexts, aims to achieve the following objectives:

- Offer a method for integrate biodiversity;
- Reduce soil erosion in hillside vineyards;
- Promote a higher presence of arthropods, due to the increased flowering of vegetation.

Fig. 4. Vineyard with spontaneous vegetation in the inter-row - Canva

First, soil samples were taken where different soil management was done to carry out the study and analysis of the level of biodiversity.

It was possible to asses the impacts of methodologies on biodiversity through:

- TBI Index: to calculate the organic matter in the soil;
- IBF Index: biological fertility index, which makes it possible to indirectly assess the activity of microorganisms and the capacity of soil to provide nutrients that can be used by plants;
- QBS-ar Index: it makes to assess soil quality through the micro-arthropods present and to inform about the level of stability and functionality of the edaphic ecosystem;
- Leaf reliefs: the leaves of vines were observed in the period of May-June, giving the possibility to assess the presence of arthropods harmful to the vine and their respective natural antagonists;
- Botanical reliefs: They made it possible to evaluate the impacts of the methods on plant biodiversity and on land cover to prevent erosion phenomena;
- Cost analysis: this operation was carried out to understand the timing and consequently the costs for the different types of soil management.

The project made it possible to establish that alternative mowing in vineyard represents the most sustainable and innovative spontaneous vegetation management technique compared to the others.

COMPLEMENTARY RESOURCES

Video:

- *The* European partnership for the protection of biodiversity in viticulture: https://www.youtube.com/watch?v=DraxyS6IGqo&list=PLF_kpm9uuCL7HDgF6FvgN2bg2tplp3QoC ;

Websites:

- *Integrated Pest Management (IPM)*, European Commission: https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/integrated-pest-management-ipm_en;
- *Organics at a glance*, European Commission: https://agriculture.ec.europa.eu/farming/organic-farming/organics-glance_en;
- *Biodiversity*, European Business and Biodiversity Compaign: : https://www.business-biodiversity.eu/en/biodiversity;
- Innovative techniques for soil management in the vineyard and their impact on the biodiversity and the fertility - T.I.GE.S.VI Project,, : https://www.tigesvi.com/the-project;

Scientific articles:

- Koninger J., Panagos P., Jones A., Briones M.J.I., Orgiazzi A. (2022), In defence of soil biodiversity: Towards an inclusive protection in the European Union, ScienceDirect: https://www.sciencedirect.com/science/article/pii/S0006320722000283;
- Snyder W.E. (2019), *Give predators a complement: Conserving natural enemy biodiversity to improve biocontrol*, ScienceDirect: https://www.sciencedirect.com/science/article/pii/S1049964419300593;
- Winter S., Bauer T., Strauss P., Kratschmer S., Paredes D., Popescu D., Landa B., Guzman J.A., Guernion M., Zaller J.G., Batary P. (2018), *Effects of vegetation managment intensitiy on biodiversity and ecosystem services in vineyards: A meta-analysis, British Ecological Society*: https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/1365-2664.13124;
- Agarbati A., Canonico L., Pecci T., Romanazzi G., Ciani M., Comitini F. (2022), *Biocontrol of Non-Saccharomyces Yeasts in Vineyard against the Gray Mold Disease Agent Botrytis cinerea*, Microorganisms: https://www.mdpi.com/2076-2607/10/2/200

LEVEL 3 - ADDITIONAL RESOURCES

Websites

- Functional biodiversity in the vineyard:

https://www.oiv.int/public/medias/6367/functional-biodiversity-in-the-vineyard-oiv-expertise-docume.pdf;

- Biodiversity and production of wine: https://environment.ec.europa.eu/news/biodiversity-and-production-wine-can-be-optimised-simultaneously-where-organic-management-enhanced-2023-08-02_en

Articles

- Giulia Zanettin , Angela Bullo, Alberto Pozzebon , Giovanni Burgio and Carlo Duso (2021), Influence of Vineyard Inter-Row Groundcover Vegetation Management on Arthropod Assemblages in the Vineyards of North-Eastern Italy, Insects journal, https://www.mdpi.com/journal/insects

- Francisco Javier Peris-Felipo, Fernando Santa, Oscar Aguado, José Vicente Falcó-Garí, Alicia Iborra, Michael Schade, Claire Brittain, Vasileios Vasileiadis and Luis Miranda-Barroso (2021), *Enhancement of the Diversity of Pollinators and Beneficial Insects in Intensively Managed Vineyards*, Insects journal, https://www.mdpi.com/journal/insects

Documents

- Documents elaborated by the partners of the project "Partnership for Biodiversity Protection in Viticulture in Europe" *Project-Nr.: 2015-1-DE02-KA202-002387:*
    - Biodiversity Guide
    - Biodiversity Action plan
    - Biodiversity

Video

- Agricultura ecologica, la biodiversidad en el suelo y lo buenos vinos, Global Nature Fund:
- https://youtu.be/-zqPS7dxQI8?si=VQJBE8BSRLep_rc4
- **Educational video** elaborated by the partners of the project "Partnership for Biodiversity Protection in Viticulture in Europe" *Project-Nr.: 2015-1-DE02-KA202-002387*: https://youtube.com/playlist?list=PLF_kpm9uuCL7HDgF6FvgN2bg2tplp3QoC

SELF-ASSESSMENT

(Introduce 5-10 questions) (Only one answer is correct)

1. What positive role do ladybugs and spiders play in a vineyard?
    a) They increase the size of the clusters
    b) They promote fruit set
    c) They are natural enemies of common vine-damaging pests
    d) They increase the sugar content

2. Which of these answers is true?
    a) Ladybugs and spiders are natural enemies
    b) EU Green Deal boosts use of chemicals to decrease biodiversity
    c) Promoting biodiversity also doesn't have positive effects on the surrounding ecosystems
    d) The EU Biodiversity Strategy for 2030 is a comprehensive, ambitious, and long-term plan to protect nature

3. Why the Nature Restoration Law is relevant for biodiversity?
    a) Because it aims to address the root causes of biodiversity loss, such as habitat destruction and degradation
    b) Bacause it incentivizes intensive viticulture
    c) Because it excludes native varieties
    d) Because it eliminates beneficial insects

4. When is a farmer elegible for financial incentives?
    a) When he implements sustainable practices and contribute to ecosystem restoration
    b) When he uses a lot of mineral nitrogen
    c) When he doesn't pruning the vineyard
    d) When he has haigh production

5. Which of the following is a long-term benefit resulting from alignment with EU policies?
    a) The purhase of cheaper pesticides
    b) The competitiveness of these vineyards due to increased consumer demand for environmentally friendly and sustainable products
    c) The largest production of wine
    d) The removal of animals harmful to the vineyard

UNIT 6 - ENERGY EFFICIENCY MANAGEMENT

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module:</td><td colspan="3">Environmental management focused on climate change – part II:

Reduction of greenhouse gas emissions – Energy efficiency – waste by-products and effluents</td></tr>
<tr><td>Type:</td><td colspan="3">Online</td></tr>
<tr><td>Workload for learner (hours):</td><td colspan="3">5 hours</td></tr>
<tr><td>Trainers:</td><td colspan="3">Carine Herbin, Emilie Adoir, Hugo Luzi, Laura Rondoni, Fabio Maria Santucci, Alessandra Antognelli</td></tr>
<tr><td>Institution(s):</td><td colspan="3">IFV, CESAR</td></tr>
<tr><td>Content/short description; duration; training/learning method:</td><td colspan="3">This module is designed to directly address the needs of wine workers and professionals in the wine industry, focusing on practical skills and applications to ensure the resilience and success of wineries amid today's environmental challenges. Learners will engage with real-life case studies from the wine industry, gaining insights into the reduction of greenhouse gas emissions, the promotion of energy efficiency, and the management of waste, by-products and effluents. Built around practical scenarios, the module offers a comprehensive learning experience that combines theory and application. Through it, learners will gain an in-depth understanding of regulatory frameworks, waste and effluent management, and techniques for reducing greenhouse gas emissions and improving energy efficiency. Amid fluctuating environmental conditions, the need to reduce emissions, increase efficiency, and manage waste, wineries are called upon to navigate complex issues. This module empowers learners with the tools to face these challenges while preserving the uniqueness of their terroir, style, and variety. The applied knowledge and competencies acquired during the course will support them in making informed decisions that ensure the continued success of their establishments despite environmental, social, and economic challenges.</td></tr>
<tr><td></td><td>Unit</td><td>Content</td><td>Duration</td></tr>
<tr><td></td><td rowspan="4">Energy efficiency management</td><td>Energy concepts</td><td rowspan="4">2 H</td></tr>
<tr><td></td><td>EU Regulatory framework</td></tr>
<tr><td></td><td>Key figures of consumption in vine and wine industry</td></tr>
<tr><td></td><td>Improving energy efficiency in the vineyard and cellar.</td></tr>
<tr><td>Learning Outcomes:</td><td colspan="3">By the end of this course, learners will be able to:

• Understand the importance of an effective energy management, in the context of wineries and wine production, focusing on calculation of</td></tr>
</table>

	energy consumption, eco-design of buildings, and limitation of fossil energy, and energy consumptions. • Identify in case studies and real-world examples how are applied plans for energy in wineries, considering both short-term and long-term sustainability goals. Reflect on personal values and their alignment with sustainability values in the wine sector, employing critical thinking skills to challenge conventional practices and propose innovative, environmentally conscious solutions.
Learning materials (e.g. exercises, data sets)	• Lectures • Further readings
Language/s of instruction (oral and written material):	English (major materials) Spanish, French, Italian, German, and Macedonian (some materials)
Method/s for teaching and learnings:	Each Unit consists of three online parts: 1. **Level 1 (CORE):** is the core learning. It includes introductory texts. All learners will read/study all the provided resources. 2. **Level 2 (RELEVANT)** has to be completed by the participants. It includes presentation.
Method/s of assessment:	Self-assessment quiz with 5 questions for each Unit
Method for evaluation of course (by students, peer review etc.)	Peer review from partners Evaluation questionnaire by participants

VIDEO INTRODUCTION

https://youtu.be/nsQJcbFvBt0

TRANSCRIPTION

Welcome today in this unit Energy efficiency management, part of module environmental management focused on climate change.

This unit is designed to directly address the needs of wine workers and professionals in the wine industry, focusing on practical skills and applications to ensure the resilience and success of wineries amid today's environmental challenges.

Learners will engage with real-life case studies from the wine industry, gaining insights about energy efficiency, especially:

Now, let's embark on this enlightening journey of learning. Enjoy the course!

LEVEL 1 - CORE LEARNING

KEY FIGURES OF ENERGY CONSUMPTION IN VINE AND WINE INDUSTRY

In the vineyard

In the vineyard, major part of direct energy consumption comes from the fuel in tractors. According to a study in French Burgundy, the positions that consume the most fuel in the vineyard over an entire campaign are tillage and pest management (Figure 1).

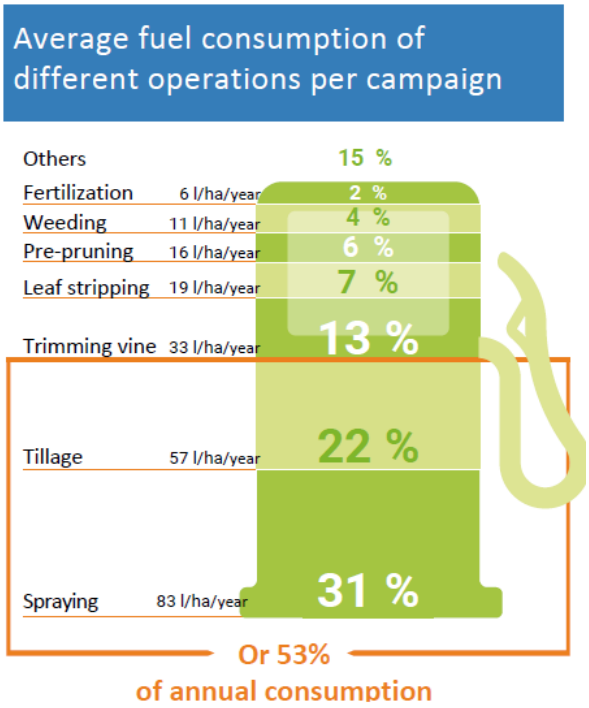

Figure 1. Average fuel consumption of different operations for one campaign *(BIVB Développement de la filière Bourgogne 2015)*

At the cellar

Energy consumption at the cellar is extremely variable, depending on the location of the cellar, the size of the farm, and the production route. "Higher quality wines require higher electricity consumption since cooling requirements are generally higher. Additionally, previous studies have shown that similar wineries (same size and same quality of wine) had different electricity consumptions, which means that there is considerable potential for energy savings in these types of industries." (TESLA Project).

Thus, the TESLA project evaluated for a typical European cellar producing 30,000 hl per year, an average consumption of 330,000 kWh, or a ratio of approximately 11 kWh/hl, and which could be very different from a cellar with the other. This project noted that previous studies determined a ratio which varied from 3 kWh/hl to 25 kWh/hl.

In France, a study carried out by the Burgundy wine inter-professional association (BIVB) calculated an energy consumption ratio of 5 to 350 kWh per hl vinified for sizes farm varying from 200 to 4,000 hl per year.

The main energy expenditure items in the cellar are, in order of importance: heating and thermal regulation, then lighting. In addition, the majority of the energy consumed is electrical energy (91.6% of the total energy consumed).

From a quantitative point of view, the cooling stages (during alcoholic and malolactic fermentations, stabilization and others) are clearly the most energy-intensive in wineries. These steps can represent almost 50% of the energy consumed.

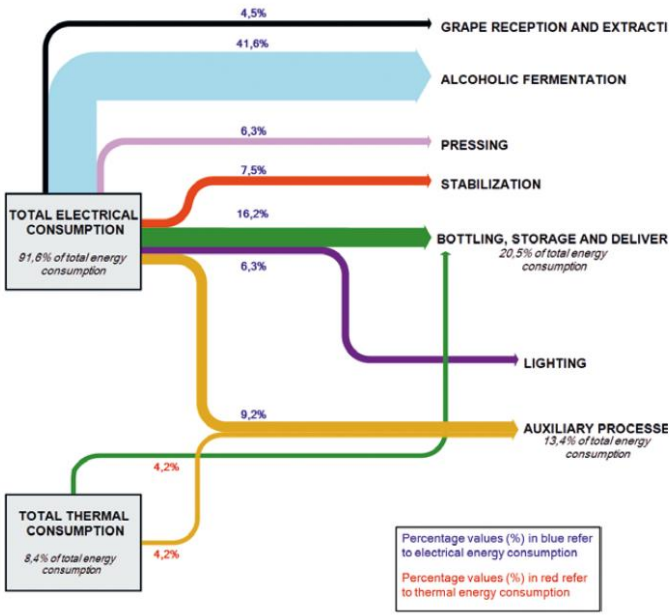

Figure 1: Energy consumption fluxes in a representative winery producing 30.000 hl wine/year (Source: Handbook: Efficient Wineries. TESLA project deliverable).

Figure 2. Energy consumption fluxes in a representative winery producing 30.000 hl wine/year *(TESLA Project)*

BEST PRACTICES FOR OPTIMIZING ENERGY EFFICIENCY IN THE VINEYARD AND CELLAR

"The practices that can be chosen with this objective, must be considered in local production conditions, as a compromise between improving energy consumption, environmental impact and economic results. In case of substitution of one practice by another, it is necessary to calculate the

effect of this change or to refer to technical references, to ensure that substitution does not cause an overall increase of primary and final energy consumption" (TESLA Project).

In the vineyards

Optimization of fuel consumption:

- rationalization of the number of operations,
- adapting tractor speed to the tool,
- coupling of tools,
- choice of less energy-consuming tools,
- reduction of tractor power,
- reduction of planting density,

In the case of anti-frost control: rationalization of energy consumption,

Substitution of fossil fuel by a biofuel.

Personal transport:

- Plan transport to avoid periods of congestion and unnecessary travel,
- Carpool,
- Practice eco-driving when traveling (flexible and reduced speed, moderate use of air conditioning, etc.).

At the cellar

We can take several measures to manage energy efficiency at the cellar, such as:

- Computer-aided design of layout and space in relation to energy consumption, equipment and work organization systems,
- Choice of less energy-consuming equipment,
- Rationalization of the number of operations consuming energy,
- Monitoring of maintenance and management processes of operations carried out at the cellar.

In the rationalization of the thermal regulation measures are:

- Adaptation of the harvest temperature: harvests as fresh as possible, resorting to night harvests if necessary,
- Use of oenological inputs (bio-inoculation),
- Use of vats and/or buildings with high thermal inertia

And for rationalization of heating, measures can be:

- Choice of eco-design and bioclimatic architecture,
- Insulation of buildings,

- Installation of solar protection elements so as to avoid direct sunlight on the exterior tanks,
- Installation of appropriate glazing, in terms of transmissivity and energy transmission factors,
- Insulation of cold areas,
- Insulation of tanks and piping,
- Limitation of heat loss through ventilation of buildings,
- Solar heating installation,
- Greening of roofs,
- Installation of Canadian well to preheat and pre-cool incoming fresh air Lighting,

For lighting, measures can be:

- Use of LEDs,
- Use of presence detectors.

BASIC RESOURCES

Joaquín Fuentes-Pila et José Luis García. UPM, Technical University of Madrid, Unjversitad Politécnica de Madrid, 2014, Handbook about the performance of wineries and energy saving measures for its facilities, https://teslaproject.chil.me/download-doc/62556

ISO, 2018. Système de management de l'énergie, ISO 50001 : https://www.iso.org/iso-50001-energy-management.htmlProjet Vitinode du Vitilab (Vinipôle Sud Bourgogne) : https://github.com/acetayls/Vitinode/tree/main

ADEME, SOLAGRO, CTIFL, ASTREDHOR, ARVALIS, FNCUMA, IDELE, IFIP, ITAVI, 2018, Agriculture et efficacité énergétique : propositions et recommandations pour améliorer l'efficacité énergétique de l'agriculture des exploitations agricoles en France, Agriculture et efficacité énergétique. Rapport (solagro.org)

SOLAGRO, 2011, Références PLANETE 2010 Fiche 6 - Production « Viticulture », Microsoft Word - RefPLANETE2010_viti.doc (solagro.org)

European Commission, 2023, European Green Deal: Energy Efficiency Directive adopted, helping make the EU 'Fit for 55', European Green Deal: Energy Efficiency Directive adopted, helping make the EU 'Fit for 55' (europa.eu)

European Commission, Energy efficiency first principle, Energy efficiency first principle (europa.eu)

European commission, Infographic on Energy Strategy, Infographic on Energy Strategy (europa.eu)

BIVB, 2015, Pages 26-27, Développement DURABLE de la filière des Vins de Bourgogne, Rapport développement durable filière des vins de Bourgogne 2015 (vins-bourgogne.fr)

Chambre d'agriculture Côte d'Or Yonne, 2015. Consommation d'énergie dans les chais : résultats en Bourgogne et perspectives : DIAP020415VINIPOLE71_conso_energie_chais (bivb.com)

ISO, 2018. Système de management de l'énergie, ISO 50001 : https://www.iso.org/iso-50001-energy-management.html

Projet Vitinode du Vitilab (Vinipôle Sud Bourgogne) : https://github.com/acetayls/Vitinode/tree/main

LEVEL 2 - LEARNING IN DEPTH

ENERGY CONCEPTS

Different measurements are used to estimate energy consumption. These can be quantified in terms of:

- primary energy, which corresponds to untransformed energy after extraction (coal, lignite, crude oil, natural gas, primary electricity), or to renewable energies before conversion (solar, wind, etc.).
- and/or final energy, that is to say the energy delivered to the consumer for their final consumption (gasoline at the pump, electricity for operations, etc.) (1). Final energy represents only a fraction of the initial primary energy, once this has been transformed into secondary energy, stored, transported and finally distributed to the final consumer. (2)

Primary energy therefore represents the total quantity of energy necessary to provide the quantity of final energy consumed by the user, that is to say by adding to this final energy the energy necessary for its production and its transport, integrating the notions of production yield and losses. (3)

Renewable energies (wind, solar, hydroelectric, marine, geothermal and from biomass, as well as biofuels) are all alternatives to fossil fuels which contribute to reducing greenhouse gas emissions, by diversifying the energy supply and reducing dependence on unreliable and volatile fossil fuel markets (particularly gas and oil). Union legislation on the promotion of renewable energies has evolved significantly over the last fifteen years. In 2018, European leaders set a target of 32% renewable energy in final energy consumption by 2030. In March 2023, in line with the Union's ambition to achieve climate neutrality. By 2050, the co-legislators have decided to increase the share of renewable energies to be achieved by 2030 to 42.5%, with the hope of reaching 45%. The update of the renewable energy action framework for 2030 and beyond 2030 is currently being negotiated. (4)

Fossil fuel is a generic term for non-renewable energy sources such as coal, coal products, natural gas, derived gas, crude oil, petroleum products and non-renewable wastes. These fuels originate from plants and animals that existed in the geological past (for example, millions of years ago). Fossil fuels can be also made by industrial processes from other fossil fuels (for example in the oil refinery, crude oil is transformed into motor gasoline).

For decades fossil fuels satisfy most of the human energy requirements. Fossil fuels are carbon-based and their combustion results in the release of carbon into the Earth's atmosphere (carbon that was stored hundreds of millions of years ago). It is estimated that roughly 80% of all manmade CO_2 and green-house gas emissions originate from fossil fuels combustion. (5)

The EU Energy Efficiency Directive uses a very broad definition: "**energy efficiency** means the ratio of output of performance, service, goods or energy, to input of energy"(6). Therefore, increasing the energy efficiency means using less energy for the same output or producing more with the same energy input, and minimising energy waste. Reducing energy consumption and energy waste across the energy system — from production to final consumption — in all economic sectors is one of the EU's strategic objectives.

Energy efficiency measures have a great potential to avoid greenhouse gas emissions and to lower the demand and price of this valuable resource. It also improves the competitiveness of EU companies and contributes to reducing the EU's dependency on imported energy sources." (7)

Energy management system means a set of interrelated or interacting elements of a strategy which sets an energy efficiency objective and a plan to achieve that objective, including the monitoring of actual energy consumption, actions taken to increase energy efficiency and the measurement of progress. " (6)

EU REGULATORY FRAMEWORK

By setting at 11.7% the reduction of final energy consumption by 2030 compared to the final energy consumption forecasts realized in 2020 for the year 2030, the energy efficiency directive (6), revised in July 2023, allows the European Union to move closer to its climate objectives of climate neutrality by 2050. This corresponds to an annual energy saving average rate of 1.49% from 2024 to 2030 (compared to 0.8% previously), and an overall reduction objective of -38% in final energy consumption between 2007 and 2030. This objective regarding final energy consumption is mandatory for Member States and is supplemented by an indicative objective of -40.6% of primary energy consumption between 2007 and 2030. (8)

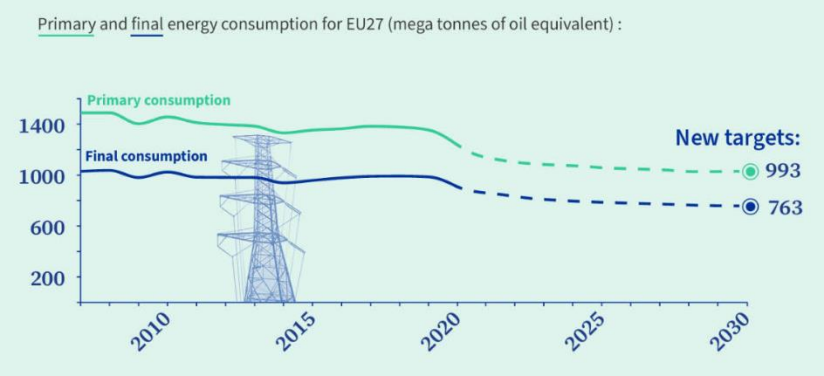

Figure 3: Targets for reducing primary and final energy consumption set by the 2023 Energy Efficiency Directive. (8)

The European Union is taking action to improve energy efficiency through a series of measures, including making buildings more energy efficient, better labelling of products, mobilising financing for energy efficiency investments and improving heating and cooling systems. (7)

Energy efficiency is an equally important part of the EU's climate neutrality plan as renewable energy, that is also subject to ambitious targets (42,5% of the consumption of final energy with renewable energy by 2030). (9)

IMPROVED ENERGY EFFICIENCY IN THE VINEYARD AND AT THE CELLAR. GENERAL APPROACH TO IMPROVE THE ENERGY EFFICIENCY OF THE VINEYARD AND AT THE CELLAR

Setting European objectives for reducing energy consumption in general, and fossil energy in particular, requires, at the sector level, the contribution of wine companies. To do this, companies in the sector must implement, on their scale, a process to improve their energy efficiency in the vineyard and in the cellar.

This approach can refer to the specific and standardized energy management system ISO 50001.

In all cases, improving energy efficiency will involve specific training of staff, as well as communication of the results of practices and of actions undertaken.

This approach firstly requires knowledge of energy consumption in the vineyard and the cellar, and to consider the best practices for improving the energy efficiency of activities.

MEASUREMENT OF ENERGY CONSUMPTION

The aim of these energy consumption measurements is to link energy consumption to cropping or oenological practices as closely as possible. This makes possible to identify the practices that consume the most energy, and to be more effective in the search for ways to reduce energy consumption. The measurement methods proposed are of increasing precision.

In the vineyard

The source of energy consumed mainly in the vineyard by tractors is non-Road Diesel. However, electric traction vehicles are tending to develop. The measurement methods are different depending on the type of energy.

For Non-Road Diesel, this being only consumed in the vineyard, we can firstly follow its consumption from the invoices for the different deliveries made during the year detailing the volume delivered and compare the evolution of consumption from year to year. To refine the diagnosis and determine which cultivation operations consume the most, it is then necessary to install a volumetric meter on the farm's non-Road Diesel pump, and to take meter readings as closely as possible, noting the type of cultural operation carried out between two surveys. This method is sometimes called the “fill-in method”.

For the electricity consumption of traction equipment, an overall annual quantification based on invoices is generally not possible, as electricity is used in large quantities in the cellar. A first approach can be to trace the number of times the batteries are recharged (taking care to note the proportion of battery consumed at the time of recharge), and using the battery capacity indicated by the manufacturer, to calculate the total electrical energy consumed for the vine, taking into account energy losses through heat at the time of battery charging (an assumption of 10% can be made). In the same way as for non-Road Diesel, we can refine the diagnosis by implementing more precise traceability, by noting the type of cultivation operation carried out between two refills.

At the cellar

At the cellar, several types of energy can be used: electricity, but also thermal energy, renewable energy (solar hot water, biomass boiler) or non-renewable energy (natural gas, fuel oil, etc.). A first diagnostic step can be to convert each energy consumption into a common unit of primary energy, to identify the type of energy consumed the most.

The second diagnostic step consists, for each type of energy, of quantifying the share of energy consumed for each oenological operation. Two complementary methods can be used for this: direct measurement by installing meters (for electricity only), and modeling of energy consumption.

For the direct measurement, it is necessary to install as many meters as possible, to each electricity-consuming equipment directly connected to the panel (this is generally the case for heat pumps). Some meters may have the option of remote transmission of readings, and thus facilitate data acquisition. In the case of equipment connected to the mains, direct measurement must be carried out manually, by connecting in series a portable measuring tool and taking a meter reading at the start and end of the operation. This measurement tool can be self-built with the same type of meter mentioned above and can also integrate a data remote transmission option. The Vinipôle Sud-Bourgogne, an applied wine research structure, has developed opensource tutorials for self-construction of connected sensors as part of its Vitilab project. However, these tutorials require advanced skills in programming and assembling of electronic elements.

If the installation of meters and taking measurements is not possible, we can first evaluate by thermodynamic modeling the part of the total electricity consumption which is consumed for thermal regulation. This is the purpose of the calculation tool called BENEFICE, developed, and not yet published by Vinipôle Sud Bourgogne. It allows, from daily monitoring of must densities, internal and external temperatures in the tanks, and the temperature outside the cellar, to estimate the energy necessary for the thermal regulation of a tank, and in particular the necessary electricity consumption. It is then necessary to add up the electricity consumption calculations carried out for each **tank**.

If gas is consumed on the farm, it seems difficult to isolate the specific energy for heating musts from the energy for domestic hot water or space heating. An approach using thermodynamic calculations with the BENEFICE tool seems necessary to overcome this difficulty.

COMPLEMENTARY RESOURCES

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- Matthieu Gasparoux. Éco-conception de bâtiment vinicole appliqué au chai de Celeyran. Agronomie. 2019. dumas-02971200 **https://dumas.ccsd.cnrs.fr/dumas-02971200**

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SELF-ASSESSMENT

(Introduce 5 questions) (Only one answer is correct)

1. Question: find the option that does not match European energy regulations

   a) Option 1: The European directive on energy efficiency dates from 2023

   b) Option 2: The European energy efficiency directive sets the reduction in final energy consumption at 11.7% by 2030/2020

   c) Option 3: energy efficiency is the relationship between the production of performances, services, goods or energy and the energy input

   d) Option 4: energy efficiency has no link with the quantities of greenhouse gases emitted

2. Question: finding the wrong definition in terms of energy

   a) Option 1: primary energy corresponds to untransformed energy after extraction (coal, lignite, crude oil, natural gas, primary electricity

   b) Option 2: secondary energy is energy from secondary era resources

   c) Option 3: Final energy is energy supplied to industry, transport, including energy consumption in international aviation, households, public and private services, agriculture, forestry, fishing and other end-use sectors, excluding energy consumption in international shipping routes, ambient energy and energy from deliveries to the processing sector and energy sector, and losses due to transmission and distribution

   d) Option 4: Final energy consumption represents the energy consumed by end users, while primary energy consumption also includes what is used for the production and supply of energy.

3. Question: finding the wrong option regarding energy diagnosis

   a) Option 1: the energy diagnosis aims to acquire adequate knowledge of energy consumption characteristics

   b) Option 2: the energy diagnosis aims to determine and quantify the energy savings that can be achieved in a profitable manner,

   (c) Option 3: the energy diagnosis aims to determine the potential for profitable use or production of renewable energy and to report the results;

   d) Option 4: Energy consumption is linear across the wine-growing activity and in the cellar

4. Question: Optimizing energy consumption in the vineyard: finding the wrong option

a) Option 1: limit tillage

b) Option 2: carpooling

c) Option 3: Reduce traffic speeds and increase travel speeds

d) Option 4: use the lowest possible engine speed

5. Question: Optimizing energy consumption in the cellar: finding the wrong option

a) Option 1: The main energy consumption items in the cellar are heating and thermal regulation, then lighting

b) Option 2: cooling stages can correspond to more than 50% of the energy consumed

c) Option 3: obligation to implement an energy management system

d) Option 4: use of night harvesting to reduce energy consumption.

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UNIT 7 - REDUCTION OF GREENHOUSE GAS EMISSIONS

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module:</td><td colspan="3">Environmental management focused on climate change – part II:

Reduction of greenhouse gas emissions – Energy efficiency – waste by-products and effluents</td></tr>
<tr><td>Type:</td><td colspan="3">Online</td></tr>
<tr><td>Workload for learner (hours):</td><td colspan="3">5 hours</td></tr>
<tr><td>Trainers:</td><td colspan="3">IFV : Carine Herbin, Emilie Adoir, Hugo Luzi, Sophie Penavayre, CESAR : Laura Rondoni, Fabio Maria Santucci, Alessandra Antognelli</td></tr>
<tr><td>Institution(s):</td><td colspan="3">IFV, CESAR</td></tr>
<tr><td>Content/short description; duration; training/learning method:</td><td colspan="3">This module is designed to directly address the needs of wine workers and professionals in the wine industry, focusing on practical skills and applications to ensure the resilience and success of wineries amid today's environmental challenges. Learners will engage with real-life case studies from the wine industry, gaining insights into the reduction of greenhouse gas emissions, the promotion of energy efficiency, and the management of waste, by-products and effluents. Built around practical scenarios, the module offers a comprehensive learning experience that combines theory and application. Through it, learners will gain an in-depth understanding of regulatory frameworks, waste and effluent management, and techniques for reducing greenhouse gas emissions and improving energy efficiency. Amid fluctuating environmental conditions, the need to reduce emissions, increase efficiency, and manage waste, wineries are called upon to navigate complex issues. This module empowers learners with the tools to face these challenges while preserving the uniqueness of their terroir, style, and variety. The applied knowledge and competencies acquired during the course will support them in making informed decisions that ensure the continued success of their establishments despite environmental, social, and economic challenges.</td></tr>
<tr><td></td><td>Unit</td><td>Content</td><td>Duration</td></tr>
<tr><td></td><td rowspan="4">Reduction of greenhouse gas emissions</td><td>EU Regulatory framework and implementation</td><td rowspan="4">2,5 H</td></tr>
<tr><td>Calculation of greenhouse gas emissions</td></tr>
<tr><td>Carbon footprint of the wine industry</td></tr>
<tr><td>General approach to Reduce the carbon footprint</td></tr>
</table>

		Carbon diagnosis and action plan evaluation tool	
		Example of the result of a carbon diagnosis on a Beaujolais farm	
		Communication limits on carbon neutrality	
Learning Outcomes:	By the end of this course, learners will be able to: • Comprehend key strategy for reducing greenhouse gas reduction, including: Calculation of greenhouse gas emissions, reducing the carbon footprint and contribution to the natural sequestration of CO_2 by developing carbon sinks. • Identify in case studies and real-world examples how are applied plans for green houses gas in wineries, considering both short-term and long-term sustainability goals. Reflect on personal values and their alignment with sustainability values in the wine sector, employing critical thinking skills to challenge conventional practices and propose innovative, environmentally conscious solutions.		
Learning materials (e.g. exercises, data sets)	• Lectures • Cases studies • Videos • Further readings		
Language/s of instruction (oral and written material):	English (major materials) Spanish, French, Italian, German, and Macedonian (some materials)		
Method/s for teaching and learnings:	Each Unit consists of three online parts: 1. **Level 1 (CORE):** is the core learning. It includes introductory texts. All learners will read/study all the provided resources. 2. **Level 2 (RELEVANT)** has to be completed by the participants. It includes presentation, videos, case study. 3. **Level 3 (OPTIONAL)** is optional and includes additional resources in different languages as well as optional tasks and experiential activities that can be completed autonomously.		
Method/s of assessment:	Self-assessment quiz with 5 questions for each Unit		
Method for evaluation of course (by students, peer review etc.)	Peer review from partners Evaluation questionnaire by participants		

VIDEO INTRODUCTION

https://youtu.be/IrM_QYt61iM

TRANSCRIPTION

Welcome today in this unit Reduction of green gas emissions, part of module environmental management focused on climate change.

This unit is centered around meeting the unique needs of individuals working in the wine industry, be they professionals or laborers. Its primary focus is on imparting practical skills to address the environmental challenges of today, ensuring the sustainability of wineries in the wine industry.

Learners will gain an in-depth understanding of regulatory frameworks, techniques for reducing greenhouse gas emissions, with special focus on:

- Carbon footprint of the wine industry
- General approach to reduce the carbon footprint
- EU Regulatory framework and implementation
- Calculation of-greenhouse gas emissions
- Carbon diagnosis and action plan evaluation tool
- Example of the result of a carbon diagnosis on a Beaujolais farm
- Communication limits on carbon neutrality

Sign up for this unit and learn more.

LEVEL 1 - CORE LEARNING

CARBON FOOTPRINT OF THE WINE INDUSTRY

The carbon footprint of the French wine industry is estimated at 0.6% of the total French carbon footprint (calculation according to Agribalyse (1), SAA (2), SDES(3). At the scale of the European Union, assuming an identical carbon footprint of the liter of wine for all EU countries as that of the liter of French wine (strong hypothesis given the variability of the energy mix), we get a carbon footprint of the European wine industry representing 0.52% of the total European carbon footprint (calculation according to Agribalyse (1) and Eurostat (4)).

Furthermore, direct emissions from French viticulture are estimated at 0.9% of direct French agricultural emissions, corresponding to 2.89% of the total French utilised agricultural area (calculation according to Agribalyse (1), CITEPA (5) and SAA (6)).

Viticulture and more broadly the wine industry therefore contribute very little in percentage to GHG emissions, but it is invited to do its part in Europe's low carbon trajectory, both in terms of reducing emissions and storing carbon in soils and woody biomass (hedges, vitiforestry). To do this, it is needed to know the breakdown of the carbon footprint of the wine sector according to its different stages.

The wine carbon footprint: what is it made of?

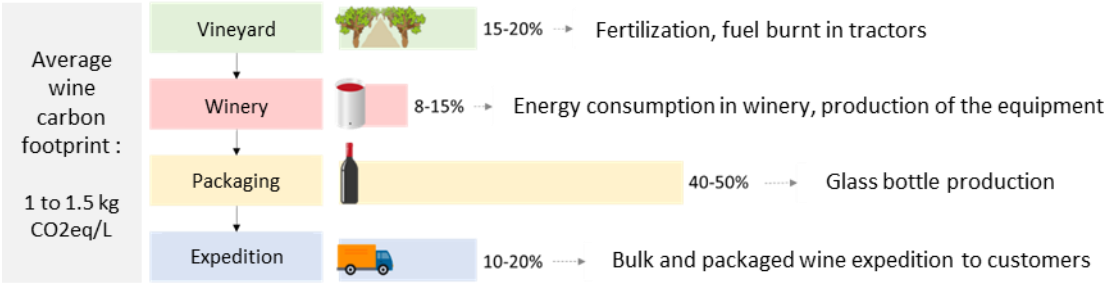


Figure 1. Average contribution to the carbon footprint of a wine sector and main contributing positions (source: IFV)

Some preliminary carbon footprint results applied to the wine industry make it possible to understand which stages of the life cycle have the most impacts.

The majority of emissions come from the packaging stage due to the manufacturing of the glass bottle, and, to a lesser extent, from the manufacturing of the other packaging elements.

Viticulture is generally the second most emitting stage of the life cycle. The main sources of emissions are: the manufacture of fertilizers, nitrogen oxide (N2O) emissions due to the degradation of nitrogen in the field, the fuel consumption of tractors and, to a lesser extent, the manufacturing of trellising elements. When anti-frost equipments are used (paraffin candles in particular), they tend to significantly increase the carbon footprint of the wine.

Transport has a variable importance which depends on the mode of transport, the destination of the wines shipped, the optimization of logistics, but also the average mass of the bottle. The means of transport with the highest emissions per km are airplanes and light utility vehicles.

The winemaking stage contribution to the total carbon footprint of wine is generally fewer, even if its impact depends on the quantity and nature of the energy used in the cellar. Thus, for example, gas heating will have a greater impact than an electrical installation for a predominantly nuclear French electricity mix.

These figures give an overview of the major issues surrounding the carbon footprint of the wine industry. However, these are averages that it is important to get more accurate to support change at the farm scale. Indeed, each operation has its specificities in terms of equipment, technical itineraries, organization, etc.

GENERAL APPROACH TO REDUCE THE CARBON FOOTPRINT

Reducing the carbon footprint is part of an environmental management approach, which requires above all establishing a carbon diagnosis of the studied activity, to identify the technical actions and inputs that contribute the most to the total carbon footprint, and to consider possible effective actions.

These actions can be summarized into two types:

- reduce its greenhouse gas emissions, by optimizing the consumption of inputs (using only the necessary quantity of inputs), or by substitution of one input/material for another one.
- contribute to the natural sequestration of CO_2, by increasing annual carbon inputs into carbon sinks (soil, woody biomass).

In the event of substitution of one practice by another (for example, inter-row grassing instead of mechanical weeding), it is necessary to calculate the effect of this change in practice or to refer to technical references, to ensure that substitution does not cause a shift in pollution.

Table 1 below summarizes the carbon footprint of the main reduction actions known to date for the wine industry. Not all of them have yet been the subject of a quantified evaluation and should therefore be considered as options to validate.

	Reduction of GHG emissions		Sequestration in carbon sinks
Stages of the wine industry	Optimization actions	Substitute actions	Natural carbon sequestration action
Viticulture	- rationalization of the supply of fertilizers - optimization of fuel consumption: rationalization of the number of operations, adapting tractor speed to the tool, coupling of tools, choice of less energy-consuming tools, reduction of tractor power, reduction of planting density - planting of resistant varieties (around -300 $kgCO_2e$/ha/year, source IFV – unpublished) - in the case of anti-frost control: rationalization of energy consumption	- substitution of fossil fuel by a biofuel - choice of fertilizers with a lower carbon footprint - electrification of machines (tractors or robots), - animal traction - ecograzing of inter-row grass cover - choice of trellising elements with a low carbon footprint (wooden stakes, etc.) - in the case of anti-frost control: substitution of the control method for a less emitting method (water sprinkling, winter veils, etc.): -22 $teqCO_2$/ha/year for substitution of paraffin candles with frost veils wintering (source: Comité Champagne)	- addition of organic amendments (manure, compost, etc.) - restitution of the shoots to the soil (around -400 $kgCO_2e$/ha/year for replacing shoots open air burning with restitution to the soil, source IFV – MOSGA project) - ground cover with plant mulch - permanent or temporary grassing of rows or inter-rows (around -350 $kgCO_2e$/ha/year for replacing mechanical weeding with permanent grassing of all rows, source IFV – MOSGA project) - planting hedges at the edge of plots and isolated trees (approximately -458.3 $keqCO_2$/100 linear meters of hedges/year for storage in the ground), - planting of intra-plot lines of trees
Winemaking	- choice of less energy-consuming equipment - rationalization of the number of operations consuming energy	- rationalization of the thermal regulation of wine musts: by the use of oenological inputs, of vats and/or buildings with high thermal inertia - substitution of natural gas with low carbon energy	- choice of biosourced materials for construction or renovation of cellars
Conditionnement	- reduction of the mass of material in a packaging unit - increase of the rate of recycled material in packaging - increase of the recyclability of packaging	- change in packaging material (lighter and/or with a lower manufacturing carbon footprint) - transition from a single-use system to a packaging reuse system. Ex of a reusable keg for distribution in Cafés-Hotels-Restaurants: -0.186 $kgCO_2e$/l of wine transported (source: IFV – ECOFASS WINE project. Ex for a glass bottle returned and reused: -0.345 $kgCO_2e$/l of wine, for 5 reuses.	None
Distribution	- Reduction of the mass of material in a packaging unit	- Change of packaging material (lighter) - Choose less emitting modes of transport - Promote bulk transport	None

Table 1: inventory of mitigation levers for each stage of the wine industry (IFV)

BASIC RESOURCES

Key figures in the wine sector:

- Analyse de cycle de vie de filières agroalimentaires, Synthèse projet ACYDU,2017, Iterg, Ctcpa, IFV, 2017 : https://www.vignevin.com/wp-content/uploads/2019/03/ACYDU_Synth%C3%A8seAcvEnviro.pdf
- L'empreinte carbone viticole : pourquoi et comment la réduire ? Article E. Adoir, IFV, to be published at the end of 2023 in Revue des œnologues de France

General approach to reduce carbon footprint

- MOSGA project results brochure, BIVB, 2023: https://extranet.bivb.com/technique-et-qualite/developpement-durable/neutralite-carbone-de-la-filiere/impacts-environnementaux-de-differents-itineraires-de-desherbage-viticole-en-bourgogne,3122,17813.html?
- Webinar restitution of the MOSGA project, BIVB, 2023: https://extranet.bivb.com/technique-et-qualite/developpement-durable/neutralite-carbone-de-la-filiere/impacts-environnementaux-de-differents-itineraires-de-desherbage-viticole-en-bourgogne,3122,17813.html?
- MOSGA project results brochure, BIVB, 2023: https://extranet.bivb.com/technique-et-qualite/developpement-durable/neutralite-carbone-de-la-filiere/impacts-environnementaux-de-differents-itineraires-de-desherbage-viticole-en-bourgogne,3122,17813.html?
- Stocker du carbone dans les sols agricoles de France, Arrouays et al, 2002, (2) (PDF) Stocker du carbone dans les sols agricoles de France (researchgate.net)
- Ecofass wine project : ECOFASS-VIN – Interreg France-Switzerland (interreg-francesuisse.eu)
- ADEME, 2023 Evaluation environnementale de consigne pour le réemploi d'emballages de verre en France, Volet A. Evaluation environnementale

LEVEL 2 - LEARNING IN DEPTH

EU REGULATORY FRAMEWORK AND IMPLEMENTATION

The scenarios for the evolution of GreenHouse Gas Emissions (GHG) concentration and atmospheric temperature based on different prospective hypotheses of future human actions, published in the 6th IPCC report in 2021, confirm that we must achieve "net zero emissions" of GHG in the 2nd half of the 21st century to remain below +2°C compared to the period 1850-1900 (see Figure 2). Therefore, this is this objective which was decided in 2015 at the end of COP 21 in the Paris Agreement, which was a historic agreement for the climate because the first agreement obliging the signatory States to establish a long-term development strategy to reach low GHG emissions. This agreement also recognizes a principle of equity for climate action: countries having contributed the most to climate change (through their past and current greenhouse gas emissions) and being capable of doing so (capacity and potential for reducing emissions) must take a more active role in global climate action.

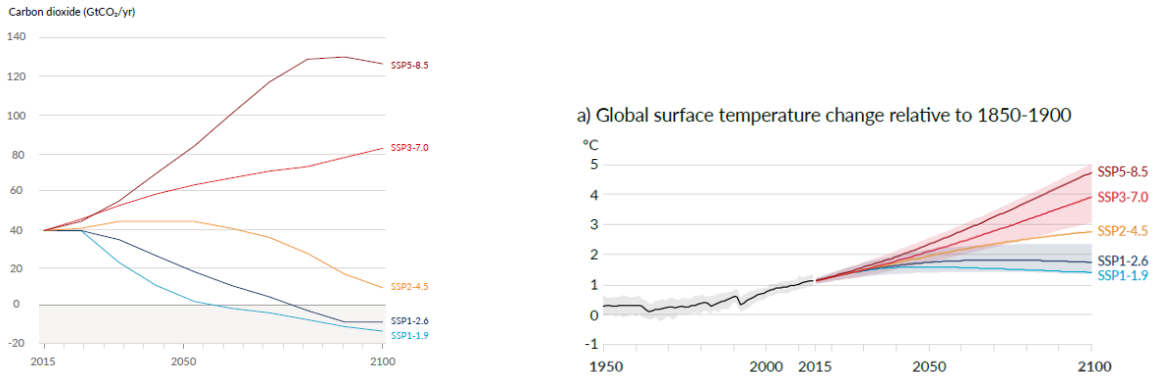


Figure 2 Scenarios for the evolution of GHG concentration in the atmosphere (left) and temperature increase (right) - IPCC, 2021 (6)

Following this Paris Agreement, the French public authorities launched the 2nd National Low Carbon Strategy (SNBC (7)) in November 2019, closely followed by Europe which launched its Green Deal in December 2019. European Green Deal and French SNBC have a major common objective: achieving carbon neutrality, respectively for Europe and France, by 2050. The French SNBC adds an objective of reducing the carbon footprint of the French people (through imported products).

There are in fact two approaches for accounting for GHG emissions (see figure 3):

- The "national inventory" approach: this is the approach used to set the objective of carbon neutrality by 2050. It includes the emissions generated by economic activities located within the geographical perimeter, the direct household emissions as well as emissions linked to the export of products resulting from these activities.
- The "carbon footprint" approach: it takes into account emissions generated by economic activities located within the geographical perimeter, direct household emissions as well as

emissions linked to imported products (inputs of economic activities or products household consumption).

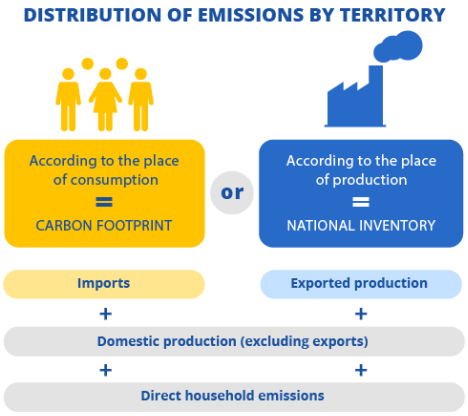


Figure 3: Two approaches to inventorying a country's GHG emissions (source: INSEE infographic) (8)

The objective of carbon neutrality in 2050 was defined according to a “national inventory” approach, and necessarily requires having in 2050 as much annual carbon capture (natural and/or technological) as annual GHG emissions on a given geographical area.

To achieve these objectives, the targeted trajectory in France is (see Figure 4):

- a 40% reduction in GHG emissions by 2030 compared to 1990
- an 84% reduction in GHG emissions by 2050 compared to 1990
- a 50% increase in carbon sinks (soils, biomass, technological sinks) by 2050 compared to 2019.

In absolute value, these objectives require a drastic reduction in GHG emissions (-378 Mt CO_2eq/year), and a small increase in annual carbon capture (around 40 Mt CO_2eq/year) over the 2015-2050 period.

This scenario is based on a fundamental principle: it is necessary to reduce emissions as much as possible before considering compensation through carbon capture. Indeed, the natural capture of biogenic carbon in soils, biomass and biosourced products is reversible: if agricultural “storage” practices are abandoned, the soil will gradually release through mineralization organic matter what it had started to store. Likewise, if biosourced products or biomass deposits are burned (vine stocks, wooden products, buildings incorporating straw, etc.), the stored CO_2 returns to the atmosphere and there will be no benefit of storage for the climate . Furthermore, CO_2 capture in geological cavities is a recent technology, and can only be considered as a minor complementary solution.

In addition to this principle, the potential for additional carbon storage in French agricultural soils was quantified during a collective INRAE expertise called the “4 per thousand study”(9). The implementation of the main storage practices per crop across all French agricultural basins with constant climate, atmospheric CO_2 concentration and land use would only allow the storage of 29.9 Mt CO_2eq/year more, or 6.5 % of national emissions and 39% of agricultural emissions in 2016. This would represent an additional annual storage of +1.8 ‰/year, that has to be added to a tendential storage subject to high uncertainty (estimated between 0 ‰/year and 3,3 ‰/year). Then, even if all the main practices that would have an effect on carbon storage would be implemented, it remains

unsure for France to reach the +4 ‰/year aim (necessary threshold on a global scale to achieve global carbon neutrality), as the overall carbon storage would be between 1.8 and 5,1 ‰/year. And it is far from the threshold of +3.4%/year to achieve French carbon neutrality without reducing emissions.

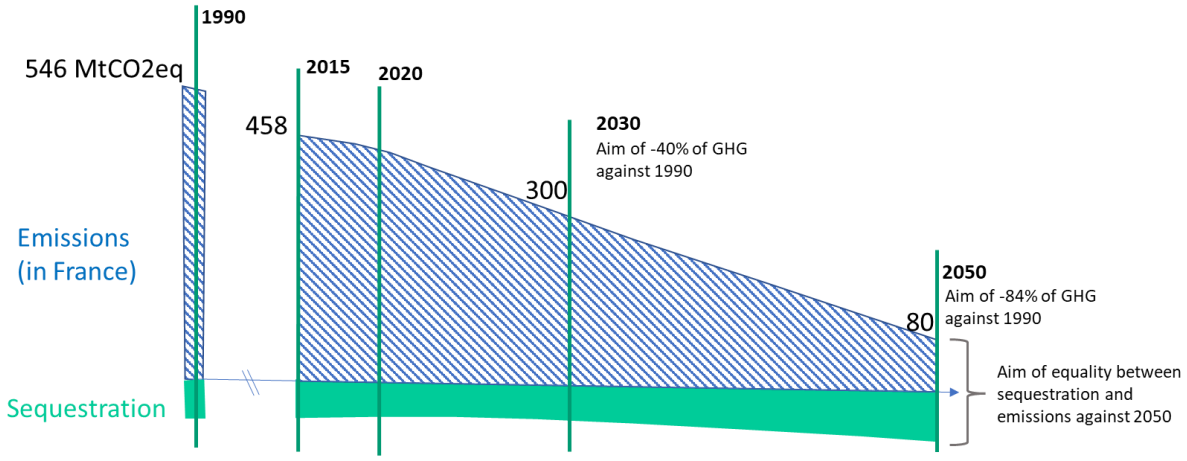


Figure 4: Trajectory of emissions and carbon capture in France targeted by the SNBC to achieve carbon neutrality in 2050 IFV (according to the Ministry of Ecological Transition) (7)

Finally, in France, the efforts of the wine industry could be rewarded by the sale of carbon credits (valorization of the CO_2 equivalent tonne reduced or captured), according to the "Label Bas Carbone" methods (a low carbon label created by the French Ministry of Agriculture). Projects of carbon footprint reduction could be approved once an official method will be approved for the different stages of the wine industry and will be implemented by professionals only if these sales will be profitable according to the price of a ton of reduced CO2 and according administrative and technical costs of such reduction projects.

Calculation of greenhouse gas emissions

The carbon footprint is an environmental assessment method which consists of accounting for all the greenhouse gases emitted by an activity, over its entire life cycle. The life cycle approach makes it possible to include emissions taking place on site (direct emissions), but also emissions taking place upstream of the activity - manufacturing of inputs, equipment, buildings, upstream transport, etc. - and the emissions induced downstream of the activity – marketing of the product, mode of consumption of the product, end of life and recycling, etc (indirect emissions). This method is standardized, according to ISO 14 064-65-67 standards. Methodological guidelines specifying the application of these standards exist for wine: we can cite the publications of the SUSTAIN group of the OIV (formerly ENVIRO), or the PEFCR Wine (Product Environmental Footprint Category Rules for Wine).

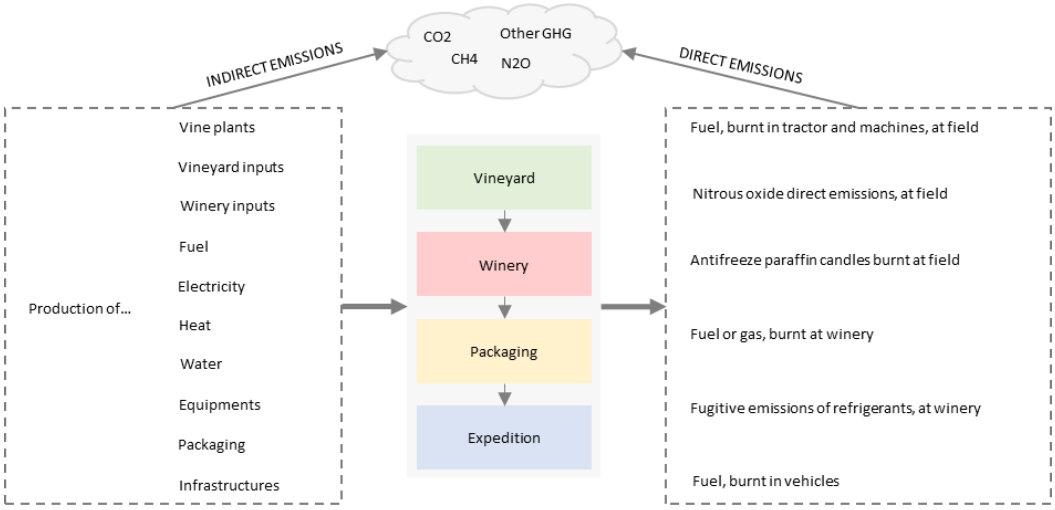


Figure 5. Direct and indirect emissions of the wine sector (source: IFV)

Thinking in terms of life cycle therefore makes it possible to understand the impacts on climate change of the activity as a whole, without focusing solely on the emissions taking place directly on the production site. It then makes it possible to avoid transfers of pollution, that is to say to ensure that a reduction in emissions on site does not result in an increase in emissions at another level of the production chain. The carbon footprint is measured in tons of carbon dioxide equivalent (T of CO_2 eq..), CO_2 having been chosen as a reference for calculating the indicator. Indeed, each greenhouse gas has a different Global Warming Potential (GWP), that means a different GWP compared to the GWP of CO_2. The estimated emissions of each greenhouse gas from an activity are therefore converted into T of CO_2 eq. by multiplying them by their respective GWP.

All GHG emissions are accounted for, the main GHG coming from human activities being CO_2 from the combustion of oils (fossil CO_2). We can also account for the emissions or capture of CO_2 contained in woody biomass or vineyard soils (biogenic CO_2) when we consider a sufficiently long residence time in the compartment (several decades). However, CO_2 emissions and capture induced in the natural annual cycle of plants (degradation of organic matter, plant respiration, fixation by photosynthesis) are generally not accounted, or are accounted separately, because it is considered as the short carbon cycle, which does not influence its concentration in the atmosphere.

The calculation of the carbon footprint is therefore a diagnosis on which wine makers can rely on to identify the sources of pollution of their activity and initiate a process to reduce emissions. Concretely, for the assessor, it involves collecting from the company all the flows of inputs consumed and waste generated for one unit of grape or wine produced, to deduce the direct and indirect emissions of the activity. This calculation of the carbon footprint and the resulting reduction strategy can be considered at several scales: at the scale of the wine sector, the territory, but also at the scale of the company.

Carbon diagnosis and action plan evaluation tool

To concretely support this low-carbon transition in wine farms and facilitate the calculation of combinations of actions, the French Institute for Vine and Wine (IFV) has created a diagnosis and

simulation tool for GHG emissions from vine cultivation, on the vineyard perimeter and distinguishing the different cropping systems in the vineyard. GES&Vit is an online carbon footprint calculator for vineyards allowing both to establish a diagnosis of the sources of pollution of the activity, to identify relevant actions, and to calculate the carbon footprint of the modified cropping systems. The result is an estimate of the emissions reductions obtained thanks to these actions even before their implementation. The originality of this tool is to provide results at the fine scale of practices, without which the diagnosis would be inaccurate and the simulation of changes in cropping systems impossible. To do this, it is necessary to describe at least a typical technical itinerary in the vineyard, but it is possible to describe up to three cropping systems to refine the diagnosis and compare them with each other.

Calculating such a carbon footprint consists of adding the direct (in the vineyard) and indirect (during the manufacturing and transport of inputs) GHG emissions of each viticultural practice. Concretely, the user collects from the winery all the input flows used by the cropping system: GES&Vit then do automatic calculations by converting the input flows into GHG flows based on recognized references (Base Carbone®, EcoInvent®, bibliography), and by modelling the evolution of carbon stock in soils using the AMG model. If the winegrower doesn't know the fuel consumption of each cultivation operation , GES&Vit can estimate this consumption based on the technical data provided.

The scope of the inputs taken into account in the tool is as exhaustive as possible:

- Non-Road Diesel, propane from thermal operations (direct emissions from combustion and indirect emissions linked to manufacturing),

- mineral fertilizers (direct emissions through denitrification and indirect emissions linked to manufacturing),

- organic and organo-mineral fertilizers and amendments, temporary and permanent grassing (direct emissions by denitrification, indirect emissions linked to the manufacture of products and seeds, carbon storage in the soil),

- management of vine shoots (direct emissions if combustion or carbon storage in the soil if restitution to the soil)

- phytosanitary products (indirect emissions linked to manufacturing).

COMPLEMENTARY RESOURCES

Green Deal objectives/Regulatory framework:

- Infography - Fit for 55: how the EU will turn climate goals into law, Council of the European Union: Infographic: how the EU delivers the green transition - Consilium (europa.eu)
- Fit for 55, Council of the European Union: Fit for 55 - The EU's plan for a green transition - Consilium (europa.eu)

Carbon footprint of the European Union:

- One third of the European Union's carbon footprint is due to its imports, INSEE, 2022: One third of the European Union's carbon footprint is due to its imports - Insee Analyses - 74
- Infography : les émissions de gaz à effet de serre dans l'Union européenne, Comprendre l'Europe, 2023: https://www.touteleurope.eu/environnement/les-emissions-de-gaz-a-effet-de-serre-dans-l-union-europeenne/

Calculation method:

- Greenhouse gases accounting in the vine and wine sector – recognised gases and inventory of emissions and sequestrations résolution OIV-CST 503AB-2015, OIV, 2015: https://www.oiv.int/public/medias/2112/oiv-cst-503ab-2015-en.pdf
- Publication: Greenhouse gases accounting in the vine and wine sector – recognised gases and inventory of emissions and sequestrations, OIV, 2015: publication-bilan-ges-en.pdf (oiv.int)
- General principles of the oiv greenhouse gas accounting protocol for the vine and wine sector, OIV, 2011: https://www.oiv.int/public/medias/2107/oiv-cst-431-2011-en.pdf

Carbon diagnosis and action plan evaluation tool

- ADEME, Base carbone® (ademe.fr)
- ECOINVENT® Home - ecoinvent
- INRAE, 2023. AMG model description : Equipe AgroImpact de l'UMRT BioEcoAgro - AMG model description (inrae.fr)

Calculation method for a wine carbon footprint:

- GES'TIM+ : la référence méthodologique pour l'évaluation de l'impact des activités agricoles sur l'effet de serre, la préservation des ressources énergétiques et la qualité de l'air" (ADEME, 2020) : Mise à Jour des données énergies-GES de Ges'tim sur la base d'ecoinvent V3 (ademe.fr)

References on mitigation actions:

- La Minute Vignevin : Qu'est-ce que le stockage carbone dans les sols ? IFV : https://www.youtube.com/watch?v=7QQtLyYam1o
- Comparing the Carbon Footprint of Conventional and Organic Vineyards in Northern Italy, 2023; https://doi.org/10.3390/su15065252
- Evaluation environnementale de la consigne pour le réemploi des emballages en verre en France, ADEME, 2023 : https://librairie.ademe.fr/dechets-economie-circulaire/6359-evaluation-environnementale-de-la-consigne-pour-le-reemploi-des-emballages-en-verre-en-france.html
- Comparative life cycle assessment of alternative systems for wine packaging in Italy, Carmen Ferrara, Giovanni De Feo 2020 : https://doi.org/10.1016/j.jclepro.2020.120888
- Life cycle assessments of wine and spirit packaging at the product and the municipal scale: a Toronto, Canada case study, Julian Cleary, 2013 : https://doi.org/10.1016/j.jclepro.2013.01.009

Study report

- Matthieu Gasparoux. Eco-design of wine cellar based on Celeyran cellar Agronomie. 2019. dumas-02971200 https://dumas.ccsd.cnrs.fr/dumas-02971200

Study cases

- Carbon footprint of products and services: The case of a winery in Greece https://doi.org/10.1016/j.scitotenv.2023.162317

LEVEL 3 - ADDITIONAL RESOURCES

EXAMPLE OF THE RESULT OF A CARBON DIAGNOSIS ON A BEAUJOLAIS FARM

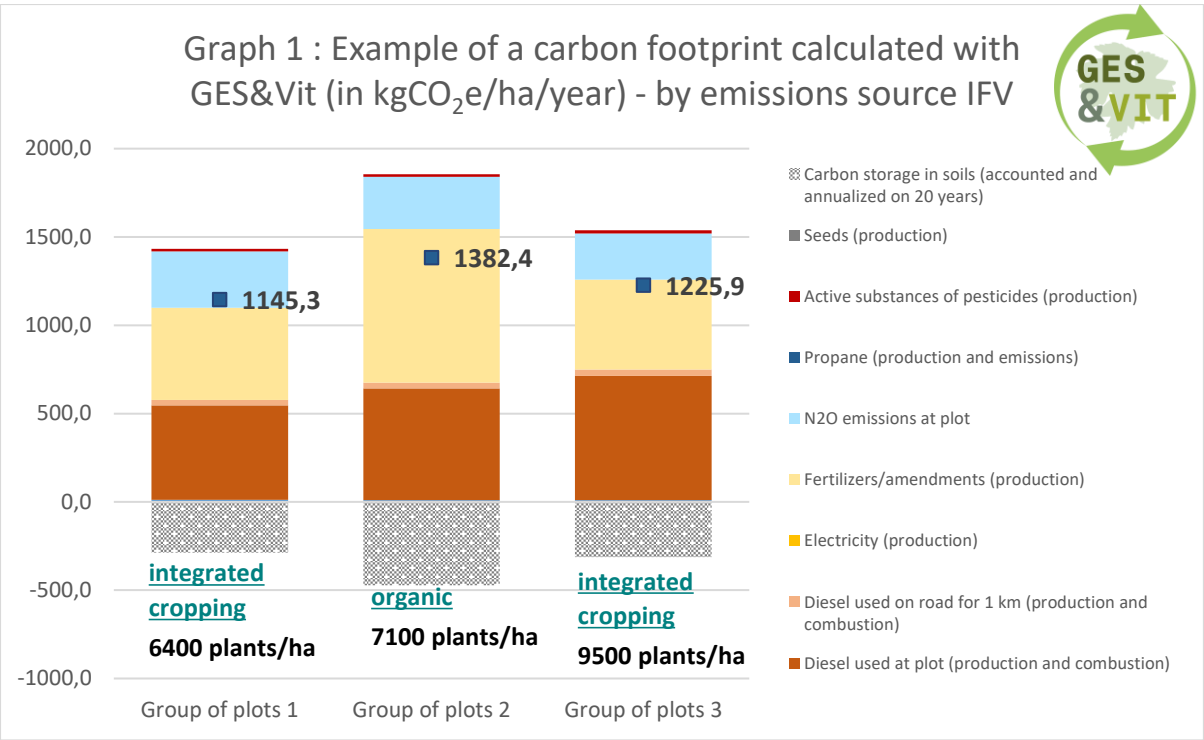
The GES&Vit tool was used to carry out the viticultural carbon diagnosis of Château de l'Eclair, an experimental vineyard of SICAREX Beaujolais operating at the same scale as a normal vineyard, and with a representative surface area of 21 ha.

After discussion with the cultivation manager, three main management modes (MC) were identified, differentiated on phytosanitary practices and planting density (see graph 1 below), and the technical itinerary specific to each MC was describe.

In Figure 6, the three MCs are compared fairly by calculating GHG emissions per hectare. The positive part of the histogram provides information on GHG emissions by item (types of inputs). The negative part provides information on the annual storage flow, resulting from the variation in stock integrated over 20 years and then smoothed over 20 years. The blue square gives the value of the net carbon footprint for each MC: considering this indicator, we see that MC2 (organic) is the most impactful system, even if the differences are quite small compared to the values observed in other vineyards. MC3 has more impact than MC1 due to the greater planting density (more linear meters = more diesel burnt).

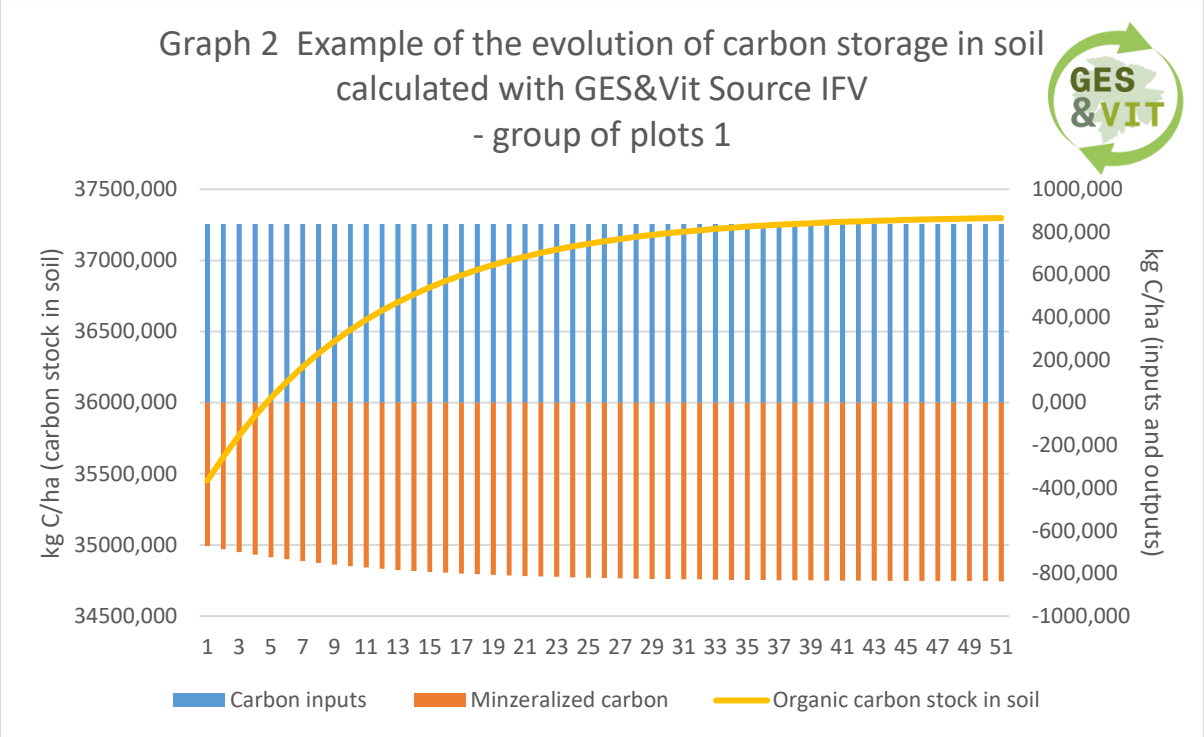
For the three MCs, the main sources of emissions are the consumption of diesel on the plot and the manufacture of fertilizers. Another type of graph available in the results shows that diesel consumption is mainly due to phytosanitary treatments, soil maintenance, then to a lesser extent to mechanical harvesting and the vine shoots shredding.

From this diagnosis, we can formulate several options for reducing emissions to assess through scenarios, and that has to be considered over different time steps: optimization of fertilization, coupling of tools, choice of less energy-consuming tools, reduction of the tractor power, substitution of diesel with biofuel, electrification of machines (tractors or robots), reduction of planting density, planting of resistant varieties, etc.



Concerning the management of organic matter in the soil, it is quite similar between the three: shredding and returning the shoots to the ground, permanent grassing on all rows, addition of organic amendments (more important in MC2). These practices having been implemented for several years, the result is a fairly high level of organic matter at the time of diagnosis (2%) and a fairly low average annual carbon flow. Indeed, the dynamics of carbon storage is exponential as we can see in another graph from GES&Vit (see graph 2). The annual storage flow is therefore very significant in the first years following the introduction of a new “storage” practice, then tends towards very low values after a few decades, when the annual carbon inputs (blue bars) and the quantities of mineralized organic matter (orange bars) balance.

Since the organic matter inputs are already significant on this farm, there is few possible actions leftto increase this annual storage rate. Consideration can still be given to increasing the biomass of grass produced per ha, in particular by installing temporary covers.



Limits of the communication on carbon neutrality

The presentation of the results of the net carbon footprint as carried out in the GES&Vit tool must be taken with the greatest caution. The results from Château de l'Eclair-Beaujolais-France present a net positive carbon footprint for the reasons explained previously (storage already started a long time ago). However, depending on the situation, it is possible to obtain a zero or even negative net carbon footprint.

Even if it is tempting to communicate about the carbon neutrality of an operation, this type of results can only be used to make an overall comparison between different cropping systems and select those which present the best performance. Absolute values alone can neither be sufficient nor justify not seeking to reduce emissions, for the reasons mentioned at the beginning of this article (reversibility of biogenic carbon storage).

Furthermore, the principle of carbon neutrality cannot be applied at the scale of a company, or even of a sector, but only at the international, European and national level (National Low Carbon Strategy to achieve carbon neutrality of the France). It is therefore not possible for a company or sector to communicate on the "carbon neutrality" of its activity or its products. Only the words "commit to collective carbon neutrality" or "implement a carbon neutrality approach" are recommended by the French National Agency for Environment ADEME (10).

ADDITIONAL RESOURCES

Podcast

- Episode 28 : https://www.theartofsellingwine.com/_Podcast :

More videos

- Entreprises du vin : pourquoi et comment connaître son empreinte environnementale ? https://youtu.be/4tC7EBdyi-k

REFERENCES

ADEME Agribalyse - Portail ADEME

SAA : Statistique Annuelle Agricole, 2019. Ministère de l'Agriculture français.

SDES : Données et études statistiques Pour le changement climatique, l'énergie, l'environnement, le logement, et les transports : Accueil | Données et études statistiques pour le changement climatique, l'énergie, l'environnement, le logement, et les transports (developpement-durable.gouv.fr)

Eurostat (website visited in September 2023) : https://ec.europa.eu/eurostat/fr/web/products-eurostat-news/-/edn-20201119-2 ; https://ec.europa.eu/eurostat/fr/web/products-eurostat-news/-/ddn-20220524-1

CITEPA EUROSTAT, EUROSTAT PUBLIE SES ESTIMATIONS DE L'EMPREINTE CARBONE DE L'UE POUR 2019 : Eurostat publie ses estimations de l'empreinte carbone de l'UE pour 2019 - Citepa

IPCC, 2021, Climate Change 2021: The Physical Science Basis | Climate Change 2021: The Physical Science Basis (ipcc.ch)

French ministery of Ecological Transition, National low carbon strategy, 2020: en_SNBC-2_summary.pdf (ecologie.gouv.fr)

One third of the European Union's carbon footprint is due to its imports, INSEE, 2022: One third of the European Union's carbon footprint is due to its imports - Insee Analyses - 74

INRAE : Storing 4 per 1000 carbon in soils: the potential in France : Storing 4 per 1000 carbon in soils: the potential in France | INRAE

ADEME, 2022. L'ADEME publie un avis d'experts sur utilisation de l'argument de neutralité carbone dans les communications, https://presse.ademe.fr/2022/02/lademe-publie-un-avis-dexperts-sur-lutilisation-de-largument-de-neutralite-carbone-dans-les-communications.html

SELF-ASSESSMENT

1. Question: What European orientation does the carbon neutrality objective correspond to?
    a) Option 1: Farm to Fork strategy
    b) Option 2: Green Deal for Europa
    c) Option 3: Action plan for a circular economy
    d) Option 4: Action plan for zero pollution

2. Question: When is the 50% GHG reduction objective planned?
    a) Option 1: 2025
    b) Option 2: 2030
    c) Option 3: 2040
    d) Option 4: 2050

3. Question How I calculate my carbon footprint ?
    a) Option 1: ecological footprint
    b) Option 2: Low carbon label
    c) Option 3: Greenhouse gas balance
    d) Option 4: Life cycle analysis

4. Question How reducing the carbon footprint?
    a) Option 1: Reduce your greenhouse gas emissions
    b) Option 2: Refresh the temperature of the musts
    c) Option 3: Use of reversible air conditioners
    d) Option 4: Resort to soil tillage

5. Question Contribution to the natural sequestration of CO_2 by developing carbon sinks
    a) Option 1: Adding organic amendment to soil
    b) Option 2: Addition of CO_2 to fermentation soils
    c) Option 3 : Weeding of plots
    d) Option 4: Use of flexible materials for the construction or renovation of cellars

UNIT 8 - MANAGEMENT OF WASTE AND BY PRODUCTS AND VINE AND WINE EFFLUENTS

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module:</td><td colspan="3">Environmental management focused on climate change – part II:

Reduction of greenhouse gas emissions – Energy efficiency – waste by-products and effluents</td></tr>
<tr><td>Type:</td><td colspan="3">Online</td></tr>
<tr><td>Workload for learner (hours):</td><td colspan="3">5 hours</td></tr>
<tr><td>Trainers:</td><td colspan="3">IFV: Carine Herbin, Sophie Penavayre, Emilie Adoir, Hugo Luzi, , CESAR: Laura Rondoni, Fabio Maria Santucci, Francesco Castellini</td></tr>
<tr><td>Institution(s):</td><td colspan="3">IFV, CESAR</td></tr>
<tr><td>Content/short description; duration; training/learning method:</td><td colspan="3">This module is designed to directly address the needs of wine workers and professionals in the wine industry, focusing on practical skills and applications to ensure the resilience and success of wineries amid today's environmental challenges. Learners will engage with real-life case studies from the wine industry, gaining insights into the reduction of greenhouse gas emissions, the promotion of energy efficiency, and the management of waste, by-products and effluents. Built around practical scenarios, the module offers a comprehensive learning experience that combines theory and application. Through it, learners will gain an in-depth understanding of regulatory frameworks, waste and effluent management, and techniques for reducing greenhouse gas emissions and improving energy efficiency. Amid fluctuating environmental conditions, the need to reduce emissions, increase efficiency, and manage waste, wineries are called upon to navigate complex issues. This module empowers learners with the tools to face these challenges while preserving the uniqueness of their terroir, style, and variety. The applied knowledge and competencies acquired during the course will support them in making informed decisions that ensure the continued success of their establishments despite environmental, social, and economic challenges.</td></tr>
<tr><td></td><td>Unit</td><td>Content</td><td>Duration</td></tr>
<tr><td></td><td rowspan="3">Management of waste and by-products and vine and wine effluents</td><td>EU Regulatory framework</td><td rowspan="3">0,5 H

1H</td></tr>
<tr><td>Reducing waste and effluents</td></tr>
<tr><td>Valuing by-products</td></tr>
</table>

Learning Outcomes:	By the end of this course, learners will be able to: • List the techniques for managing waste, effluents, and by-products, including reducing waste and effluents and valuing by-products. • Identify in case study and real-world examples how are applied plans for waste, effluents, and by-products in wineries. Reflect on personal values and their alignment with sustainability values in the wine sector, employing critical thinking skills to challenge conventional practices and propose innovative, environmentally conscious solutions.
Learning materials (e.g. exercises, data sets)	• Lectures • Cases studies • Videos Further readings
Language/s of instruction (oral and written material):	English (major materials) Spanish, French, Italian, German, and Macedonian (some materials)
Method/s for teaching and learnings:	Each Unit consists of three online parts: 1. **Level 1 (CORE):** is the core learning. It includes introductory texts. All learners will read/study all the provided resources. 2. **Level 2 (RELEVANT)** has to be completed by the participants. It includes presentation, videos, case study. 3. **Level 3 (OPTIONAL)** is optional and includes additional resources in different languages as well as optional tasks and experiential activities that can be completed autonomously.
Method/s of assessment:	Self-assessment quiz with 5 questions for each Unit
Method for evaluation of course (by students, peer review etc.)	Peer review from partners Evaluation questionnaire by participants

VIDEO INTRODUCTION

https://youtu.be/eDhEuJchhGc

TRANSCRIPTION

Welcome today to this unit, Management of Waste and By-products and Vine and Wine Effluents, part of the module Environmental Management focused on climate change.

This unit has been designed to answer specifically to the requirements of wine industry professionals and workers, with a strong emphasis on practical skills and applications that strengthen wineries' resilience and success in the face of today's environmental challenges.

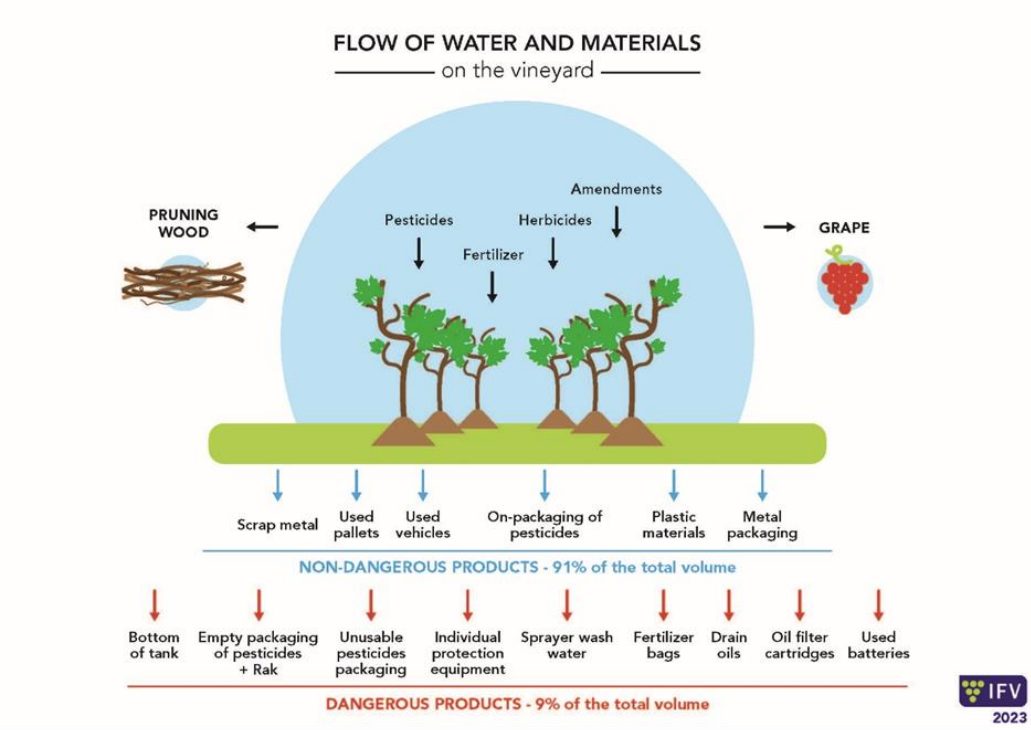
Learners will learn the reasons why management of waste and by-products, including vine and wine effluents, holds significant importance, with special focus on:

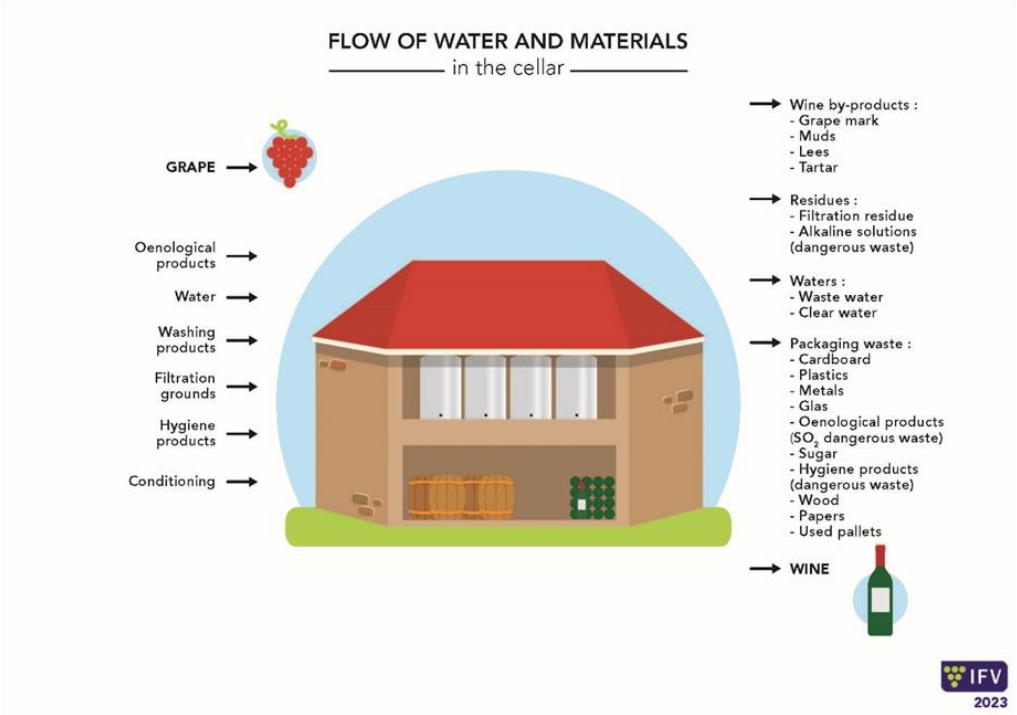
- EU Regulatory framework
- Reducing waste and effluents
- Valuing by-products

Enjoy the course and embark on a journey of discovery to expand your knowledge further!

LEVEL 1- CORE LEARNING

FLOW OF WATER AND MATERIALS ON THE VINEYARDS AND IN THE CELLAR





REDUCTION OF VINE AND WINE EFFLUENTS AND WASTE

Reduction vine and wine Waste Strategy

The legislation first regulated the conditions for waste elimination, then the reduction of waste at the source, selective management approaches, the strengthening of the responsibility of the waste producer, and finally the implementation of a waste prevention plan, strategy based on the reduction of the use of non-renewable resources, the increase the use of materials recycled and the increase the recyclability of the products.

Appropriately, the waste strategy will deploy measures upstream and downstream of production.

Upstream approach:

- Carry out a diagnosis of the waste generated and sold
- Raise awareness, train and motivate staff;
- Rely on the 3 Rs: reduce, reuse, recycle.
- Reduce waste and its toxicity at source
- Sort: separation before revaluation or elimination of waste (hazardous or not) and by-products in order to facilitate their treatment or elimination in specific sectors.
- Promote the recycling or recovery of manufacturing by-products

Downstream approach:

- Carry out selective sorting
- resort to waste treatment or pre-treatment
- Ensure the traceability of each waste

Reduction of vineyards effluent

The major measure consists of limiting the tank bottom volumes to be treated.

Reduction of cellar effluent

Water saving: water saving leads to a reduction in the volume of effluent discharged and therefore to be treated.

- Install a water meter specific to winemaking activity. This will make it possible to control consumption and facilitate staff awareness.
- Adapt the design of the cellars. Prior reflection, possibly associated with visits to installations, allows the design to be optimized. Several aspects are particularly important:
    - Rational drainage devices (sufficient slope, close drainage points)
    - Choice of easily cleanable flooring and winemaking equipment
- Limit losses
    - Detect leaks

    - Install automatic shut-off devices at the end of water pipes
- Optimize cleaning operations
    - Carry out dry pre-cleaning (broom, squeegee)
    - Use cleaning and disinfection products precisely according to the instructions for use
    - Use a booster
    - Increase contact time thanks to the foam cannon
    - Use hot water.

Reduction of effluent discharges: Reduce the pollutant load of effluents

- Recover the by-products (sludge and lees) which are very loaded with organic matter and which can be recycled in the distillery. Scraping the lees from the bottom of the tank before washing is necessary to recover as much as possible. Dry solid scale is purchased by tartaric acid manufacturing industries.

Recover residues

- Soda descaling juices can be recycled by companies specializing in tartaric acid recovery; the filtration soils, when the stripping has been carried out dry, can be recycled through a suitable sector.
- Screen wastewater
- This operation prior to purification makes it possible to eliminate coarse elements and possibly foreign bodies (avoiding obstruction of the pipes or damage to the pumps).

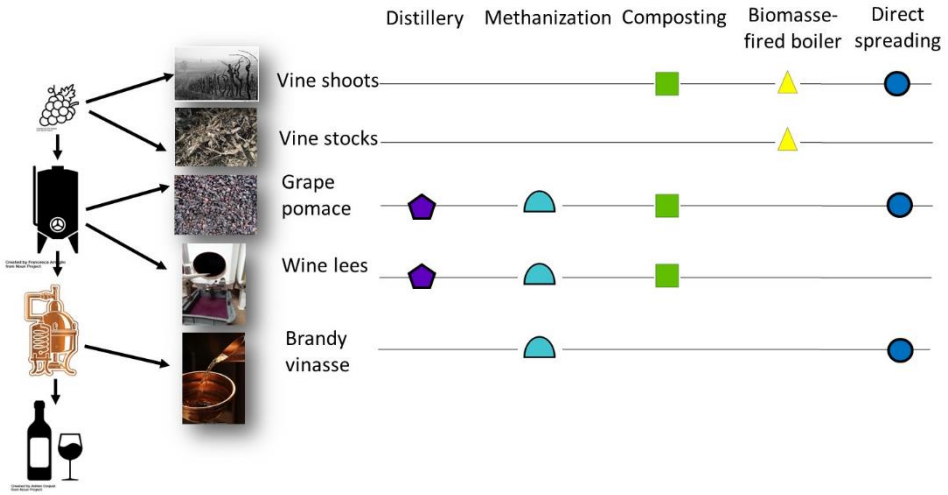
VALORIZATION OF BY-PRODUCTS

By-products are generated by viticulture and winemaking: vine shoots, stumps, grape marc, wine lees, lees, etc. They represent an irreducible part of biomass which can be valorized from an environmental, agronomic and economic point of view.

The distillation of grape marc and wine lees, as well as the spreading, composting and methanization of grape marc have been studied in France since 2010 with the aim of answering the following questions: What technical feasibility? What environmental impact? What cost for the winegrower? What regulatory constraints must be respected, particularly in environmental matters? The results of the tests and studies carried out as part of the National Experiment on the valorization of wine by-products (IFV, 2010-2013) are summarized in the IFV Route Book No. 25: Grape marc, wine lees and lees: What management of wine by-products?

In France, the practice of burning branches and stumps is called into question by the circular of November 18, 2011 prohibiting the open burning of green waste. On the other hand, until 2014, the community obligation to eliminate marc, lees and lees translated for French winegrowers into the obligation to deliver all by-products to approved wine distilleries. Since August 2014, this obligation can be met by distillation, methanization, composting or spreading.

Holders of wine by-products are required to enter into a circular economy approach.



The possible ways of valorization of the different vine and wine by-products
© Emilie Adoir, IFV

BASIC RESOURCES

- IFV, 2004, Itinéraire IFV n°8 : Gestion des effluents des petites et moyennes caves : ITV08_01et24 (vignevin.com) ITV08_01et24 (vignevin.com)
- IFV, 2006, Itinéraire IFV n°13 Gestion durable des sous-produits et déchets des exploitations viticoles et des caves Itin_13_GestionDurable.pdf (vignevin.com)
- IFV, 2012, Cahier itinéraire n°25, 2013. Marcs de raisins, lies de vin et bourbes : Quelle gestion des sous-produits vinicoles ? Itin-25-Modif_dec-2.pdf (vignevin.com)
- Arrêté du 26/11/12 relatif aux prescriptions générales applicables aux installations relevant du régime de l'enregistrement au titre de la rubrique n° 2251 (préparation, conditionnement de vins) de la nomenclature des installations classées pour la protection de l'environnement Arrêté du 26/11/12 relatif aux prescriptions générales applicables aux installations relevant du régime de l'enregistrement au titre de la rubrique n° 2251 (préparation, conditionnement de vins) de la nomenclature des installations classées pour la protection de l'environnement | AIDA (ineris.fr)
- Arrêté du 15/03/99 relatif aux prescriptions générales applicables aux installations classées pour la protection de l'environnement soumises à déclaration sous la rubrique n° 2251 (Préparation, conditionnement de vin, la capacité de production étant supérieure à 500 hl/an mais inférieure ou égale à 20 000 hl/an). Arrêté du 15/03/99 relatif aux prescriptions générales applicables aux installations classées pour la protection de l'environnement soumises à déclaration sous la rubrique n° 2251 (Préparation, conditionnement de vin, la capacité de production étant supérieure à 500 hl/an mais inférieure ou égale à 20 000 hl/an). | AIDA (ineris.fr)
- Décret n° 2002-540 du 18/04/02 relatif à la classification des déchets : Décret n° 2002-540 du 18/04/02 relatif à la classification des déchets | AIDA (ineris.fr)

LEVEL 2 - LEARNING IN DEPTH

EU REGULATORY FRAMEWORK

Waste and by-product regulations

The European legal framework regarding waste, by-products and their management is European Directive 2008/98/EC (1), amended by Directive (EU) 2018/851 (2).

European Directive 2008/98/EC (0)
Defines basic notions such as waste, recovery, elimination, etc.)

Establishes the essential requirements relating to waste management, namely the obligation for an establishment or company carrying out waste management operations to hold an authorization or to be registered and the obligation for Member States to establish waste management plans.

It also sets out the main principles such as:

- The obligation to treat waste in a way that is not harmful to the environment and human health,
- Encouragement to apply the waste hierarchy.

And, in accordance with the polluter pays principle, the requirement that the cost of waste disposal must be borne by the holder of the waste, previous holders or producers of the product generating the waste.

Waste is defined, at European level, as “any substance or object which the holder discards or which he intends or is obliged to discard”. Art. 3 point 1

The waste hierarchy (European directive 2008/98/EC):

1. Prevention

“Measures taken before a substance, material or product becomes waste and reducing:

a. The amount of waste, including through reuse or product life extension;

b. The harmful effects of waste produced on the environment and human health; Or

c. The content of harmful substances in materials and products;

Ecodesign (systematic integration of environmental aspects into product design with a view to improving the environmental performance of the product throughout its life cycle), is one of the prevention tools, like environmental management systems (EMAS), ISO 14001 standard)).

2. Preparation for reuse

“Preparation for reuse”: any control, cleaning or repair operation with a view to recovery, by which products or components of products which have become waste are prepared so as to be reused without further pretreatment operation ;

Reuse: any operation by which products or components which are not waste are used again for a use identical to that for which they were designed; Art. 3 item 13

Example: bottle deposit and refilling after cleaning.

3. Recycling

Any recovery operation by which waste is reprocessed into products, materials or substances for the purposes of their initial function or for other purposes. This includes the reprocessing of organic materials, but does not include energy recovery, conversion for use as fuel or for backfilling operations; Art. 3 point 17

Example: manufacturing bottles from cullet (crushed glass).

4. **Other recovery**, in particular energy recovery;

5. **Disposal**

Any operation which is not recovery even when said operation has as a secondary consequence the recovery of substances or energy. Annex I lists a non-exhaustive list of disposal operations;

By-products: A substance or an object resulting from a production process whose primary aim is not the production of said good can only be considered as a by-product and not as waste [...], only if the conditions following are fulfilled:

- The subsequent use of the substance or object is certain;

- The substance or object can be used directly without additional processing other than common industrial practices;

- The substance or object is produced as an integral part of a production process;

- And the subsequent use is legal, i.e. the substance or object meets all relevant product, environmental and health protection regulations intended for the specific use and will have no impact.

Art. 5 point 1

Valorization of by-products

“Recovery”: any operation whose main result is that waste is used for useful purposes by replacing other materials which would have been used for a particular purpose, or that waste is prepared to be used for this purpose, in the factory or throughout the economy. " Art. 15 item 15,

VALORIZATION OPERATIONS annex II

R 1 Main use as fuel or other means of producing energy (*)

R 2 Recovery or regeneration of solvents

R 3 Recycling or recovery of organic substances that are not used as solvents (including composting operations and other biological transformations) (**)

R 4 Recycling or recovery of metals and metal compounds

R 5 Recycling or recovery of other inorganic materials (***)

R 6 Regeneration of acids or bases

R 7 Recovery of products used to capture pollutants

R 8 Recovery of products from catalysts

R 9 Regeneration or other reuse of oils

R 10 Spreading on the ground for the benefit of agriculture or ecology

R 11 Use of residual waste obtained from one of the operations numbered R 1 to R 10

R 12 Exchange of waste with a view to submitting it to one of the operations numbered R 1 to R 11 (****)

R 13 Storage of waste prior to one of the operations numbered R 1 to R 12 (excluding temporary storage, before collection, on the waste production site) (*****)

What is the circular economy?

“The circular economy is a model of production and consumption, which involves sharing, renting, reusing, repairing, refurbishing and recycling existing materials and products for as long as possible. In this way, the life cycle of the products is extended.

In practice, this means reducing waste to a minimum. When a product reaches the end of its life, its materials are kept in the economy wherever possible through recycling. These can be used productively again and again, creating additional value. » (0)

Amending Directive (EU) 2018/851 (0) strengthens prevention and directs measures towards the circular economy.

It “establishes measures to protect the environment and human health by preventing or reducing the generation of waste and the harmful effects of the production and management of waste, and by reducing the overall impacts of use of resources and an improvement in the efficiency of that use, which are essential for the transition to a circular economy and the long-term competitiveness of the Union. " First article

Vine effluent regulations

Vineyard effluents consist of tank bottoms, internal and external rinsing water from the sprayer, and are considered hazardous waste. As such, “the collection and transport of hazardous waste, as well as their storage and treatment, are carried out under conditions of protection of the environment and human health” (article 17) (0).

As with all hazardous waste, their mixing is prohibited (with other categories of hazardous waste, with other waste, substances or materials. Mixing includes the dilution of dangerous substances. By way of derogation, mixing may be subject to conditions (Art. 18 (0))

The single European list of waste (0) lists dangerous waste and non-dangerous waste under nomenclature.

Wine effluent regulations

Wine effluents are considered urban wastewater (0) defined in the European Union (EU), in Council Directive 91/271/EEC (0): domestic wastewater or the mixture of domestic wastewater with industrial wastewater and/or runoff water.

“This directive (0) concerns the collection, treatment and discharge of urban waste water, and waste water coming from certain industrial sectors, including cellars, and sets the objectives of depollution, installation of collection systems and treatment, before discharge, of waste water, according to a defined schedule. So-called “sensitive” and “less sensitive” areas are identified according to their sensitivity to pollution, hence the existence of stricter regulations for these areas. The competent authorities or appropriate bodies of each Member State must monitor the quantities and composition of wastewater treatment plant discharges using reference methods common to all. »

French prevention and eco-design plans applied to vineyards and wineries

In France, as an extension of the European waste directives, the Law no. 2020-105 of February 10, 2020 relating to the fight against waste and the circular economy establishes the obligation to reduce waste and to apply eco -design to all producers [wineries comprised]:

“Any producer [subject to polluter-pays sectors] is required to develop and implement a prevention and eco-design plan with the objective of reducing the use of non-renewable resources, increasing the use of materials recycled and to increase the recyclability of its products in processing facilities located on the national territory.

“This plan is revised every five years. It can be individual or common to several producers. It includes an assessment of the previous plan and defines the objectives and prevention and ecodesign actions which will be implemented by the producer over the next five years. The eco-organization set up by the producers can develop a common plan for all of its members.

“The individual and joint plans are transmitted to the eco-organization set up by the producers, which publishes a summary accessible to the public, after presentation to the representative body of the stakeholders in the sector. " Art. 72

The wine industry eco-organization, ADELPHE, has produced a video on the prevention and eco-design plan as well as the wine eco-design guide.

COMPLEMENTARY RESOURCES

Videos

ADELPHE, 2022, Les plans de prévention et d'écoconception ADELPHE : https://youtu.be/2cpGtPQJTd4

IFV, 2019, approche territorialisée des voies de valorisation de la biomasse vitivinicole : https://youtu.be/HaRrr2DJ3Wg

Lempereur V, Penavayre S, IFV, Les entretiens Vigne Vin Languedoc-Roussillon, Narbonne **2014.** Quelle gestion des sous-produits vinicoles ? Valorisations actuelles et perspectives de recherche, https://youtu.be/Uh3qM37sl-Y?list=PL1dRoyJUp7dyH39_MLIofMHMBJsGO5HGQ

Links

European legislation on waste management: EUR-Lex - ev0010 - EN - EUR-Lex (europa.eu)

European parliament, 2018, Repair, re-use and recycle!: https://multimedia.europarl.europa.eu/en/repair-reuse-and-recycle_V007-0034_ev

ADEME, 2018, Grands principes de la réglementation européenne sur les déchets, Grands principes de la réglementation européenne sur les déchets – Ademe

Case study

2021, FAMILIA TORRES DESIGNS A PIONEERING SYSTEM TO CAPTURE AND REUSE CO2 FROM WINE FERMENTATION: FAMILIA TORRES DESIGNS A PIONEERING SYSTEM TO CAPTURE AND REUSE CO2 FROM WINE FERMENTATION | FAMILIA TORRES | FAMILIA TORRES DESIGNS A PIONEERING SYSTEM TO CAPTURE AND REUSE CO2 FROM WINE FERMENTATION | FAMILIA TORRES |

LEVEL 3 - ADDITIONAL RESOURCES

Articles

Besnier A., Farrant L., Penavayre S., Bosque F., Labau M.-P., Lempereur V., Pernet C., Berner J.-L., Jolibert F. (2016). LCI of food products sectors: from field data collection to the big picture, LCA Food, Dublin, Ireland.

REFERENCES

European Directive 2008/98/EC relating to waste, EUR-Lex - 32008L0098 - EN - EUR-Lex (europa.eu)

European Directive 2018/851, **2018/851**

Circular economy: definition, importance and benefits, 2023, Circular economy: definition, importance and benefits | News | European Parliament (europa.eu)

Single European list of waste, EUR-Lex - 32000D0532 - EN - EUR-Lex (europa.eu))

Eurostat statistic explainded, 2023, Glossaire:Eaux usées urbaines - Statistics Explained (europa.eu)

Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment; EUR-Lex - 31991L0271 - EN - EUR-Lex (europa.eu)

LOI n° 2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire : Article 72 - LOI n° 2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire (1) - Légifrance (legifrance.gouv.fr)

SELF-ASSESSMENT

1. Question: Which option is right?
    a) Option 1: a waste can become a by-product
    b) Option 2: the waste holder has no obligation to bear the cost of disposing of the waste he has produced
    c) Option 3: sludge is dangerous waste
    d) Option 4: the personal protective equipment used is not non-dangerous waste

2. Question: What is not the circular economy?
    a) Option 1: a model of production and consumption
    b) Option 2: a linear production model
    c) Option 3: an extension of the product life cycle
    d) Option 4: a model based on “reuse, repair and recycle”

3. Question: What is the false option?
    a) Option 1: Prevention is priority number 1 in the waste hierarchy
    b) Option 2: Ecodesign is priority number 2 in the waste hierarchy
    c) Option 3: deposit and refilling of bottles helps reduce waste
    d) Option 4: elimination is the operation which has no recovery even if secondarily there is recovery of substances or energy

4. Question: Which of the following options is the odd one out?
    a) Option 1: ecodesign is one of the prevention tools
    b) Option 2: ecodesign aims at the circular economy
    c) Option 3: eco-design systematically integrates environmental aspects from the cradle to the grave of the product
    d) Option 4: eco-design improves the environmental performance of products

5. Question: Which of the following options does not correspond to the reduction of effluents and waste in the vineyard and in the cellar?
    a) Option 1: Limitation of tank bottoms to be treated
    b) Option 2: Saving water in the cellar
    c) Option 3: Reduction of packaging volume
    d) Option 4: Storage of viticultural and wine packaging

UNIT 9 - LOCAL AND HISTORICAL KNOWLEDGE

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module:</td><td colspan="3">Wine culture and society from a climate change perspective</td></tr>
<tr><td>Type:</td><td colspan="3">Online</td></tr>
<tr><td>Workload for learner (hours):</td><td colspan="3">Estimation 2h + 2h = 4h total</td></tr>
<tr><td>Trainer:</td><td colspan="3">TBC</td></tr>
<tr><td>Institution(s):</td><td colspan="3">UNIR</td></tr>
<tr><td rowspan="6">Content/short description; duration; training/learning method:</td><td colspan="3">Short description:

The module aims to educate learners about the significance of wine production and culture and its role in the local environment, society, and economy, as well as provide them with the knowledge and skills needed to implement sustainable wine production practices. The module is divided into 2 units.</td></tr>
<tr><td>Unit</td><td>Content</td><td>Duration</td></tr>
<tr><td rowspan="2">n. Local and historical knowledge</td><td>• A drink of the gods: History of wine production
• Modern wine production
• The Importance of Local and Historical Wine Cultures
• Challenges of the wine industry</td><td>1h</td></tr>
<tr><td>• Regulations on food and agricultural products
• Regulations on wine
• Geographical indications and quality schemes
• Market trends and consumer preferences
• Wine tourism</td><td>1h</td></tr>
<tr><td rowspan="2">n. Sustainable production</td><td>• Environmental, social and economic dimensions of sustainability
• Corporate social responsability</td><td>1h</td></tr>
<tr><td>• Environmental Impacts of the Supply Chain
• Organic farming and winemaking principles
• Certification and labelling</td><td>1h</td></tr>
</table>

Learning Outcomes:	By the end of Unit 1, learners will be able to: • Understand the significance of local and historical knowledge of wine production and viticultural landscapes. • Familiarise with the challenges of the wine industry. • Outline trading regulations, market trends, and consumer preferences and the promotion it through sustainable tourism. By the end of Unit 2, learners will be able to: • Identify the environmental, social, and economic dimensions of sustainability. • Recognize the environmental impacts of the supply chain • Understand the basic organic farming and winemaking principles. • Familiarise with certification and labelling schemes
Learning materials (e.g. exercises, data sets)	Lectures (PPT) Case studies Videos Further readings
Language/s of instruction (oral and written material):	Core: English, Spanish, French, Italian, German, and Macedonian Relevant: English Optional: English
Method/s for teaching and learnings:	E-learning methodology with virtual platform. Each unit consists of three online parts: 1. **Level 1 (CORE):** is the core learning. It includes introductory texts, video lectures and PowerPoint. All the learners will watch/read/study all the provided resources. 2. **Level 2 (RELEVANT)** must be completed by the learner. It includes external readings, videos, and presentations. 3. **Level 3 (OPTIONAL)** is optional and includes additional resources in different languages as well as optional tasks and experiential activities that can be completed autonomously.
Method/s of assessment:	Self-evaluation test with 5-10 questions after every unit.
Method for evaluation of course (by learners, peer review etc.)	Peer review from partners Evaluation questionnaire by learners

VIDEO INTRODUCTION

https://youtu.be/l41_dkhSWCU

TRANSCRIPTION

Welcome to unit 9 of the Green Vineyards Course.

This unit focuses on the Local and Historical Knowledge of the fascinating world of winemaking.

Wine is more than just a beverage. It is a cultural tradition that has been passed down for centuries. Each region has its own unique wine culture, shaped by its history, climate, and geography.

In this unit, you will be able to learn about:

- The rich history of wine through the archaeological evidence spanning thousands of years.
- The production of modern wines. Modern winemaking is a delicate blend of tradition and science.
- The Importance of Local and Historical Wine Cultures, and its benefits for the environment, society, and the economy.

The world of wine faces challenges – from climate change to sustainability. Discover how winemakers are embracing innovation and sustainability to ensure the future of this ancient beverage.

Let's start with this UNIT level 1.

LEVEL 1 - CORE LEARNING

GEOGRAPHICAL INDICATIONS AND QUALITY SCHEMES

E.U. quality policy aims to protect the names of specific products to promote their unique characteristics, linked to their geographical origin as well as traditional know-how. Recognised as intellectual property, geographical indications play an increasingly important role in trade negotiations between the E.U. and other countries. The differences between PDO and PGI are linked primarily to how much of the product's raw materials must come from the area, or how much of the production process must take place within the specific region.

Products with a **protected designation of origin (PDO)** owe their quality or characteristics to the geographical environment, including its natural and human factors. These products must always be produced, processed and prepared in the specific geographical region from which they take their name.

Products with a **protected geographical indication (PGI)** have a particular quality, reputation or other characteristic attributable to a geographical origin. They are produced, processed or prepared in the geographical area from which they take their name.

Traditional specialities guaranteed (TSG) are products with specific features which differentiate them from other foods in the same category. They are produced from traditional raw materials or feature a traditional composition or method of production or processing.

Market trends and consumer preferences

Knowing the market and understanding competition and customer preferences is crucial. Some strategies include:

- Targeting **niche markets** can help attract a broader range of consumers and visitors: focusing on wine and food pairings, organic or biodynamic wines, wine education and tasting experiences, or wine and wellness tourism.
- **Brand loyalty** provides a consistent income stream for wineries, and loyal customers can act as ambassadors for their wines.
- Effective **marketing and management strategies** are essential in wine tourism. Utilising digital platforms and social media can help reach a wider audience and promote the unique aspects of wine tourism.
- **Sustainable wines** result from the increase of awareness from winegrowers and consumers that are basing their purchasing decisions not solely on the product quality characteristics, but also on the influence these products have at environmental, health, and social levels. Traditional wineries, family-owned businesses and even multinationals are gradually becoming committed to sustainable viticulture.

Furthermore, sustainable wine practices often align with cultural preservation efforts. By maintaining traditional farming methods, protecting native grape varieties, and supporting local communities, wine producers contribute to preserving cultural heritage.

Source: https://unsplash.com/photos/udj2tD3WKsY

WINE TOURISM

The winemaking techniques, grape varieties and oenological practices reflect the cultural heritage and shape the region's identity. Wine tourism, culture and heritage intertwine to create a rich and multifaceted experience that allows visitors to connect with the cultural and historical aspects of the region while enjoying its signature wines. By attracting tourists, wine tourism can generate income that can be reinvested in protecting and maintaining cultural assets. It can also support local businesses such as restaurants, lodging and transportation services, thereby contributing to the region's overall economic development.

Wine tourism is growing in popularity around the world. Wine tourists tend to be well-educated and have higher incomes than the general population. They are often between 35 and 54 years old, with interest from the younger generation also increasing. They often engage in vineyard tours, wine tastings, food and wine pairings, visits to museums and interpretation centres, wine and art activities, stargazing at night in the vineyard, wine and wellness, grape harvesting, winemaking workshops, etc.

Source: Johny Goerend. https://unsplash.com/photos/pnigODapPek

The feasibility of wine tourism depends on the wine region's size, tourism infrastructure, non-wine attractions, market demand, and vineyard/winery resources and skills. Wine production involves primary and secondary industries, while winemaking is product-focused. Some may have little desire to be involved in a tertiary business – the service industry of wine tourism.

While large companies may not need to use wine tourism as a marketing strategy, small ones may benefit. Also, wine tourism can be a viable and successful option for some established wine regions with strong tourism infrastructure and high brand recognition. However, developing wine tourism can be challenging for smaller or emerging wine regions with limited resources and infrastructure. These regions may need to carefully evaluate their market potential and collaborate with other stakeholders to create an engaging wine tourism experience. Collaborative marketing and branding can help raise awareness of these routes and attract a wide range of wine tourists.

Another issue arises when booming tourism leads to saturation in certain areas, causing significant negative impacts on the environment, infrastructure, and local communities. Therefore, coordination among governments and organisations at local, regional, and national levels is essential for successful development of wine tourism regions. It is vital for wine regions and wineries to carefully monitor visitor numbers, assess the impacts of tourism activities, control access to certain areas, diversify tourism offerings, or promote sustainable tourism practices to ensure that the threshold for wine tourism flows is not exceeded.

The Importance of Local and Historical Wine Cultures

This importance is due to:

- **Biodiversity**: Vineyards provide habitat for various plants and animals that conform to viticulture landscapes and ecosystems. In addition, vines can help prevent soil erosion and desertification. Their deep roots help to anchor the soil, and their leaves help to shade the ground and reduce evaporation.

- **Economy:** Wine production creates jobs in viticulture, winemaking, and tourism. In addition, wine can be a valuable export, generating income for local businesses.
- **Heritage:** These heritage vineyards and wineries showcase traditional winemaking methods, architecture, and artefacts. Many opening museums and interpretive centres are dedicated to wine's history and cultural importance.
- **Social Cohesion:** Wine is often seen as a symbol of community, and it can be used to bring people together. Wine festivals and events showcase not only the wine varieties but also the region's traditions, music, cuisine, and art.

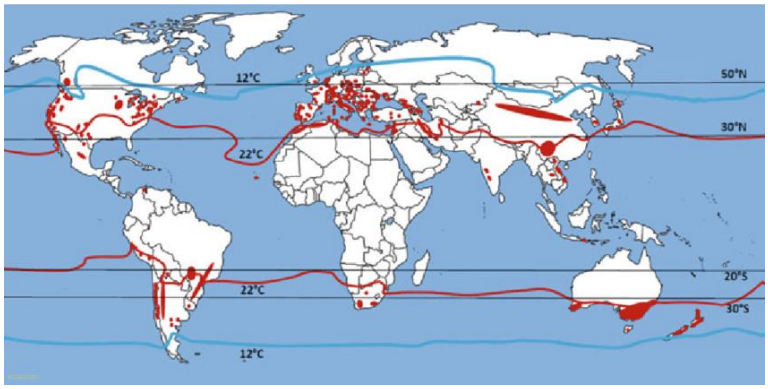
Video: How to Generate Value for your Wine with Territorial Identity and Sustainability

Source: Infowine. https://www.youtube.com/watch?v=eKhed6ZwsWE&t=240s

CHALLENGES OF THE WINE INDUSTRY

The challenges facing the wine business can be grouped into two categories: global challenges and regional challenges. Global challenges include changes in climate and consumer preferences, while regional challenges are specific to each wine region or country and can include issues such as low competitiveness, low investment attractiveness, high taxes, and political conflicts (Goncharuk, 2017[i]).

- Grapes are susceptible to various **pests**, including insects, mites, and fungi, making them unviable for winemaking.
- **Geopolitical conflicts** can disrupt the global wine trade.
- **Habitat loss** caused by wildfires reduces the land available for vineyards.
- **Climate change** is already having a significant impact and therefore threatening the sustainability of the winemaking sector by modifying both the potential regions where wine grows and affecting grape chemical composition. Rising temperatures force vineyards to move to higher altitudes and northern latitudes. Wine grapes are extremely sensitive to the changes in temperature and season. Below 12 °C grapes don't ripen due to winter frost; above 22 °C, grapes experience changes in sugar content, acidity, and flavour compounds.



Major and developing viticultural regions of the world. Typically, wine cultivation occurs within latitudes between 30-50 °N and 30-40 °S, and a temperature range from 12°C to 22°C.

Source: Schultz and Jones (2010)[ii]

How a warming climate disrupts wine chemistry

Video: Wine and Climate Change

Source: Wine and Climate Change. Conservation International.
https://www.youtube.com/watch?app=desktop&v=EJuoqU5Uo0M

Despite these challenges, winemakers constantly work to adapt and produce high-quality wine. They are developing new pest control methods, selecting more resilient varieties, and finding new ways to make winemaking a sustainable industry by reducing water and energy use, applying regenerative agriculture practices, etc. More information about this topic is available in unit 3.

BASIC RESOURCES

Databases

- Vine varieties database. OIV. https://www.oiv.int/index.php/what-we-do/viticulture-database-report?oiv=

News Articles

- Chrobak, U., & Zimmer, K. (2022). Climate change is altering the chemistry of wine. *Knowable Magazine | Annual Reviews*. https://doi.org/10.1146/knowable-062222-1

Podcasts

- GuildSomm International https://www.guildsomm.com/public_content/features/podcasts/
- The Wine 101 Podcast https://vinepair.com/wine-101-podcast/

Videos

- Ribera del Duero. Collection of Videos. https://www.riberadelduero.es/enopedia (Spanish)

Websites

- Explore wine regions from all over the world. https://winefolly.com/wine-regions/
- Major grape varieties of the world. https://winefolly.com/grapes/

LEVEL 2 - LEARNING IN DEPTH

The wine sector is covered under its specific regulation, which includes the application of E.U. quality schemes:

REGULATIONS ON FOOD AND AGRICULTURAL PRODUCTS

- Regulation (E.U.) No 1151/2012 on quality schemes for agricultural products and foodstuffs
- Commission Delegated Regulation (E.U.) No 664/2014 on the logos to be used for PDOs, PGIs and TSGs
- Commission Delegated Regulation (E.U.) No 2022/891 amending Delegated Regulation (E.U.) No 664/2014
- Commission Implementing Regulation (E.U.) No 668/2014 on how Regulation (E.U.) No 1151/2012 on quality schemes for agricultural products and foodstuffs should be applied
- Commission Implementing Regulation (E.U.) No 2022/892 amending Implementing Regulation (E.U.) No 668/2014
- Commission communication: Labelling guidelines for foodstuffs using PDOs or PGIs as ingredients

REGULATIONS ON WINE

- Regulation (E.U.) No 1308/2013 on establishing a common organisation of the markets in agricultural products.
- Regulation (E.U.) No 1306/2013 on the financing, management and monitoring of the common agricultural policy.
- Regulation (E.U.) No 2021/2117 amending Regulation (E.U.) No 1308/2013
- Regulation (E.U.) No 2021/2116 on the financing, management and monitoring of the common agricultural policy.
- Regulation (E.U.) No 2019/934 supplementing Regulation (E.U.) No 1308/2013 regarding wine-growing areas where the alcoholic strength may be increased, authorised oenological practices and restrictions applicable to the production and conservation of grapevine products.
- Commission Delegated Regulation (E.U.) 2019/33 supplementing Regulation (E.U.) No 1308/2013 regarding applications for protection of designations of origin, geographical indications and traditional terms in the wine sector.
- Commission Delegated Regulation (E.U.) 2018/273 as regards the scheme of authorisations for vine plantings, the vineyard register, accompanying documents and certification, the inward and outward register, compulsory declarations, notifications and publication of notified information, relevant checks and penalties.
- Commission Delegated Regulation (E.U.) 2016/1149 as regards the national support programmes in the wine sector.
- Commission Implementing Regulation (E.U.) 2019/34 regarding applications for protection of designations of origin, geographical indications and traditional terms in the wine sector.
- Commission Implementing Regulation (E.U.) 2019/935 as regards analysis methods for determining the physical, chemical and organoleptic characteristics of grapevine products and notifications of E.U. countries decisions concerning increases in natural alcoholic strength.

- Commission Implementing Regulation (E.U.) 2019/34 laying down rules for the application of Regulation (E.U.) No 1308/2013 as regards applications for protection of designations of origin, geographical indications and traditional terms in the wine sector.
- Commission Implementing Regulation (E.U.) 2018/274 as regards the scheme of authorisations for vine plantings, certification, the inward and outward register, compulsory declarations and notifications, and relevant checks.
- Commission Implementing Regulation (E.U.) 2017/256 laying down rules for the application of Regulation (E.U.) No 1308/2013 of the European Parliament and of the Council as regards the national support programmes in the wine sector.
- Commission Implementing Regulation (E.U.) 2016/1150 laying down rules for the application of Regulation (E.U.) No 1308/2013 as regards the national support programmes.

COMPLEMENTARY RESOURCES

Databases

- Geographical Indications Registers https://agriculture.ec.europa.eu/farming/geographical-indications-and-quality-schemes/geographical-indications-registers_en
- GI/AO Database Report. OIV. https://www.oiv.int/what-we-do/giao-database-report?oiv=

Maps

- Mapa de las Denominaciones de Origen Protegidas de Vinos de España. https://www.alimentosdespana.es/images/es/Cartel_mapa_vino_nov20_web_tcm69-569838.pdf

Websites

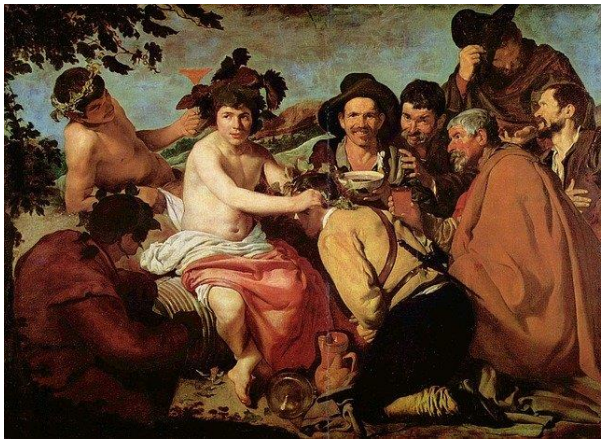
- EU wine legislation. (n.d.). Agriculture.ec.europa.eu. https://agriculture.ec.europa.eu/farming/crop-productions-and-plant-based-products/wine/eu-wine-legislation_en
- Geographical indications and quality schemes explained. (n.d.). Agriculture.ec.europa.eu. https://agriculture.ec.europa.eu/farming/geographical-indications-and-quality-schemes/geographical-indications-and-quality-schemes-explained_en
- Origen España. (n.d.). Asociación Española de Denominaciones de Origen. Origenespana.es. Retrieved August 18, 2023, from https://origenespana.es/ (Spanish)
- Wines and wine sector products — protected designations of origin, protected geographical indications, traditional terms, labelling and presentation. EUR-Lex - 4386346 - EN - EUR-Lex. (n.d.). Eur-Lex.europa.eu. Retrieved August 18, 2023, from https://eur-lex.europa.eu/EN/legal-content/summary/wines-and-wine-sector-products-protected-designations-of-origin-protected-geographical-indications-traditional-terms-labelling-and-presentation.html

LEVEL 3 – ADDITIONAL RESOURCES

A DRINK OF THE GODS: HISTORY OF WINE PRODUCTION

Wine production has a long history. Even the Greek god Dionysus and the Roman God Bacchus were dedicated to this beverage. *Vitis vinifera,* known as the common grape vine, is a plant species native to the Mediterranean region, Central Europe, and southwestern Asia. Only a few of the vast array of grape varieties are of commercial significance for wine and table grape production. The grape itself, the fruit of this plant, serves as the foundational ingredient for crafting wine. A **variety** refers to the grape itself, whereas **varietal** refers to the wine made from it. The land area dedicated to cultivating vines is referred to as a **vineyard**.

The Feast of Bacchus by Velázquez



Source: Museo del Prado https://en.wikipedia.org/wiki/The_Triumph_of_Bacchus#/media/File:Vel%C3%A1zquez_-_El_Triunfo_de_Baco_o_Los_Borrachos_(Museo_del_Prado,_1628-29).jpg

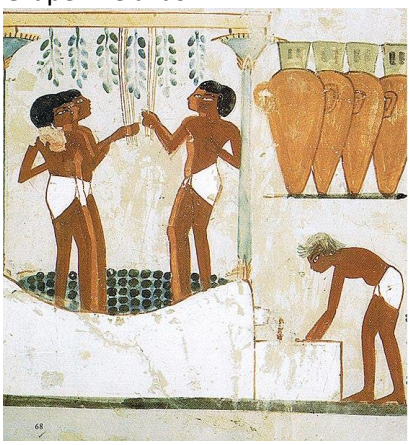
Winemaking is largely influenced by tradition and **terroir**. The former refers to the long history of a wine region, while the latter refers to specific characteristics of a place, such as climate, soil, topography, geography, and biodiversity. Viniculture considers these factors to produce wines with distinct and unique characteristics exclusive of their place of origin. (OIV/VITI resolution 333/2010)

The wealth of visual representations such as frescoes, wall paintings found in tombs and temples, vase paintings, sculptures, iconography, mosaics, and miniatures, along with written materials including cuneiforms, epigraphs, papyri, ostraca, and manuscripts, constitute the primary and crucial sources for deciphering the historical evidence of winemaking (Harutyunyan, 2022[iii]).

It is believed that humans encountered the wild Eurasian grapevine (*Vitis vinifera sylvestris*) in Lebanon around 60,000 to 100,000 years ago during the Paleolithic period (MacNeil, 2015[iv]). Archaeologists have unearthed fascinating evidence of winemaking from the Neolithic. Grape seeds dating around 7,000 to 9,000 years have been found in Jiahu, China (Li et al., 2018[v]). Similar evidence from 5,400–5,000 BC has been uncovered in the Zagros Mountains of Mesopotamia and the Neolithic site of Dikili Tash in Greece (Sicard et Legras, 2011[vi]). Other studies suggest that the tomb

of Ptah-Hotep built 6,000 years ago, depicts the scenes of viticulture, grape harvesting and winemaking in ancient Egypt (McGovern et al., 1996[vii]).

Image x. Papyrus stem columns holding up Grapevine arbor



Source: Matthias Seidel, Abdel Ghaffar Shedid: Das Grab des Nacht. Kunst und Geschichte eines Beamtengrabes der 18. Dynastie in Theben-West, von Zabern, Mainz 1991 ISBN 3805313322 via Wikimedia Commons https://commons.wikimedia.org/wiki/File:Tomb_of_Nakht_(13).jpg

Image X. Dionysus mosaic (detail), from around A.D. 220/230

Source: Römisch-Germanisches Museum, Cologne https://commons.wikimedia.org/wiki/File:Dionysus_mosaic_%28detail%29,_from_around_A.D._220_230,_Romisch-Germanisches_Museum,_Cologne_%288115572538%29.jpg

From 800 BCE, winemaking was evident in Greece and spread to other Mediterranean (600 BCE–400 BCE). The Romans also played a significant role in spreading viticulture and winemaking technologies across Europe. They learnt their viticulture and oenology techniques from the Greeks and implemented them across the Italian peninsula. The expansion of the Roman Empire led to viticulture and winemaking technologies spreading westward throughout Europe.

The terms **Old World, New World, and Ancient World** help categorise wine regions based on their historical context, traditions, and cultural significance in winemaking (Li et al., 2018)[3].

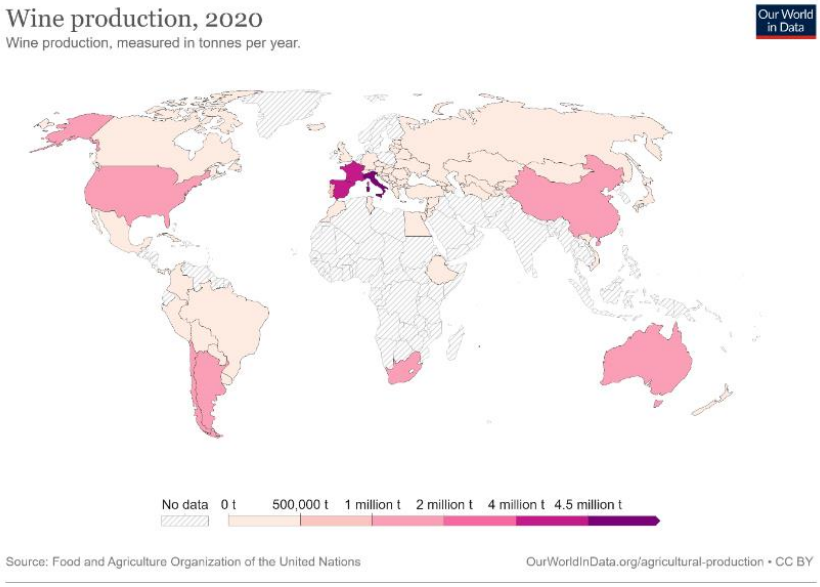
- **Old World:** are wine-producing regions that have a long history of viticulture and winemaking around the Mediterranean area, including Greece, France, Italy, Spain, Germany, Portugal, Austria, and Hungary

- **New World:** It emerged when Spanish and British colonists introduced viticulture and winemaking technologies into the United States, Australia, New Zealand, Chile, South Africa, and Argentina. The New World is characterised by its innovative approaches to winemaking, experimentation with different grape varieties, and the use of modern technologies.

- **Ancient World:** is a category that recognises wine production's historical significance and cultural heritage in regions like China, Greece, and Georgia.

Modern wine production

The global wine market is worth an estimated $300 billion. The average production of wine ranges from 26-27 billion litres per year.



Animated timeline of wine production from 1961 to 2020. Source: Food and Agriculture Organization of the United Nations. OurWorldInData.org/agricultural-production • CC BY
https://ourworldindata.org/grapher/wine-production?time=2020

Modern wine is produced using various techniques and methods based on the wine type and the winemaker's preferences. Typically, it involves the subsequent stages:

- **Harvesting:** Grapes are carefully picked from the vineyards when they are ripe. The timing of the harvest is crucial as it affects the flavour and quality of the wine.

Source: Vindemia Winery. https://unsplash.com/photos/zBwxaS0SkTk

- **Crushing:** The harvested grapes are crushed to break their skins and release the juice. It can be done mechanically or using traditional methods like stomping on the grapes.

- **Fermentation:** The extracted grape juice, or "must," is transferred to fermentation vessels. Yeast, naturally present on the grape skins or added, converts the sugars in the juice into alcohol and carbon dioxide. This process typically takes one to two weeks.

- **Ageing:** The young wine is often aged to develop its flavour after fermentation. It can be aged in various containers such as oak barrels or modern stainless-steel tanks. The ageing process can take several months to several years, depending on the desired style of wine.

- **Clarification:** During ageing, sediment and particles can settle in the wine. To make it clear and stable, winemakers might use fining agents or filtration to remove these unwanted elements.
- **Bottling:** Once the wine has matured and reached its desired flavour profile, it is bottled. Some winemakers might also blend different batches of wine to achieve a specific taste.

- **Corking and Sealing:** The bottles are sealed with corks or alternative closures like screw caps. The choice of closure can impact the ageing process and preservation of the wine.

Source: Vindemia Winery. https://unsplash.com/photos/OQ_o-SaEMil

- **Ageing** in the Bottle (Optional): Certain wines benefit from additional ageing in the bottle. This allows the flavours to evolve and become more complex over time.

Source: Svetlana Gumerova. https://unsplash.com/photos/nZVjwM1xWU0

- **Transport:** Transporting wine from the winery to various markets requires careful consideration of factors such as temperature control and packaging to preserve its quality.

- **Commercialisation** involves marketing strategies, distribution networks, and sales efforts to bring the wine to consumers' attention and make it available for purchase. 'HORECA' channel in Spain and *Negociant* role in France are examples of such strategies.

- **Consumption:** It is recommended to serve wine at the right temperature to appreciate its aroma, taste, and character. Wine pairing involves matching different types of wines with specific foods to enhance the overall dining experience. By carefully selecting wines that complement the dishes' flavours, textures, and characteristics, wine pairing can elevate both the taste of the food and the wine.

Video Introduction to Winemaking

Source: GuildSomm.

https://www.youtube.com/watch?v=2PIvfUvlBvg

Additional Resources

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The World History of Modern Wine. Trinity College. https://www.edx.org/es/course/the-world-history-of-modern-wine?index=spanish_product&queryID=65e663728e363e6ace84493b29a21220&position=3&results_level=second-level-results&term=wine&objectID=course-0af6995d-ecda-4835-a4fb-a52fa5b3b745&campaign=The+World+History+of+Modern+Wine&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Fes%2Fsearch

Wine Tasting: Sensory Techniques for Wine Analysis. University of California, Davis. https://learning.edx.org/course/course-v1:UCDavis+VIT1009+1T2023/home

World of Wine: From Grape to Glass. University of Adelaide. https://learning.edx.org/course/course-v1:AdelaideX+Wine101x+2T2016/home

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Virtual Museum

Vivanco cultura de vino: Fundación y Museo https://my.matterport.com/show/?m=pniZK3o7VPf

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SELF-ASSESSMENT

1. What does the term "terroir" refer to in winemaking?
   a) The long history of a wine region.
   b) The process of grape fermentation.
   c) Specific characteristics of a place affecting wine production.
   d) The variety of grapes used in winemaking.

2. Which wine-producing regions are typically considered part of the "New World"?
   a) France, Italy, Spain
   b) Greece, Portugal, Austria
   c) Australia, Chile, South Africa
   d) China, Georgia, Hungary

3. What role do heritage vineyards and wineries play in preserving local culture?
   a) They focus exclusively on modern winemaking techniques.
   b) They have no connection to traditional winemaking methods.
   c) They showcase traditional winemaking methods, architecture, and artefacts.
   d) They contribute solely to biodiversity conservation.

4. What is one impact of climate change on the wine industry?
   a) Climate change has no effect on grape composition.
   b) Climate change makes grapes less susceptible to pests.
   c) Climate change can alter the regions suitable for wine production.
   d) Climate change only affects consumer preferences.

5. What is the potential impact of wine tourism on a region's economy and culture?
   a) Wine tourism only benefits large companies, not small ones.
   b) Wine tourism can support local businesses and contribute to economic growth.
   c) Wine tourism is only appealing to the older generation.
   d) Wine tourism has no connection to cultural heritage.

UNIT 10 - SUSTAINABLE PRODUCTION

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module:</td><td colspan="3">Wine culture and society from a climate change perspective</td></tr>
<tr><td>Type:</td><td colspan="3">Online</td></tr>
<tr><td>Workload for learner (hours):</td><td colspan="3">Estimation 2h + 2h = 4h total</td></tr>
<tr><td>Trainer:</td><td colspan="3">TBC</td></tr>
<tr><td>Institution(s):</td><td colspan="3">UNIR</td></tr>
<tr><td rowspan="6">Content/short description; duration; training/learning method:</td><td colspan="3">Short description:

The module aims to educate learners about the significance of wine production and culture and its role in the local environment, society, and economy, as well as provide them with the knowledge and skills needed to implement sustainable wine production practices. The module is divided into 2 units.</td></tr>
<tr><td>Unit</td><td>Content</td><td>Duration</td></tr>
<tr><td rowspan="2">n. Local and historical knowledge</td><td>• A drink of the gods: History of wine production
• Modern wine production
• The Importance of Local and Historical Wine Cultures
• Challenges of the wine industry</td><td>1h</td></tr>
<tr><td>• Regulations on food and agricultural products
• Regulations on wine
• Geographical indications and quality schemes
• Market trends and consumer preferences
• Wine tourism</td><td>1h</td></tr>
<tr><td rowspan="2">n. Sustainable production</td><td>• Environmental, social and economic dimensions of sustainability
• Corporate social responsability</td><td>1h</td></tr>
<tr><td>• Environmental Impacts of the Supply Chain
• Organic farming and winemaking principles
• Certification and labelling</td><td>1h</td></tr>
</table>

Learning Outcomes:	By the end of Unit 1, learners will be able to: • Understand the significance of local and historical knowledge of wine production and viticultural landscapes. • Familiarise with the challenges of the wine industry. • Outline trading regulations, market trends, and consumer preferences and the promotion it through sustainable tourism. By the end of Unit 2, learners will be able to: • Identify the environmental, social, and economic dimensions of sustainability. • Recognize the environmental impacts of the supply chain • Understand the basic organic farming and winemaking principles. • Familiarise with certification and labelling schemes
Learning materials (e.g. exercises, data sets)	Lectures (PPT) Case studies Videos Further readings
Language/s of instruction (oral and written material):	Core: English, Spanish, French, Italian, German, and Macedonian Relevant: English Optional: English
Method/s for teaching and learnings:	E-learning methodology with virtual platform. Each unit consists of three online parts: 1. **Level 1 (CORE):** is the core learning. It includes introductory texts, video lectures and PowerPoint. All the learners will watch/read/study all the provided resources. 2. **Level 2 (RELEVANT)** must be completed by the learner. It includes external readings, videos, and presentations. 3. **Level 3 (OPTIONAL)** is optional and includes additional resources in different languages as well as optional tasks and experiential activities that can be completed autonomously.
Method/s of assessment:	Self-evaluation test with 5-10 questions after every unit.
Method for evaluation of course (by learners, peer review etc.)	Peer review from partners Evaluation questionnaire by learners

VIDEO INTRODUCTION

https://youtu.be/fA6y5AlxsoU

TRASNCRIPTION

Welcome to unit 10 of the Green Vineyards Course.

This unit focuses on sustainable wine production in all levels, from viticulture to distribution.

In level 1, you will learn to:

- Identify the environmental, social, and economic dimensions of sustainability in the wine industry.
- And understand how wine producers can take meaningful steps towards a brighter and more equitable future through corporate social responsibility.

And if you are interested in diving deeper, in level 2 of this unit, you will have the opportunity to:

- Learn to recognize the environmental impacts of the supply chain.
- Discover the secrets behind organic farming and winemaking principles.
- And unravel the world of certifications and labels that guide us to identify sustainable wines.

Get ready to embark on this sustainable journey. A journey of responsibility, innovation, and above all, a celebration of our shared commitment to a sustainable future.

Let’s start with this Unit level 1

LEVEL 1 CORE LEARNING

ENVIRONMENTAL, SOCIAL AND ECONOMIC DIMENSIONS OF SUSTAINABILITY

Sustainable vitiviniculture is a rising trend due to consumer demands and the imperative for adopting environmentally friendly practices in response to climate change. There are 5 principles of sustainability in vitiviniculture:

- Principle 1: Sustainable approach integrates environmental, social, and economic aspects.
- Principle 2: Sustainable vitiviniculture respects the **environment.**
- Principle 3: Sustainable vitiviniculture is sensitive to **social and cultural aspects.**
- Principle 4: Sustainable vitiviniculture seeks to maintain **economic viability.**
- Principle 5: Sustainable initiatives require **planning and assessment.**

Table 1. The three key (environmental, social, and economic) dimensions of winery sustainability

Key Dimensions	Measures and Actions
Environmental	Recovery of rainwater
	Reduced production of wastewater and recycle wastewater
	Recovery and recycle of wastes
	Waste-to-energy
	Recovery of energy and heat
	Use of renewable resources
	Acquisition of green cars and delivery trucks
	Use of low-impact innovative materials for packaging
Economic	Reduced consumption of water
	Reduced consumption of energy
	Sequestration and reuse of CO_2 produced with fermentation
	Recognisability on the market
Social	Protection of health and safety
	Ethical reputation
	Exploitation of local resources, workers, and growers
	Corporate welfare

Source: Baiano, 2021[viii].

The achievement of sustainability goals must consider the following characteristics (OIV):

- It has a strong link with the territory, its history, culture, and customs.

- It is based on agricultural production that cannot be delocalised, requiring specific know-how, and generates employment in a rural area on all levels of competencies, from agricultural workers to managers.
- It manufactures products of high-added value and important export potential.
- It uses endogenous resources of the genetic diversity of grapevine (ancestral grape varieties, new grape varieties, genotypic diversity within grape varieties), contributing to valuing and conserving them.
- It plays an essential role in the creation and preservation of landscapes.
- Is a major factor identifying a region – has an important potential for the development of tourism.
- Is affected by the impacts of climate change and societal changes.
- Is open to technological innovations.
- A sector where sectoral organisations prevail making it possible to generate and implement collective strategies.
- It assumes its responsibility towards sustainability goals of the United Nations Organisation.

Corporate Social Responsibility

Sustainability in agriculture "involves everything that can be done on the farm, including economics, environmental impacts of everything done on the farm and all aspects of human resources, including employees and the surrounding community".

Corporate Social Responsibility (CSR) refers to organisations' responsible practices and behaviours to integrate economic, social, and environmental aspects into their business strategies, management tools, and activities. It goes beyond compliance and invests more in human, social, and environmental capital. Therefore, CSR includes responsible practices related to different organisational operations areas: i.e., internal practices, such as human resources management and working environment conditions; external practices, such as community involvement, the promotion of the territory and its social, cultural, and economic development; environmental practices to reduce organisation environmental impacts, resource withdrawal, and waste production.

The International standard ISO 26000: Social Responsibility provides guidance for businesses and organisations committed to operating in a socially responsible way.

BASIC RESOURCES

Strategic Programmes

International Organisation of Vine and Wine. OIV STRATEGIC PLAN 2020-2024. The 2020-2024 Strategic Plan and its key objectives are guided by the various challenges the international vitivinicultural sector is facing, but also by a desire to integrate the 2030 perspectives of the Sustainable Development Goals (SDGs), elaborated under the aegis of the United Nations, into the Organisation's work. https://www.oiv.int/sites/default/files/documents/OIV-STRATEGIC_PLAN%20_2020-2024.pdf

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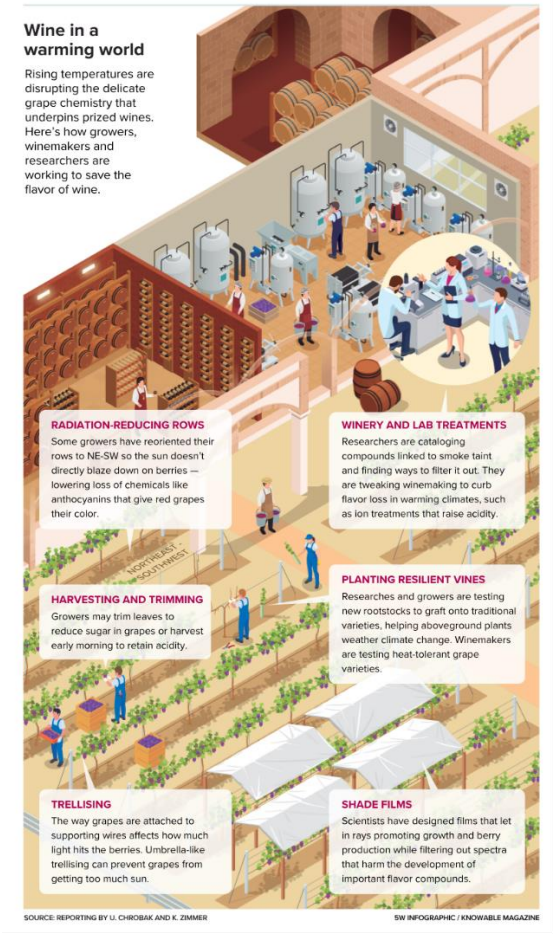
LEVEL 2 - LEARNING IN DEPTH

ENVIRONMENTAL IMPACTS OF THE PRODUCTION CHAIN

All stages of wine production have an impact on the environment, from grape production to botteling and distribution. The following image shows the sustainable practices that can be taken in the different stages of the production chain and their effects on air, water, plant/soil, and landscape/society.

Growers and winemakers are continuously innovating to ensure that the production of high-quality wine goes hand in hand with sustainability. They are at the forefront of pioneering sustainable practices, including innovative approaches to pest control, the careful selection of hardy grape varieties, and the pursuit of sustainable winemaking methods that reduce water and energy consumption. For more in-depth insights into these sustainable practices and their impact, please go to Unit 4



Source: https://knowablemagazine.org/article/food-environment/2022/climate-change-altering-chemistry-wine

While the environmental impacts of viticulture are well-documented, there is a need for simultaneous evaluation of economic and environmental sustainability. The lack of homogeneity of

the methods and indicators used to assess sustainability creates a challenge in comparing regions, farms, and crops. The most used approaches include:

- **Life Cycle Analysis (LCA)** is a methodology to assess the environmental impacts of a product/service. It evaluates resources used and substances emitted in each lifecycle step. LCA is used to assess viticulture activities and for decision-making.
- **GHG emissions** are the most frequently used environmental indicator. The main greenhouse gases are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6). GHG emissions are measured in units of carbon dioxide equivalent (CO2e). CO2e is a way of comparing the emissions of different gases by considering their different global warming potentials (GWPs).
- **Environmental footprint:** in December 2021, the Commission adopted a revised Recommendation on the use of Environmental Footprint methods, helping companies calculate their environmental performance using dependable, verifiable, and comparable data.

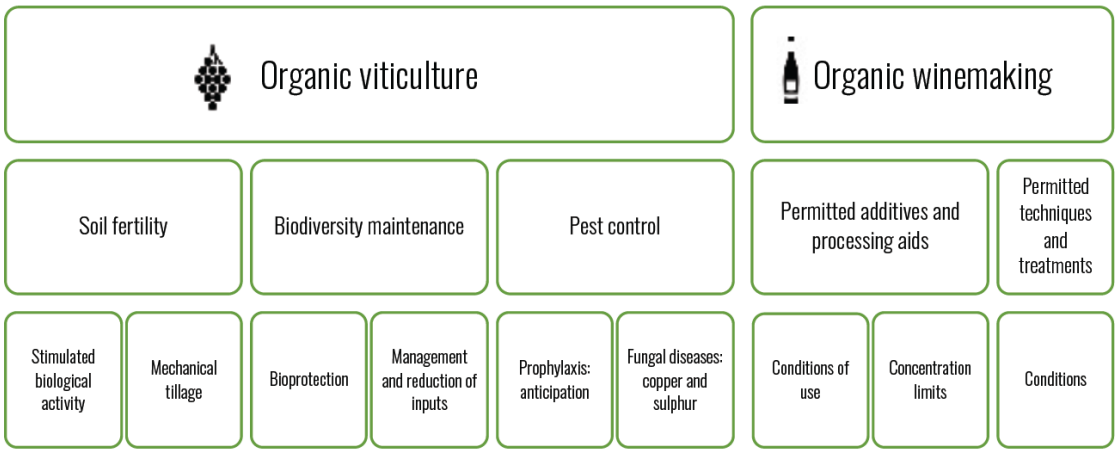
Organic farming and organic winemaking

According to Resolution OIV-ECO 460-2012, organic viticulture is based on three principles: soil fertility, maintaining biodiversity, and pest control under ecological cycles and processes to:

- Maintain ecosystems and the fertility of soils in the long term.
- Increase biodiversity and the protection of natural resources.
- Promote the use of ecological processes and cycles.
- Minimise or eliminate external interventions and viticultural practices that require the use of chemical synthesis products.
- Use organic products and processes in transformation and production processes, trying to avoid all techniques that have a considerable negative impact on the environment.
- Excludes the use of genetically modified organisms and inputs derived from genetically modified organisms.
- Avoids the use of synthetic pesticides and fertilisers, and instead relying on natural methods to control pests and enrich the soil.

Organic winemaking requires extra care at every stage of production. Wineries can reduce their use of chemicals by using natural cleaning products and sanitisers, and by minimising sulfites in wine production. According to Beaumelle et al. 2023, organic farming promoted biodiversity and biological pest control but was associated with lower wine production levels than conventional farming.

Image Technical principles of organic viticulture and organic winemaking in the EU



Source. OIV, 2020[ix]. https://www.oiv.int/standards/oiv-guide-for-the-implementation-of-principles-of-sustainable-vitiviniculture-

COMPLEMENTARY RESOURCES

Strategic Programmes

VIVA PROGRAM (Italy). VIVA is the programme by the Italian Ministry of the Environment and Energy Security which since 2011 has been promoting the sustainability of the Italian wine sector. VIVA provides for the public standard in measuring and improving the sustainability performance of viticulture in Italy. https://viticolturasostenibile.org/en/viva-program/

Technical documents

International Organisation of Vine and Wine (OIV). (2018) Functional Biodiversity in the Vineyard. https://www.oiv.int/sites/default/files/2022-09/functional-biodiversity-in-the-vineyard-oiv-expertise-docume_en.pdf

International Organisation of Vine and Wine (OIV). (2021). Information Report on Water in Oenology. https://www.oiv.int/sites/default/files/2022-09/oiv-information-report-on-water-in-enology%20%281%29_en.pdf

International Organisation of Vine and Wine (OIV). (2021). The World Organic Vineyard. https://www.oiv.int/public/medias/8514/en-focus-the-world-organic-vineyard.pdf

International Organisation of Vine and Wine (OIV). (2018). Managing By-Products of Vitivinicultural Origin. https://www.oiv.int/sites/default/files/2022-09/managing-viticulture-by-products-web_en.pdf

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Websites

(n.d.). Environmental Footprint methods. Green Business. Retrieved August 23, 2023, from https://green-business.ec.europa.eu/environmental-footprint-methods_en

(n.d.). Organic viticulture is gaining terrain | OIV. Oiv.int. Retrieved August 23, 2023, from https://www.oiv.int/organic-viticulture-is-gaining-terrain

(n.d.). Wine Institute | The Advocacy Group for the California Wine Industry. Wine Institute. Retrieved August 23, 2023, from https://wineinstitute.org/

LEVEL 3- ADDITIONAL RESOURCES

CERTIFICATION AND LABELLING

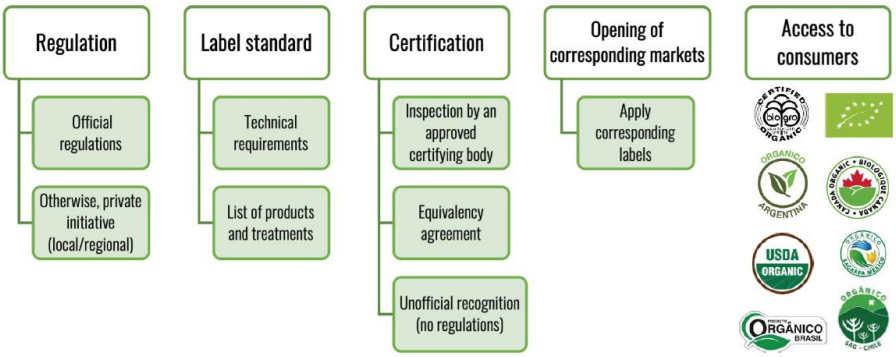
Various certification schemes and labelling regulate organic grape and wine production. The market contains numerous categories of “green” wines, which include natural, organic, biodynamic, and sustainable wine, among others. This proliferation of country-specific regulations, certification standards, and logos causes confusion among consumers.

The regulations governing **organic farming** in Europe aim to establish a well-defined framework for producing organic goods across the EU. The primary objective is to meet the expectations of consumers for dependable organic products while ensuring a level playing field for producers, distributors, and marketers. In the European Union, organic production, labelling, and controls are currently regulated by Regulation (EU) 834/2007, Regulation (EU) 2018/848, Regulation (EU) 889/2008 and Regulation (EU) 1235/2008, which specify the rules that underlie organic production, import, processing, official controls, and labelling of all the existing organic foods, including those deriving from grape and wine processing.

Source: European Commission, 2023

The European labelling scheme on sustainability is already advocated within the European **Farm to Fork strategy**. Labelling provides consumers with information concerning the characteristics of food products. According to EU Regulation No. 1308/2013, wine labels must include some compulsory information on the label (vine grape category, designation of origin, alcohol content by volume, indication of provenance and bottler or importer, etc.) and optional information (vintage year, grape varieties, indication of production methods). Consequently, there is a discrepancy between the consumer demand for information regarding wine consumption’s impact on human health and the surrounding environment and the information provided.

Image. Overview of the regulatory framework for organic certification in vitiviniculture



Source. OIV, 20203. https://www.oiv.int/standards/oiv-guide-for-the-implementation-of-principles-of-sustainable-vitiviniculture-

A **biodynamic** farm is a self-sufficient system that produces everything needed for vineyards, wineries, and the farmers' lives. To be biodynamic, a company must first be certified as organic and comply with organic agriculture regulations in the EU. As a result, biodynamic wines have dual certification: organic and biodynamic. Wineries must adhere to strict wine processing standards to receive certification for their Biodynamic® wines from the Demeter Association. Only if 100% of the grapes used are Biodynamic®. However, if the manipulation of grapes during vinification does not meet the vinification standard, the wine will not be certified as Biodynamic®.

The **Italian Ministry developed the VIVA label** for the Environment, Land, and Sea to calculate sustainability performance in vineyards and wine production. It analyses four indicators: air, which reflects the total greenhouse gas emission expressed as kg of CO2 equivalents, directly or indirectly associated with the production of a 0.75 litre bottle of wine; water, which expresses the potential environmental impacts resulting from the use of fresh water, and takes into account the litres of water directly consumed and polluted in the vineyard, and in the cellar, for the production of a 0.75 L bottle of wine; vineyard, which measures the agricultural practices impact expressed on a scale from A to E (A = minimal environmental impact; E = strong environmental impact); and territory, assesses the impact of winery's activities on surrounding biodiversity, local workforce (both in terms of job creation and job quality), and local communities (producers and consumers).

The standard **Fairtrade** has a comprehensive approach to sustainability for wineries to provide workers with living wages and safe conditions and must pay growers a fair price.

Additional Resources

Scientific articles

Beaumelle, L., Giffard, B., Tolle, P., Winter, S., Entling, M. H., Benítez, E., Zaller, J. G., Auriol, A., Bonnard, O., Charbonnier, Y., Fabreguettes, O., Joubard, B., Kolb, S., Ostandie, N., Reiff, J. M., Richart-Cervera, S., & Rusch, A. (2023). Biodiversity conservation, ecosystem services and organic

viticulture: A glass half-full. *Agriculture, Ecosystems & Environment*, *351*, 108474. https://doi.org/10.1016/j.agee.2023.108474

Bonn, I., & Fisher, J. (2011). Sustainability: The missing ingredient in strategy. *Journal of Business Strategy*, *32*(1), 5-14. https://doi.org/10.1108/02756661111100274

Capitello, R., & Sirieix, L. (2019). Consumers' Perceptions of Sustainable Wine: An Exploratory Study in France and Italy. *Economies*, *7*(2), 33. https://doi.org/10.3390/economies7020033

Gallenti, G., Troiano, S., Marangon, F., Bogoni, P., Campisi, B., & Cosmina, M. (2019). Environmentally sustainable versus aesthetic values motivating millennials' preferences for wine purchasing: Evidence from an experimental analysis in Italy. *Agricultural and Food Economics*, *7*(1), 1-16. https://doi.org/10.1186/s40100-019-0132-x

Gutiérrez-Gamboa, G., & Zheng, W. (2020). Current viticultural techniques to mitigate the effects of global warming on grape and wine quality: A comprehensive review. *Food Research International (Ottawa, Ont.)*, *139*. https://doi.org/10.1016/j.foodres.2020.109946

Maicas, S., & Mateo, J. J. (2019). Sustainability of Wine Production. *Sustainability*, *12*(2), 559. https://doi.org/10.3390/su12020559

Mariani, A., & Vastola, A. (2023). Sustainable winegrowing: Current perspectives. *International Journal of Wine Research*. https://doi.org/68003

Moscovici, D., & Reed, A. (2018). Comparing wine sustainability certifications around the world: History, status and opportunity. *Journal of Wine Research*. https://doi.org/1433138

Mosedale, J. R., Abernethy, K. E., Smart, R. E., Wilson, R. J., & Maclean, I. M. D. (2016). Climate change impacts and adaptive strategies: lessons from the grapevine. *Global Change Biology*, *22*(11), 3814–3828. https://doi.org/10.1111/gcb.13406

Nesbitt, A. (2016). A climate for sustainable wine production: Modelling the effects of weather variability and climate change on viticulture in England and Wales. Semanticscholar.org. Retrieved August 23, 2023, from https://www.semanticscholar.org/paper/A-climate-for-sustainable-wine-production%3A-the-of-Nesbitt/74c6f6bc4e58fddad0bf6f90941361af7796475f

Ohmart, Cliff. (2008). Innovative outreach increases adoption of sustainable winegrowing practices in Lodi region. California Agriculture. 62. 142-147. https://doi.org/10.3733/ca.v062n04p142

SELF-ASSESSMENT

(Introduce 5-10 questions) (Only one answer is correct)

1. What characteristics must be considered when achieving sustainability goals in vitiviniculture according to the OIV?
   a) It focuses exclusively on economic viability and profitability.
   b) It requires the use of non-local agricultural practices to enhance diversity.
   c) It considers the impacts of climate change and societal changes.
   d) It has a strong link with the territory, its history, culture, and customs; it generates employment in rural areas; it plays an essential role in landscape preservation; and it assumes its responsibility towards the sustainability goals of United Nations.

2. What does Corporate Social Responsibility (CSR) involve for organisations?
   a) Complying with legal regulations
   b) Focusing solely on economic aspects
   c) Integrating economic, social, and environmental aspects into business strategies
   d) Exclusively investing in environmental capital

3. Which methodology assesses the environmental impacts of a product or service by evaluating resources used and substances emitted in each step of the process?
   a) Greenhouse gas emissions (GHG) analysis
   b) Environmental footprint analysis
   c) Carbon footprint analysis
   d) Life Cycle Analysis (LCA)

4. What are the three fundamental principles of organic viticulture according to the OIV?
   a) Profit Maximization, use of synthetic pesticides
   b) Soil fertility, increased biodiversity, ecosystem maintenance
   c) Genetic modification, use of a mixture of synthetic fertilizers and organic products
   d) Fast production, excessive intervention, low biodiversity

5. What is the purpose of the European Union regulations on organic farming in relation to organic grape and wine production?
   a) To encourage competition among organic producers
   b) To provide a clear structure for organic food and beverage production
   c) To regulate the import of organic foods
   d) To create confusion among consumers regarding organic products

UNIT 11 - VALUING SUSTAINABILITY

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module</td><td colspan="3">Embracing sustainability and future trends in the wine sector</td></tr>
<tr><td>Type</td><td colspan="3">Online</td></tr>
<tr><td>Workload for learner</td><td colspan="3">6 hours</td></tr>
<tr><td>Trainer</td><td colspan="3">Prof. Dr. Angelina Taneva-Veshoska, Ass. Prof. Slavica Trajkovska,
Ass. Ana Tomikj</td></tr>
<tr><td>Institution</td><td colspan="3">IECE</td></tr>
<tr><td>Content/short description; duration</td><td colspan="3">Short description:
This module responds to the growing need of embracing sustainability in the wine sector. Winery management are facing complex problems in recent years, trying to reduce costs, increase quality, be profitable, handle climate changes, labour shortage, (drought, smoke, fires, rainfall etc), be on top of new technological advances, comply with sustainability requirements and simply and follow up fast-moving world. At the same time wineries are expected to create a wine that is true to its territory, style, and variety. This module will provide learners competencies on how approach and tackle these challenges. Learners will work on real-life scenarios/cases from the wine industry, developing the following competencies: critical thinking, futures literacy, systems thinking, problem framing and valuing sustainability.</td></tr>
<tr><td></td><td>Unit</td><td>Content</td><td>Dur.</td></tr>
<tr><td></td><td rowspan="3">Valuing sustainability</td><td>Introduction to sustainability</td><td rowspan="3">1 h</td></tr>
<tr><td></td><td>Importance of valuing sustainability in the wine industry</td></tr>
<tr><td></td><td>Importance of reliable actions and the danger from green washing</td></tr>
<tr><td></td><td rowspan="3">Individual perspective on managing a winery</td><td>Introduction to critical thinking</td><td rowspan="3">2 h</td></tr>
<tr><td></td><td>Introduction to futures literacy</td></tr>
<tr><td></td><td>Case study addressing the individual perspective of a person managing a winery</td></tr>
<tr><td></td><td rowspan="4">Addressing modern challenges in the wine sector</td><td>Introduction to system thinking</td><td rowspan="4">3 h</td></tr>
<tr><td></td><td>Introduction to problem framing</td></tr>
<tr><td></td><td>Future trends in the wine sector connected with sustainability</td></tr>
<tr><td></td><td>Case study addressing the modern challenges which wineries are faced with</td></tr>
</table>

Learning Outcomes	By the end of this course, students will be able to: • Assess information based on personal, social, and cultural backgrounds, applying critical thinking skills to challenge the status quo and propose alternative perspectives. • Demonstrate the following critical thinking skills: envisioning alternative sustainable futures, developing alternative scenarios, and identifying the steps needed to achieve a preferred sustainable future. • Understand the difference between short-, medium- and long-term approaches and their implications for sustainability scenarios. • Reflect on personal values and its alignment with sustainability values relevant to the wine sector. • Apply the framework of solving complex sustainability problems using the project-based learning methodology in proposing sustainable solutions to their work conditions.
Learning materials	• Lectures (PPT) • Cases • Videos • Further readings
Language/s of instruction	English (all materials) Spanish, French, Italian, German, and Macedonian (some materials)
Method/s for teaching and learnings	Each Unit consists of three online parts: 1. **Level 1 (CORE):** is the core learning. It includes introductory texts, videos. All the learner will watch/read/study all the provided resources. 2. **Level 2 (RELEVANT)** has to be completed by the students. It includes presentation, videos, case study, problem-based learning method, case study, project-based learning methods and assignments. 3. **Level 3 (OPTIONAL)** is optional and includes additional resources in different languages, optional tasks and experiential activities that can be completed autonomously.
Method/s of assessment	Short quiz with 5-10 questions for each Unit Assignment (optional)
Method for evaluation	Peer review from partners Evaluation questionnaire by students

VIDEO INTRODUCTION

https://youtu.be/SWJxVO7iqto

TRANSCRIPTION

Welcome to the Green Vineyard Course and the Unit Valuing Sustainability.

The unit will begin with an introduction to sustainability. What does it mean to be sustainable?

Sustainability is about balance, ensuring we meet today's needs without compromising tomorrow's resources.

Discover how sustainable practices contribute to eco-friendly viticulture, preserving the environment, and maintaining the rich traditions of winemaking.

Next, we'll explore why sustainability matters in the wine industry and how to embrace it in our everyday work.

We will also explore the importance of reliable actions and the danger of greenwashing.

So, whether you're a winemaker, a wine enthusiast, or simply curious about sustainability in the wine industry, join us on this journey to explore how sustainability is shaping the future of wine production and wine consumption.

Let's start with the basics.

Click the next lesson to dive into 'Introduction to Sustainability'.

LEVEL 1 - CORE LEARNING

INTRODUCTION TO SUSTAINABILITY IN THE WINE INDUSTRY

There is a lot of history, custom, and culture in the world of wine. It echoes the care and skill of the people who tended the trees and made the elixir inside the bottles, telling stories that span generations. But now that we live in a more socially and environmentally aware time, the wine business, like many others, is going through a major change. The important idea of survival is at the center of this change.

Sustainability in the wine industry isn't just a trend or a way to boost sales; it's a way of thinking and acting that aims to keep the industry going for a long time while leaving as little of an impact on society and the environment as possible. This learning material starts a journey to look into why sustainability is so important in the wine business. These pages will talk about the three main aspects of sustainability: the environmental, the social, and the economic. We will also look at how these aspects interact in this important business.

You can't say enough about how important sustainability is in the wine business. The wine business has a unique chance to make a difference in the world, where climate change, resource loss, and social inequality are still big problems. Vineyards and wineries can help make the world a better place and protect their own futures by using sustainable methods.

Adopting sustainability is not only a way to protect the environment, encourage social duty, and make sure the economy stays strong, but it is also a way to keep the winemaking tradition alive for future generations.

As a key part of viticulture, the vine industry is an important part of global agriculture and the making of wine, which is one of the oldest and most beloved drinks in the world. Sustainable practices in this sector are not only prudent but essential for its longevity and continued contribution to our lives.

International Organisation of Vine and Wine (OIV) emphasizes the importance of sustainable development in the vine and wine sector, recognizing its role in preserving natural resources and ensuring the economic viability of wine production.

WHY IS SUSTAINABILITY IMPORTANT FOR THE VINE SECTOR?

a. Terroir Preservation: The concept of terroir, the unique combination of soil, climate, and vine that gives each wine its distinct characteristics, is intrinsically linked to the health of the land. Sustainable practices in vineyards help maintain and enhance terroir, preserving the authenticity and quality of wines.

b. Biodiversity Conservation: Vineyards are ecosystems teeming with life. Adopting sustainable agricultural practices ensures the conservation of biodiversity, promoting a harmonious coexistence between vines and the surrounding environment.

c. Economic Resilience: Sustainable viticulture is not only ecologically responsible but also economically viable. By optimizing resource use, minimizing waste, and embracing innovation, vineyards can enhance their economic resilience in the face of evolving global challenges.

Personal sustainability and viticultural sustainability are two very important parts of life that are intertwined. When we understand and embrace the importance of sustainability in both areas, we not only help the planet's health, but we also make sure that the age-old tradition of growing vines and making wines that tell the story of the land they come from continues.

INSPIRING BEST PRACTICES FROM EUROPE

How do wine growers and wineries in different countries approach sustainability?

Look into the different ways that wine farmers and wineries in different countries are trying to be more environmentally friendly. We will be talking about a lot of different best practices from around the world in the next part. These will include many examples that you can use as ideas for your own projects. Find out what new ideas, industry-specific changes, and game-changing projects these businesses have used to move toward sustainable viticulture and viniculture. Each case shows a different aspect of sustainable practices, from eco-friendly farm management to cutting-edge production methods. These examples will help you on your own journey to become more sustainable in the wine world. Take in the big picture of sustainable winemaking around the world, and let these interesting stories help you make decisions that will help the wine business have a more sustainable future.

The Drivers of the Sustainability of Spanish Wineries: Resources and Capabilities

This article looks at four resources that are often linked to sustainability in the literature: (marketing resources, technological resources, innovation resources, and financial resources. The goal is to find out what makes a company decide on its sustainability policies. Spain has the biggest vineyard area in the world, so in this study, 411 observations were gathered from a large survey of wineries that took place in 2020 and 2021.

A careful quantitative study using Box–Cox models showed that promoting innovation and telling consumers about these innovations in a way that makes them seem like good steps forward is very important for the successful implementation of sustainability policies. These results show that the traditional focus on financial and technological resources as the main drivers of sustainability policies in the wine business needs to be reevaluated. Instead, the study suggests that companies should change their strategies to focus on new ideas and communication methods that are more in line with what customers want and how they think.

Scientists Create Future Climate Change Conditions in German Vineyard

Learn about the threat of global warming to the wine production and the experiment at the German Hochschule Geisenheim. Some parts of the university's vineyard are exposed to higher amounts of carbon dioxide to make them feel like they would in 2050. Early data show that the size of the

grapes has changed, they are absorbing more water, and moths are reproducing faster. Even with the changes, the wines still taste pretty much the same, which shows that the experiment is still going on.

Slow Wine Guide for Sustainable Local Wine

Read about the initiative "Slow Wine Guide for Sustainable Local Wine" that could help promote the Macedonian wine in the region. The project will strengthen the link between wine lovers and small-scale local producers by showing 15 new small-scale wineries, the indigenous varieties they grow, and the traditional methods they use.

Making Italian wine more sustainable.

An example from Piedmont, Italy where the best wines in the country are made from the best grapes. In the video Syngenta shows that sustainable farming and innovative crop protection can go together.

Organic wine gradually leaving its mark in the French wine industry

Read about how more and more winemakers in France are choosing to switch to organic growing.

Is There a Wrong Way to Approach Sustainability? - Importance of Reliable Actions and the Danger of Greenwashing in the Wine Industry

The wine industry, like many others, has recognized the growing importance of sustainability in recent years. With consumers increasingly seeking eco-friendly and socially responsible products, wineries have started to embrace sustainable practices to meet this demand. While real efforts to be more environmentally friendly are great, it is important to tell the difference between honest actions and the dangerous practice known as "greenwashing" in the wine business.

Reliable Actions for Sustainability

Reliable actions in the wine industry encompass genuine efforts to minimize the environmental impact, support local communities, and promote sustainable practices. Some key aspects include:

1. Environmental Stewardship

Sustainable wineries prioritize environmentally responsible practices, such as organic or biodynamic farming, minimizing water usage, and reducing carbon emissions. These efforts not only reduce the industry's ecological footprint but also contribute to the protection of natural resources and ecosystems.

2. Certifications and Transparency

Many wineries obtain third-party certifications, such as organic, biodynamic, or sustainable certifications, to demonstrate their commitment to sustainability. Transparent labeling and clear communication of sustainable practices help consumers make informed choices.

3. Social Responsibility

Reliable actions extend beyond the vineyards and winemaking process to include fair labor practices, community engagement, and support for social initiatives. Sustainable wineries invest in their communities, ensure equitable working conditions, and promote social well-being.

The Danger of Greenwashing

While sustainability has gained momentum in the wine industry, the rise of greenwashing poses a significant threat. Greenwashing refers to deceptive marketing practices in which a company exaggerates or falsely claims its environmental or social responsibility efforts to appear more sustainable than it truly is. This practice undermines the credibility of genuinely sustainable businesses and misleads consumers.

Misleading Labels and Claims

Greenwashing often manifests through misleading labels, vague claims, or ambiguous terminology that can confuse consumers. For example, a wine label might use terms like "natural," "eco-friendly," or "green" without providing concrete evidence or certifications to support these claims.

Inconsistent Practices

Some wineries engage in greenwashing by making minor adjustments to their practices or packaging while avoiding substantial changes. These superficial changes may not significantly reduce their environmental impact but can create a false impression of sustainability.

Lack of Third-Party Verification

Greenwashing thrives in the absence of third-party verification. Reliable sustainability efforts are often backed by certifications from respected organisations, while greenwashing lacks external validation.

The Importance of Consumer Awareness

Consumer awareness plays a pivotal role in combating greenwashing in the wine industry. As consumers become more informed and discerning, they can make conscious choices that support genuinely sustainable wineries and reject those engaged in greenwashing.

Wineries, in turn, must prioritise transparency, authenticity, and accountability in their sustainability initiatives. By providing clear information, obtaining credible certifications, and genuinely committing to sustainable practices, wineries can build trust with consumers and contribute to the industry's overall sustainability goals.

In conclusion, the wine industry's journey towards sustainability is vital for environmental conservation and social responsibility. However, distinguishing between reliable actions and greenwashing is crucial. Consumers should seek out transparent and certified wineries while remaining vigilant against deceptive marketing practices. By collectively valuing and promoting

reliable sustainability efforts, the wine industry can contribute to a more sustainable and responsible future.

Video: Greenwashing: When Companies Aren't as Sustainable as They Claim

Source: https://www.youtube.com/watch?v=2NsBcVrPQok&ab_channel=TheWallStreetJournal

BASIC RESOURCES

Videos

- The Choice (Short Animated Movie)
- Global Warming 101 | National Geographic
- What is Sustainability

Links

- Sustainability in the wine industry: key questions and research trends
- What can the wine industry teach us about sustainability?
- Sustainable wine for everyone
- Sustainable wine
- Sustainable Viticulture

LEVEL 2 - LEARNING IN DEPTH

INTRODUCTION TO SUSTAINABILITY

Sustainability is an idea that has become more well-known recently as the world has dealt with more environmental, social, and economic problems. It looks at these problems from a big picture point of view by trying to balance the needs of the present without making it harder for future generations to meet their own needs.

As long as we treat people fairly, take care of the earth, and use energy wisely, we can all enjoy a good quality of life now and in the future.

Image: What is Sustainability

Source: https://www.youtube.com/watch?v=zx04Kl8y4dE

Sustainability includes a promise to use resources wisely, reduce pollution and waste, and work for fairness and social well-being.

Sustainability is an idea that comes from a number of different principles: economic principles (maximizing welfare and improving efficiency), ecological principles (living within carrying capacities and conserving resources) and equity principles (the difference in wealth between generations or between regions of the world).

Sustainability involves everything you do on the farm, including economics, the environmental impacts of everything done on the farm, and all aspects of human resources, including not only you and your family but also your employees and the surrounding community". This shows how hard it is to be sustainable in agriculture.

There is a distinction between green and green-green businesses. Green-green businesses have been environmentally friendly since the beginning, while green businesses only become green after managers, who are not motivated by moral concerns, have realized the benefits that being "sustainable" could bring to the business, such as better marketing, better public perception, or lower costs.

TRIPPLE BOTOM LINE

Sustainability is often represented by the "triple bottom line" framework, which considers three interrelated dimensions:

People - The Heart of the Matter

The third part of the triple bottom line (3P) is "People." Companies that put people first know that their workers, customers, and the communities they serve are not just clients, but also important partners on their journey. They know how important it is to pay workers fairly, make sure the

workplace is safe, and look out for their health. It is important for these companies to promote an open, diverse, and socially responsible culture.

Investing in people isn't just the right thing to do in the 3P plan; it's a strategic decision. When workers are inspired, happy, and feel like they have a role to play in their company, they are more creative and productive. Customers also like companies that put people first, which makes them more loyal to and trusting of the brand.

Planet - Our Shared Home

The "Planet" part of the 3P model takes into account that companies are part of a larger ecological context. It recognizes that the Earth's resources are limited and that overusing them and damaging the environment are bad for everything. Green practices are at the heart of this concept.

Companies that care about the environment try to leave as little of an impact on the environment as possible. They use environmentally friendly methods in their supply chain, cut down on waste, and put money into clean energy sources. In doing so, they not only help make the world a better place, but they also often find ways to save money and work more efficiently.

Image: Triple Bottom Line

Source: Own image

Profit - The Reward for Balance

That being said, "Profit" is one of the three pillars of the 3P method, so it's important to keep that in mind. It's instead seen as a result of finding a balance between people's well-being and the need to preserve the planet. In this case, profit is a serious and long-lasting goal.

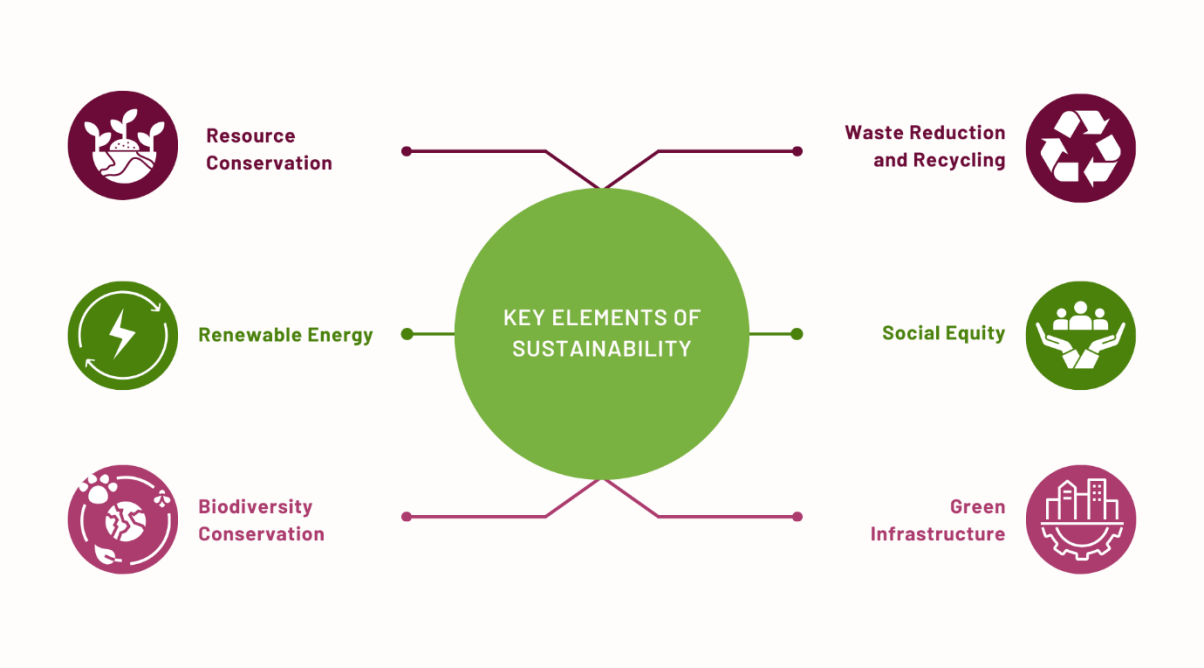
Businesses that put people and the environment first often find that it doesn't hurt their profits; in fact, it can help them make more money. Customers, funders, and business partners all value ethical and environmentally friendly actions. Also, companies that think about the long term and how their actions will affect people and the environment are more likely to be able to handle changes in the market.

Video: Triple bottom line (3 pillars): sustainability in business

Source: Sustainability Illustrated, https://www.youtube.com/watch?v=2f5m-jBf81Q

KEY ELEMENTS AND IMPORTANCE OF SUSTAINABILITY

Key Elements of Sustainability



Sustainability is a complex and multifaceted concept, but several key elements are essential for achieving sustainable practices:

1. Resource Conservation: This involves responsible use of natural resources like water, energy, and raw materials to reduce waste and minimize environmental impacts.

2. Renewable Energy: Transitioning from fossil fuels to renewable energy sources like solar, wind, and hydropower is critical to reduce greenhouse gas emissions and combat climate change.

3. Biodiversity Conservation: Protecting and restoring biodiversity is crucial for ecosystem health and resilience. This includes efforts to prevent habitat destruction and species extinction.

4. Waste Reduction and Recycling: Minimizing waste generation, promoting recycling, and adopting circular economy principles help reduce the environmental burden of waste disposal.

5. Social Equity: Ensuring equal access to resources, education, healthcare, and opportunities for all individuals, regardless of their background or circumstances.

6. Green Infrastructure: Developing sustainable infrastructure such as green buildings, public transportation, and sustainable agriculture systems to reduce environmental impact.

The Importance of Sustainability

Sustainability is vital for several reasons, including:

1. Environmental Stewardship: It helps protect the planet's natural resources, ecosystems, and biodiversity, ensuring a healthier environment for current and future generations.

2. Economic Resilience: Sustainable practices can lead to cost savings, improved efficiency, and long-term economic stability for businesses and communities.

3. Social Well-being: Promoting social equity and well-being enhances the quality of life for all members of society, reducing disparities and fostering inclusivity.

4. Climate Change Mitigation: Sustainable practices are essential for mitigating the impacts of climate change, reducing greenhouse gas emissions, and ensuring a habitable planet.

5. Global Collaboration: Sustainability transcends borders and requires international cooperation to address global challenges collectively.

By embracing the key elements of sustainability and recognising its importance, individuals, businesses, and governments can contribute to a more sustainable and resilient future.

Video: Go Green, Your Way!

https://www.youtube.com/watch?v=lzVWXyXnarI&ab_channel=MinistryofSustainabilityandtheEnvironment

Why is Sustainability Important for Us?

With everything going on in the world today, it's easy to forget how each person affects the surroundings. But the decisions we make every day have effects on more than just our direct surroundings. They have effects on the ecosystem as a whole. To its core, sustainability is not just a word; it's a way of thinking that tells us to take care of the world responsibly.

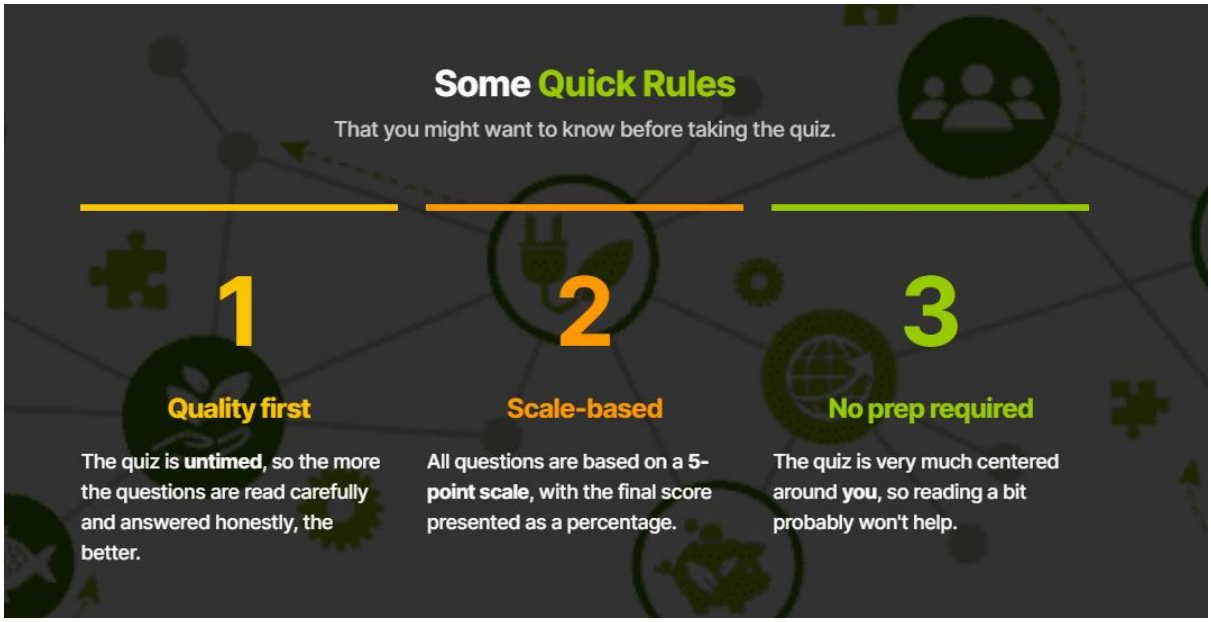
Sustainability in Your Own Life

a. Environmental stewardship means that everything we do, no matter how big or small, affects the planet's health. As stewards of the environment, we reduce our impact on the Earth and protect it for future generations by using sustainable methods.

b. Your personal health: Living in a way that is sustainable can often make you better. These choices, like eating healthy food and cutting down on waste, can improve your physical and mental health.

c. Social Responsibility: Being sustainable is more than just good habits; we all have to do our part. By using sustainable methods, we improve the health of communities around the world and encourage a feeling of social responsibility and connection.

If you want to understand how sustainable you take this [Personal Sustainability Quiz.]



Source: https://sustainabilitist.com/quiz/#quiz

Videos

- Defining Sustainability: Absolutely | Anjila Hjalsted | TEDxGoodenoughCollege
- The Wine Society Sustainability Plan - Protecting the wines we love
- Wine and Climate Change
- Planeta Winery's approach to sustainable wine production
- Sustainability in the Marlborough Winery

LEVEL 3 – ADDITIONAL RESOURCES

The Sustainable Development Goals (SDGs) are a set of 17 interconnected global goals established by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development. These goals are designed to address a wide range of social, economic, and environmental challenges facing the world, with the aim of creating a more equitable, sustainable, and prosperous future for all. Here's an explanation of each of the 17 SDGs:

1. **No Poverty (SDG 1):** End poverty in all its forms everywhere. This goal focuses on eradicating extreme poverty and ensuring that all people have access to basic necessities such as food, clean water, and shelter.

2. **Zero Hunger (SDG 2):** End hunger, achieve food security and improved nutrition, and promote sustainable agriculture. This goal aims to eliminate hunger and malnutrition while promoting sustainable agricultural practices.

3. **Good Health and Well-being (SDG 3):** Ensure healthy lives and promote well-being for all at all ages. SDG 3 targets improving healthcare access, reducing maternal and child mortality, and combating major diseases.

4. **Quality Education (SDG 4):** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. This goal seeks to provide quality education to all, regardless of gender, age, or socioeconomic status.

5. **Gender Equality (SDG 5):** Achieve gender equality and empower all women and girls. SDG 5 aims to eliminate discrimination and violence against women and promote equal participation in all aspects of life.

6. **Clean Water and Sanitation (SDG 6):** Ensure availability and sustainable management of water and sanitation for all. This goal addresses issues related to clean drinking water, sanitation, and water resource management.

7. **Affordable and Clean Energy (SDG 7):** Ensure access to affordable, reliable, sustainable, and modern energy for all. This goal promotes the use of renewable energy sources and improved energy efficiency.

8. **Decent Work and Economic Growth (SDG 8):** Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all. SDG 8 focuses on job creation, economic productivity, and fair labor practices.

9. **Industry, Innovation, and Infrastructure (SDG 9):** Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation. This goal aims to support economic development through improved infrastructure and innovation.

10. **Reduced Inequalities (SDG 10):** Reduce inequality within and among countries. SDG 10 addresses issues of income inequality, social inclusion, and equitable access to resources and opportunities.

11. **Sustainable Cities and Communities (SDG 11):** Make cities and human settlements inclusive, safe, resilient, and sustainable. This goal focuses on urban planning, infrastructure, and sustainable development in urban areas.

12. **Responsible Consumption and Production (SDG 12):** Ensure sustainable consumption and production patterns. SDG 12 aims to reduce waste, promote resource efficiency, and encourage sustainable production and consumption.

13. **Climate Action (SDG 13):** Take urgent action to combat climate change and its impacts. This goal addresses the need to reduce greenhouse gas emissions, increase climate resilience, and support climate adaptation efforts.

14. **Life Below Water (SDG 14):** Conserve and sustainably use the oceans, seas, and marine resources for sustainable development. SDG 14 focuses on marine conservation, fisheries management, and ocean health.

15. **Life on Land (SDG 15):** Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. This goal aims to protect terrestrial ecosystems and biodiversity.

16. **Peace, Justice, and Strong Institutions (SDG 16):** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels. This goal addresses issues of peace, governance, and access to justice.

17. **Partnerships for the Goals (SDG 17):** Strengthen the means of implementation and revitalise the global partnership for sustainable development. SDG 17 emphasises the importance of collaboration and partnerships among governments, civil society, and the private sector to achieve the other SDGs.

These 17 SDGs provide a comprehensive framework for addressing the most pressing global challenges and working toward a more sustainable and equitable future for all. They are interconnected and require collective efforts from governments, businesses, civil society, and individuals to achieve.

Source: UN https://www.un.org/sustainabledevelopment/news/communications-material/

WHAT CAN YOU DO ABOUT SUSTAINABILITY?

Here is a list of associations and organisations where you can join, depending on your location:

1. Spanish Organic Wines
2. Sustainable Wine Roundtable
3. VIVA sustainable wine
4. France Vin Bio
5. Vignerons Engagés - Le premier label RSE et durable du vin (vignerons-engages.com)
6. HVE - accueil - HVE - Haute Valeur Environnementale (hve-asso.com)
7. Vignerons - Demeter
8. TERRA VITIS : certification vin responsable et durable
9. Objectif 100% certifié | Le site officiel du Champagne
10. Accueil (biodyvin.com)
11. FNAB - La Fédération Nationale d'Agriculture Biologique
12. Accueil - Agri Confiance

(when translating this part, partners can add links from their own countries and share them with us)

ADDITIONAL RESOURCES

Database

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Vineyards_in_the_EU_-_statistics

Scientific papers

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Dumitriu, G.D.; Teodosiu, C.; Cotea, V.V. *Management of Pesticides from Vineyard to Wines: Focus on Wine Safety and Pesticides Removal by Emerging Technologies*; IntechOpen: London, UK, 2021; pp. 1–27

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Organisations and Consumers Shape Markets, 31-51. (https://link.springer.com/chapter/10.1007/978-3-030-79660-0_3)

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SELF-ASSESSMENT

(Introduce 5-10 questions) (Only one answer is correct)

1. Sustainability is to …
    a) focus only on environmental protection and nature preservation.
    b) recycle, reduce and reuse.
    c) meet the needs of the present without compromising the ability of future generations to meet their own needs.
    d) invest into expensive equipment for less pollution.

2. What does 3P (triple bottom line) include?
    a) prosperity, pollution-free cities and peace
    b) people, planet and profits
    c) persistence, preserving and peace
    d) peace, prospect and planet

3. Which of the following is not key elements of sustainability?
    a) Resource Conservation
    b) Green Infrastructure
    c) Social Equity
    d) Certifications and Transparency

4. Why is sustainability important?
    a) Individual freedom
    b) Freedom of speech
    c) Climate Change Mitigation
    d) Fighting corruption

5. What are not the reliable actions for sustainability in the wine industry?
    a) Greenwashing
    b) Environmental Stewardship
    c) Certifications and Transparency
    d) Social Responsibility

UNIT 12 - INDIVIDUAL PERSPECTIVE ON MANAGING A WINERY

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module</td><td colspan="3">Embracing sustainability and future trends in the wine sector</td></tr>
<tr><td>Type</td><td colspan="3">Online</td></tr>
<tr><td>Workload for learner</td><td colspan="3">6 hours</td></tr>
<tr><td>Trainer</td><td colspan="3">Prof. Dr. Angelina Taneva-Veshoska, Ass. Prof. Slavica Trajkovska,
Ass. Ana Tomikj</td></tr>
<tr><td>Institution</td><td colspan="3">IECE</td></tr>
<tr><td>Content/short description; duration</td><td colspan="3">Short description:
This module responds to the growing need of embracing sustainability in the wine sector. Winery management are facing complex problems in recent years, trying to reduce costs, increase quality, be profitable, handle climate changes, labour shortage, (drought, smoke, fires, rainfall etc), be on top of new technological advances, comply with sustainability requirements and simply and follow up fast-moving world. This module will provide learners competencies on how approach and tackle these challenges. Learners will work on real-life scenarios/cases from the wine industry, developing the following competencies: critical thinking, futures literacy, systems thinking, problem framing and valuing sustainability.</td></tr>
<tr><td></td><td>Unit</td><td>Content</td><td>Dur.</td></tr>
<tr><td></td><td rowspan="3">Valuing sustainability</td><td>Introduction to sustainability</td><td rowspan="3">1 h</td></tr>
<tr><td></td><td>Importance of valuing sustainability in the wine industry</td></tr>
<tr><td></td><td>Importance of reliable actions and the danger from green washing</td></tr>
<tr><td></td><td rowspan="3">Individual perspective on managing a winery</td><td>Introduction to critical thinking</td><td rowspan="3">2 h</td></tr>
<tr><td></td><td>Introduction to futures literacy</td></tr>
<tr><td></td><td>Case study addressing the individual perspective of a person managing a winery</td></tr>
<tr><td></td><td rowspan="3">Addressing modern challenges in the wine sector</td><td>Introduction to system thinking</td><td rowspan="3">3 h</td></tr>
<tr><td></td><td>Introduction to problem framing</td></tr>
<tr><td></td><td>Future trends in the wine sector connected with sustainability</td></tr>
<tr><td></td><td></td><td>Case study addressing the modern challenges which wineries are faced with</td><td></td></tr>
<tr><td>Learning Outcomes</td><td colspan="3">By the end of this course, students will be able to:
• Assess information based on personal, social, and cultural backgrounds, applying critical thinking skills to challenge the status quo and propose alternative perspectives.</td></tr>
</table>

	• Demonstrate the following critical thinking skills: envisioning alternative sustainable futures, developing alternative scenarios, and identifying the steps needed to achieve a preferred sustainable future. • Understand the difference between short-, medium- and long-term approaches and their implications for sustainability scenarios. • Reflect on personal values and its alignment with sustainability values relevant to the wine sector. • Apply the framework of solving complex sustainability problems using the project-based learning methodology in proposing sustainable solutions to their work conditions.
Learning materials	• Lectures (PPT) • Cases • Videos • Further readings
Language/s of instruction	English (all materials) Spanish, French, Italian, German, and Macedonian (some materials)
Method/s for teaching and learnings	Each Unit consists of three online parts: 1. **Level 1 (CORE):** is the core learning. It includes introductory texts, videos. All the learner will watch/read/study all the provided resources. 2. **Level 2 (RELEVANT)** has to be completed by the students. It includes presentation, videos, case study, problem-based learning method, case study, project-based learning methods and assignments. 3. **Level 3 (OPTIONAL)** is optional and includes additional resources in different languages as well as optional tasks and experiential activities that can be completed autonomously.
Method/s of assessment	Short quiz with 5-10 questions for each Unit Assignment (optional)
Method for evaluation of the course	Peer review from partners Evaluation questionnaire by students

VIDEO INTRODUCTION

https://youtu.be/33BnWpt6QIU

TRANSCRIPTION

Welcome to the Green Vineyard Course and the Unit Introduction to individual perspective on managing a winery.

The unit will help you understand the concepts of critical thinking and future literacy, their elements and how they affect the work you do.

Nest, we will explore how critical thinking and future literacy contribute to sustainability, preserving the environment, and maintaining the rich traditions of winemaking.

We will also explore case study and assessment questions, where we will spotlight the tangible application of these concepts, showcasing their real-world significance and relevance.

This course will help you demonstrate the following critical thinking skills: envisioning alternative sustainable futures, developing alternative scenarios, and identifying the steps needed to achieve a preferred sustainable future.

So, whether you're a winemaker, a wine enthusiast, or simply curious about sustainability in the wine industry, join us on this journey to explore how sustainability is shaping the future of wine production and wine consumption.

Click the next lesson to dive into this unit.

LEVEL 1 - CORE LEARNING

CASE STUDY ADDRESSING THE INDIVIDUAL PERSPECTIVE MANAGING A WINERY IN SPAIN

Spain, a major player in the global wine industry, faces the challenge of climate change impacting its extensive vineyard acreage. The wine industry, which owns 13% of the world's vineyards, is taking action to adapt to climate change by by implementing innovative strategies such as cultivating at higher latitudes and seeking drought-resistant grape varieties. In response to customer demands for sustainability, the industry is also working to lower its carbon footprint and use eco-design principles.

An example of a committed winery is Familia Torres Wineries, who hold, among others, two important sustainability seals within the Spanish wine sector: Sustainable Wineries for Climate Protection (SWfCP) and International Wineries for Climate Action (IWCA).

Sustainable Wineries for Climate Protection (SWfCP) is the certification developed by the Spanish Wine Federation (FEV) that allows wineries to demonstrate in a solid and quantifiable way, through audits carried out by accredited certification bodies, their sustainability in all its facets (environmental, social, economic, and governance). It was created in 2015 to demonstrate wineries' commitment to combating climate change, and currently, there are more than 90 certified wineries under the SWfCP seal. Furthermore, within the certification, there is a more demanding category in carbon footprint reduction, Spanish Wineries for Emission Reduction (WfCP+). Currently, 6 wineries, including Familia Torres, have this category.

International Wineries for Climate Action (IWCA), developed by Family Torres in collaboration with Jackson Family Wines, is a group of 45 wineries around the world working together to get to net-zero emissions by 2050. They prefer direct answers to carbon offset credits. Organic wineries like Herència Altés see sustainability as a way to stay ahead of the competition and join groups like IWCA, committing to substantial emission reductions.

Herència Altés, supported by proACCIÓ Green vouchers and inèdit, engages in calculating and reducing its carbon footprint. Some ways to reduce carbon emissions are to add more solar panels, put in lithium batteries, and make bottles 30% lighter. Addressing indirect emissions from suppliers is crucial, since almost 92% of the winery's emissions come from goods and services provided by third parties. Supplier impact is a key part of meeting decarbonization goals and getting everyone on board with sustainability.

Familia Torres has an impact on suppliers by asking for carbon footprint estimates and eco-design to be built into packaging since 2015. The case study shows how important it is to have an impact on suppliers, since a company's indirect emissions usually make up most of its carbon output.

When it comes to packaging, one approach is to make glass bottles lighter and use eco-friendly design on the labels, corks, capsules, and packaging. The La Vinyeta winery is a great example of eco-design at work, as it has made big changes to the environment. Reusing bottles, as shown by the reWINE project, is the best thing for the earth. Catalonia's wine industry could save over 100 million kg of CO_2 equivalents and cut trash by 21,756 tons each year through reuse programs. This would help the wine industry's carbon footprint drop by 28%.

The case study shows how the wine industry is taking action against climate change, how important it is for global groups to work together, and how sustainability can help businesses be more competitive. It also stresses how important it is for suppliers to be involved, eco-design to be used, and bottles to be reused as part of a larger plan to make the wine industry less harmful to the environment.

Read the full case study here.

Critical Skills in the Case Study:

- **Critical Thinking:** The wine sector's awareness of the impacts of climate change on vineyards and wine quality demonstrates critical thinking in recognizing and addressing challenges.
- **Decision-Making:** The decision of Família Torres to intensify its environmental commitment in 2008, creating a program to reduce its carbon footprint, reflects strategic decision-making.
- **Problem Solving:** Actions taken by wineries, such as cultivating at higher latitudes, seeking adapted grape varieties, and applying agronomic techniques for soil moisture, indicate problem-solving in response to climate change impacts.
- **Adaptability:** The adoption of sustainable practices, such as obtaining the SWfCP certificate, or joining the International Wineries for Climate Action (IWCA), shows adaptability to changing environmental and consumer demands.
- **Leadership Skills:** Wineries like Família Torres and Herència Altés demonstrate leadership in environmental commitment and sustainability, influencing the industry through initiatives like SWfCP certificate or the IWCA.
- **Analytical Skills:** The calculation of carbon footprints and identification of emission sources by wineries like Herència Altés involves analytical skills in understanding and addressing environmental impact.

Future Literacy in the Case Study:

- **Trend Awareness:** The collaboration between Família Torres and Jackson Family Wines to establish the International Wineries for Climate Action reflects awareness of global trends in sustainable and climate-conscious practices.
- **Strategic Foresight:** Família Torres' alliance in 2019 with Jackson Family Wines to form IWCA demonstrates strategic foresight in addressing climate change collectively and working towards net-zero emissions by 2050.
- **Technology Adoption:** The use of proACCIÓ Green vouchers and assistance from inèdit for calculating carbon footprints and implementing decarbonization measures indicates the adoption of technology for sustainability.
- **Market Intelligence:** Wineries like Herència Altés joining initiatives like IWCA based on the belief that it provides a competitive advantage reflects market intelligence and awareness of consumer preferences for sustainable products.

- **Environmental Scanning: F**amília Torres' commitment to environmental care and sustainability since 2008 indicates ongoing environmental scanning and proactive adaptation to the changing climate scenario.
- **Collaboration for Innovation:** The creation of IWCA and collaborative efforts among wineries for decarbonization shows a commitment to collaboration and innovation for a sustainable future.

BASIC RESOURCES

Videos

Fundamentals: Introduction to Critical Thinking

Critical thinking - Fundamentals: Deductive Arguments

Critical thinking - Fundamentals: Abductive Arguments

Critical thinking - Fundamentals: Validity

Critical thinking- Fundamentals: Truth and Validity

Critical thinking- Fundamentals: Soundness

Critical thinking- Fundamentals: Bayes' Theorem

Critical thinking- Fundamentals: Correlation and Causation

What is Futures Literacy and what tools do we have to support policy makers to consider the future?

Futures Literacy

LEVEL 2 – LEARNING IN DEPTH

To get more familiar with others' actions, we propose you to explore the following real-life case studies:

- The Spanish wine industry, a symbol of tradition and global standard
- The Loire Valley's Eco-Friendly Vineyards
- Making Italian wine more sustainable
- Sustainable Italy: how our producers are keeping it green
- An italian wine region takes a sustainable approach
- https://sustainable-winegrowing.org/
- Bordeaux, a sustainable vineyard
- Organic wine gradually leaving its mark in the French wine industry
- How winemakers are adapting to a warmer world
- Sustainability, Organic Viticulture, and Biodynamics: 3 Wineries Leading The Way
- Reuse of wine bottles
- Potential of the Macedonian wine

ASSESS THE VALUE OF CRITICAL THINKING IN YOUR WORK

1. Can you provide an example of a situation where your critical thinking skills were crucial in decision-making in your work?
2. How do you prioritize decisions in your work, especially when faced with competing interests?
3. Can you describe a decision you made that had a significant impact on the quality or efficiency of wine production/other process?
4. Provide an example of a time when you had to adapt to unexpected changes in the winery environment.
5. How do you analyze data related to grape quality, fermentation, or other winemaking processes?
6. Can you discuss a specific situation where data analysis led to improvements in wine production/other process of your work?
7. How do you ensure effective communication among team members during the winemaking process?
8. Describe your approach to leading a team in a high-pressure situation, such as during harvest or bottling.
9. How do you prioritize tasks during peak seasons to ensure timely and efficient wine production?
10. Can you share a situation where effective time management contributed to the success of your work?
11. How do you assess and mitigate risks in the winemaking process, especially related to weather conditions or grape quality?
12. Share an experience where your risk management skills prevented potential issues in wine production.

Assess the Value of Future Literacy in Your Work

1. How do you stay informed about emerging trends in the wine industry, such as changes in consumer preferences or sustainable practices?
2. Can you provide an example of how your awareness of industry trends influenced a decision or strategy in the winery?
3. How do you engage in scenario planning to anticipate potential future challenges or opportunities for the winery?
4. Can you describe a situation where scenario planning was beneficial in preparing for a future event or trend?
5. How do you incorporate strategic foresight into long-term planning for the winery, considering factors like climate change and market shifts?
6. Share an example of a decision or initiative where strategic foresight played a crucial role in the winery's success.
7. How do you assess and integrate new technologies or innovations that could impact winemaking processes in the future?
8. Provide an example of a successful implementation of technology to enhance winery operations.
9. How do you conduct environmental scanning to identify external factors, such as climate conditions, that may affect grape cultivation and wine production in the future?
10. Can you discuss a time when environmental scanning led to proactive measures in the winery?
11. How do you consider global factors, such as international market trends and geopolitical events, in the winery's strategic planning?
12. Describe a situation where global awareness had an impact on decision-making in the winery.
13. How do you engage in professional networks to gain insights and perspectives from other experts in the wine industry?
14. Provide an example of how networking contributed to your understanding of future developments in winemaking.
15. Can you discuss a situation where the winery faced challenges due to a lack of future literacy, and what measures were taken to learn from those experiences?
16. How do you encourage a culture of learning from mistakes and adapting for the future within the winery?
17. How do you invest in the ongoing education and development of yourself and your team to enhance future literacy skills?
18. Share a specific initiative or program you implemented to promote continuous learning in the winery.

Complementary Resources

- Critical thinking - Fallacies: Formal and Informal Fallacies
- Critical thinking - Fallacies: Equivocation
- Critical thinking - Fallacies: Fallacy of Composition
- Critical thinking - Fallacies: Fallacy of Division
- Critical thinking - Fallacies: Introduction to Ad Hominem Fallacies
- Critical thinking - Fallacies: Ad Hominem
- Critical thinking - Fallacies: Post Hoc Ergo Propter Hoc
- Critical thinking - Fallacies: Appeal to the People

- Critical thinking - Fallacies: Straw Man Fallacy
- Critical thinking - Fallacies: Slippery Slope
- Critical thinking - Fallacies: Red Herring
- Futures Literacy and Futures & Foresight compared
- Green Competences Framework

LEVEL 3 – ADDITIONAL RESOURCES

WHAT IS CRITICAL THINKING?

In a society overwhelmed with an excessive amount of information, where there is an excess of opinions and a scarcity of facts, the skill of critical thinking is more important than ever. Critical thinking is more than just a mental exercise; it is a way of approaching the world, a tool for judgment and understanding.

Critical thinking is the practiced skill of separating, combining, judging, and using facts to shape your views and actions. It means questioning assumptions, noticing biases, weighing facts, and looking at things from different points of view. It's about looking for the truth, taking into account how complicated things are, and making smart choices.

At its core, critical thinking is a way of thinking that tries to understand ideas and solve problems in a way that is correct, useful, and clear. It's about not just accepting information on the surface, questioning what you already think, and using logic and facts to come to well-informed opinions.

Video: What is critical thinking?

Link: https://www.youtube.com/watch?v=HnJ1bqXUnIM

Core Components of Critical Thinking

1. Questioning and Inquiry

One of the foundational pillars of critical thinking is asking thoughtful and probing questions. These questions delve into the heart of the matter, seeking to uncover underlying assumptions, motivations, and implications. Effective questioning leads to a deeper understanding of the subject and helps identify gaps in knowledge.

2. Analysis and Evaluation

Critical thinkers break down complex information into its constituent parts to examine its structure, patterns, and relationships. They evaluate the quality and reliability of information, considering the source, evidence, logic, and potential biases. This analytical process is essential for forming well-rounded, evidence-based judgments.

3. Synthesis and Integration

Synthesis involves combining disparate ideas or information to create a new understanding or perspective. It's about seeing connections between seemingly unrelated elements. Critical thinkers synthesize information to generate innovative solutions, bridge gaps, and create a more comprehensive understanding of the subject.

4. Reflection and Metacognition

Reflection is the act of pondering and reviewing one's own thinking processes. Metacognition involves being aware of one's thoughts and strategies, understanding how they influence decision-making. Critical thinkers engage in reflective practices, learning from experiences and adapting their thinking strategies for future situations.

5. Decision-making

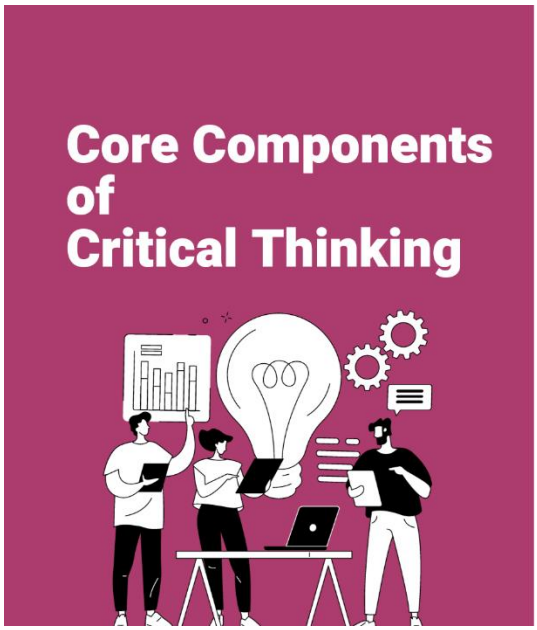
Decision-making is part of critical thinking, and the and the two processes are interconnected. When you're critical thinking, making a choice means picking one course of action from several options after giving the evidence, possible outcomes, and underlying assumptions a lot of thought. When making decisions, critical thinkers use a methodical and analytical approach to make sure their choices are well-informed, logical, and take into account the complexities of different situations.

6. Problem-solving

To solve problems in the world of critical thinking, you need to take a methodical approach that goes beyond a quick fix. Critical thinkers use careful analysis and strategic thought to figure out how to solve problems.

To begin, critical thinkers recognize that there is a problem by finding contradictions, knowledge gaps, or places where things could be better. Being aware of this is the first step in critical thinking; it shows that you need to be careful and thoughtful.

If you are interested in ways to approach problem solving enrol to unit 13: ADDRESSING MODERN CHALLENGES IN THE WINE SECTOR



1. Questioning and Inquiry
2. Analysis and Evaluation
3. Synthesis and Integration
4. Reflection and Metacognition
5. Decision-making
6. Problem-solving

CULTIVATING CRITICAL THINKING

1. Embrace a Growth Mindset

A growth mindset fosters a belief that abilities and intelligence can be developed through dedication and hard work. Encourage yourself to see challenges as opportunities for growth and learning, cultivating a resilient and proactive approach to critical thinking.

2. Practice Intellectual Humility

Recognize that you don't know everything and be open to different perspectives and ideas. Admit when you are wrong or unsure, and be willing to learn from others. Intellectual humility lays the foundation for continuous learning and improvement.

3. Sharpen Analytical Skills

Regularly engage in activities that require analysis, such as dissecting arguments, evaluating research papers, or solving complex puzzles. Sharpening your analytical skills will enhance your ability to break down complex problems into manageable components and evaluate them critically.

4. Collaborate and Discuss

Engage in discussions and collaborate with others, especially those with differing opinions. This fosters exposure to alternative viewpoints, challenging your own assumptions and improving your ability to think critically in a social context.

5. Situational Awareness

Situational awareness is an important part of critical thinking because it helps you make smart choices and solve problems quickly. It requires a deeper awareness and understanding of one's surroundings, along with the ability to see how different factors in a situation affect each other. As a part of critical thinking, situational awareness means seeing what information is relevant, understanding its context, judging it in real time, and finding patterns and trends.

6. Engage in Thoughtful Reading and Writing

Reading diverse materials and writing thoughtfully about what you've read can enhance your critical thinking. Analyze the author's arguments, evidence, and biases, and form your own well-reasoned opinions. Writing helps you clarify and articulate your thoughts effectively.

Cultivating Critical Thinking

Video: 5 tips to improve your critical thinking

Link: https://www.youtube.com/watch?v=dItUGF8GdTw

Introduction to Futures Literacy

In a rapidly evolving world, the ability to anticipate, envision, and navigate potential futures is more important than ever. Futures literacy is the competence to understand and use the future consciously and deliberately. It equips individuals with the tools and perspectives to critically engage with the future, allowing for informed decision-making and action in the present.

Video: What is 'Futures Literacy' and why is it important to consider our futures?

Link: https://www.youtube.com/watch?v=BolBjeM8TzU

The Scope of Futures Literacy

Futures literacy encompasses a broad spectrum of skills and knowledge related to understanding and engaging with the future. It involves:

1. Futures Thinking

Futures thinking is the process of exploring possible, probable, and preferable futures by analyzing trends, emerging issues, and potential disruptions. It helps individuals and organizations prepare for uncertainties and adapt to change effectively.

2. Scenario Planning

Scenario planning involves creating narratives or stories about potential future outcomes to inform strategic planning and decision-making. It allows for the exploration of various futures and the development of strategies that are robust and flexible across multiple scenarios.

3. Horizon Scanning

Horizon scanning involves systematically monitoring and analyzing emerging trends, technologies, and social changes to anticipate future developments. It helps in identifying opportunities and threats on the horizon.

4. Wild Cards and Black Swans

Understanding wild cards and black swans involves exploring highly improbable and unexpected events that could have a significant impact on the future. It encourages preparedness for the unexpected.

5. Backcasting

Backcasting is a method that starts with a desirable future scenario and works backward to identify the steps and actions required to achieve that future. It helps in setting goals and planning actions based on a preferred future.

Developing Futures Literacy

Futures literacy is a powerful tool for individuals and societies to navigate the complex and uncertain terrain of the future. By honing our skills in futures thinking, scenario planning, horizon scanning, and backcasting, we can make informed decisions, craft resilient strategies, and shape a better tomorrow. Embracing futures literacy ensures that we are not passive recipients of the future but active participants in its creation.

1. Education and Training

Formal education and training programs focused on futures literacy can provide individuals with the foundational knowledge and skills needed to engage with the future critically.

2. Experiential Learning

Engaging in real-world exercises, workshops, and simulations allows individuals to apply futures thinking methodologies and develop practical experience in envisioning and shaping the future.

3. Interdisciplinary Collaboration

Collaborating with experts from diverse fields facilitates the exchange of ideas, perspectives, and methodologies, enriching the understanding of the future and enhancing futures literacy.

4. Continuous Learning and Reflection

Actively seeking new information, reflecting on experiences, and incorporating feedback are essential components of lifelong learning in futures literacy. It ensures an ongoing improvement of skills and knowledge related to understanding and engaging with the future.

Video: Futures Literacy: shaping your present by reimagining futures

Source: https://www.youtube.com/watch?v=lGvFS6nAMmI

Ethical Considerations in Futures Literacy

Understanding the future and its potential implications raises ethical concerns. Responsible futures literacy involves considering the ethical implications of various future scenarios and actions. It requires careful consideration of how future developments may impact individuals, communities, and the environment, and striving for futures that are equitable, sustainable, and beneficial for all.

Why is Future Literacy Important to Us?

Future literacy is crucial for addressing climate change and sustainability in the wine sector for several reasons:

Anticipating Climate Change Impacts: Future literacy involves the ability to understand and anticipate future trends and changes. In the context of the wine sector where weather factors have a big effect on growing grapes, it's important to know about the possible effects of climate change. If the wine business knows how climate change might affect temperature, rainfall, and growing seasons, it can change how it does things to ensure the continued production of high-quality grapes.

Adapting to Changing Conditions: The wine sector is highly sensitive to variations in climate, and even small changes can affect the quality and taste of wine. Future literacy helps the industry adjust

to new conditions by using new grape varieties, adjusting planting and harvesting schedules, and introducing new tools that lessen the effects of climate change.

Sustainable Practices: Future literacy in the wine sector also involves an understanding of sustainable practices. As climate change raises concerns about resource scarcity and environmental degradation, the wine industry needs to adopt sustainable viticulture and winemaking practices. This includes reducing water usage, minimizing chemical inputs, and adopting organic or biodynamic farming methods.

Market Trends and Consumer Preferences: Being future-literate means being able to predict market trends and understand what consumers want. As people become more concerned about the environment, there is a greater demand for goods like wine that are made in a way that doesn't harm the environment. Future-literate businesses in the wine sector can stay ahead of market trends, respond to consumer preferences, and position themselves as leaders in sustainable and climate-resilient wine production.

To sum up, future literacy is important in the wine industry for climate change and sustainability because it helps the industry deal with climate problems ahead of time, use environmentally friendly methods, meet customer needs, and comply with new regulations. Adopting this holistic understanding of the future will help your business to remain resilient and thrive in a changing global environment.

Video

- Critical thinking - Cognitive Biases: Alief
- Critical thinking - Cognitive Biases: Anchoring
- Critical thinking - Cognitive Biases: Pricing biases
- Critical thinking - Cognitive Biases: Reference Dependence and Loss Aversion
- Critical thinking - Cognitive Biases: Mental Accounting
- Critical thinking - Cognitive Biases: Peak-End Effect
- Critical thinking - Cognitive Biases: The GI Joe Fallacy
- Course on future literacy

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SELF-ASSESSMENT

In this self-assessment quiz, some questions may have more than one correct answer.

1. What is critical thinking?
    a) Being critical of something.
    b) Mental exercise to critically think of something.
    c) Art of analysing, synthesising, evaluating, and applying information to guide beliefs and actions
    d) Tool for analysing and applying information to critique.

2. Which of the following is **not** a core of critical thinking?
    a) Analysis and Evaluation
    b) Reading
    c) Reflection and Metacognition
    d) Decision-making and Problem-solving

3. What are the scope of futures literacy?
    a) Making future plans
    b) Scenario Planning
    c) Horizon Scanning
    d) Wild Cards and Black Swans

4. How can futures literacy be developed?
    a) Education and Training
    b) Experiential Learning
    c) Interdisciplinary Collaboration
    d) Continuous Learning and Reflection

5. What are the ethical considerations in futures literacy?
    a) Ignoring the potential impacts of future developments on individuals and communities.
    b) Prioritizing personal gain over the well-being of others in future scenarios.
    c) Overlooking the importance of sustainable and equitable futures.
    d) Careful consideration of how future developments may impact individuals, communities, and the environment, and striving for futures that are equitable, sustainable, and beneficial for all.

UNIT 13 - ADDRESSING MODERN CHALLENGES IN THE WINE SECTOR

GREEN VINEYARDS PROJECT
2021-1-ES01-KA220-VET-33311

SYLLABUS

<table>
<tr><td>Title of the module</td><td colspan="3">Embracing sustainability and future trends in the wine sector</td></tr>
<tr><td>Type</td><td colspan="3">Online</td></tr>
<tr><td>Workload for learner</td><td colspan="3">6 hours</td></tr>
<tr><td>Trainer</td><td colspan="3">Prof. Dr. Angelina Taneva-Veshoska, Ass. Prof. Slavica Trajkovska,
Ass. Ana Tomikj</td></tr>
<tr><td>Institution</td><td colspan="3">IECE</td></tr>
<tr><td>Content/short description; duration</td><td colspan="3">Short description:
This module responds to the growing need of embracing sustainability in the wine sector. Winery management are facing complex problems in recent years, trying to reduce costs, increase quality, be profitable, handle climate changes, labour shortage, (drought, smoke, fires, rainfall etc), be on top of new technological advances, comply with sustainability requirements and simply and follow up fast-moving world. At the same time wineries are expected to create a wine that is true to its territory, style, and variety. This module will provide learners competencies on how approach and tackle these challenges. Learners will work on real-life scenarios/cases from the wine industry, developing the following competencies: critical thinking, futures literacy, systems thinking, problem framing and valuing sustainability.</td></tr>
<tr><td></td><td>Unit</td><td>Content</td><td>Dur.</td></tr>
<tr><td></td><td rowspan="3">Valuing sustainability</td><td>Introduction to sustainability</td><td rowspan="3">1 h</td></tr>
<tr><td></td><td>Importance of valuing sustainability in the wine industry</td></tr>
<tr><td></td><td>Importance of reliable actions and the danger from green washing</td></tr>
<tr><td></td><td rowspan="3">Individual perspective on managing a winery</td><td>Introduction to critical thinking</td><td rowspan="3">2 h</td></tr>
<tr><td></td><td>Introduction to futures literacy</td></tr>
<tr><td></td><td>Case study addressing the individual perspective of a person managing a winery</td></tr>
<tr><td></td><td rowspan="4">Addressing modern challenges in the wine sector</td><td>Introduction to system thinking</td><td rowspan="4">3 h</td></tr>
<tr><td></td><td>Introduction to problem framing</td></tr>
<tr><td></td><td>Future trends in the wine sector connected with sustainability</td></tr>
<tr><td></td><td>Case study addressing the modern challenges which wineries are faced with</td></tr>
</table>

Learning Outcomes	By the end of this course, students will be able to: • Assess information based on personal, social, and cultural backgrounds, applying critical thinking skills to challenge the status quo and propose alternative perspectives. • Demonstrate the following critical thinking skills: envisioning alternative sustainable futures, developing alternative scenarios, and identifying the steps needed to achieve a preferred sustainable future. • Understand the difference between short-, medium- and long-term approaches and their implications for sustainability scenarios. • Reflect on personal values and its alignment with sustainability values relevant to the wine sector. • Apply the framework of solving complex sustainability problems using the project-based learning methodology in proposing sustainable solutions to their work conditions.
Learning materials	• Lectures (PPT) • Cases • Videos • Further readings
Language/s of instruction	English (all materials) Spanish, French, Italian, German, and Macedonian (some materials)
Method/s for teaching and learnings	Each Unit consists of three online parts: 1. **Level 1 (CORE):** is the core learning. It includes introductory texts, videos. All the learner will watch/read/study all the provided resources. 2. **Level 2 (RELEVANT)** has to be completed by the students. It includes presentation, videos, case study, problem-based learning method, case study, project-based learning methods and assignments. 3. **Level 3 (OPTIONAL)** is optional and includes additional resources in different languages as well as optional tasks and experiential activities that can be completed autonomously.
Method/s of assessment	Short quiz with 5-10 questions for each Unit Assignment (optional)
Method for evaluation	Peer review from partners Evaluation questionnaire by students

VIDEO INTRODUCTION

https://youtu.be/4x3FW1efs50

Transcription

Welcome to Unit 13: Addressing Modern Challenges in the Wine Sector. In this unit, we delve into the crucial concepts of system thinking and problem framing, essential tools for navigating the complex landscape of the wine industry. We'll embark on a journey to understand how these concepts are integral to addressing modern challenges faced by wineries.

Our exploration begins with an introduction to system thinking, a holistic approach that considers the interconnected elements within the wine sector. We'll unravel the layers of problem framing, recognizing that the challenges extend beyond immediate concerns and often require a nuanced understanding of the systemic issues at play.

Looking towards the future, we'll examine emerging trends in the wine sector linked with sustainability. This involves understanding how system thinking and problem solving contribute to preserving the environment and upholding the rich traditions of winemaking.

To bring these concepts to life, we'll delve into a compelling case study that demonstrates the real-world application of system thinking and problem framing, in addressing the challenges modern wineries encounter. Through this, we aim to spotlight the practical significance and relevance of these concepts in the wine industry.

As you progress through this unit, you'll not only enhance your system thinking skills but also develop the ability to envision alternative sustainable futures and identify the necessary steps to achieve them. Whether you're a seasoned winemaker, a passionate wine enthusiast, or simply intrigued by sustainability in the wine world, join us on this enlightening journey.

Together, we'll explore how these fundamental concepts shape the future of wine production and consumption.

LEVEL 1 - CORE LEARNING

ESG

By 2024, proposed rules in Europe and the US indicate that all public companies around the world will have to report on their providers' ESG scores.

ESG stands for "environmental, social, and corporate governance." It is a group of elements that investors should think about when choosing companies. These factors include environmental issues, social issues, and corporate governance issues.

When it comes to wine, ESG will have an effect on things like water use, greenhouse gas emissions, and social problems. There are consulting firms that try to help wineries understand ESG measures and follow global rules.

The ESG scores are becoming more and more important for both private and public wine companies. As ESG screens are used by banks and consumers expect more information, ESG scores could affect both lending decisions and consumer choices. ESG isn't just about following the rules; it's also a way to make an organisation more resilient, assess risks, and run more smoothly in the long term.

CASE STUDY ADDRESSING THE MODERN CHALLENGES WHICH WINERIES ARE FACED WITH – GLOBAL LESSONS

Crittenden Winery in Australia and Duckhorn Portfolio in the US are two of the best examples of wineries that follow Environmental, Social, and Governance (ESG) principles. They do this to meet the needs of Generation Z and Millennials who care about the environment. Sustainability isn't just a buzzword for them; it's an important part of how they do business and how they live their lives.

Sustainability

Sustainability is a big part of what Crittenden Winery does. They care about the earth and are committed to biological farming, composting, water conservation, and renewable energy. The fact that Duckhorn Portfolio focuses on certifications like California Certified Organic Farmers and Certified California Sustainable Winegrowing shows how committed they are to using sustainable farming practises. Both wineries show that making choices that are good for the earth and also good for making good wines is possible.

How System Thinking Is Used

Crittenden Winery and Duckhorn Portfolio are good examples of businesses that use a systemic method. Crittenden uses environmentally friendly methods like biological farming and water saving to make an ecosystem that helps the health of the vineyard. The way Duckhorn farms, using cover crops and integrated pest control, shows that he thinks about the environment in a broad sense. Both farms show how ESG practises can be used in every part of the production process, from managing the vineyards to making sure the soil is healthy.

Framing the Problem

The problem these businesses have to deal with is that customer tastes are changing, especially among younger people. As the number of young people who drink wine drops, the issue is seen as a call for wineries to change to meet the needs of current customers. Crittenden and Duckhorn show that the answer is more than just making wine. It's also about doing it in a way that is sustainable, socially responsible, and good for business.

Last but not least, Crittenden Winery and Duckhorn Portfolio are examples for the wine business of how ESG principles can be built into the way a winery works. In showing others in the industry how to be sustainable, these wineries show that ESG is more than just a trend; it's a way to a more aware and successful future.

Read the full case study here.

Case Study Addressing the Modern Challenges Which Wineries Are Faced With – European Context

Sustainability

French winemakers are taking action on climate change because they know it needs to be dealt with right away. They are supporting sustainability projects that go beyond simple response. There is a move towards climate-resilient vineyards that combine scientific research with information that has been passed down for hundreds of years. Chemical analysis can be used to control the smell, rules about grape types can be loosened, and even cellar practises can be changed to help vines that are stressed by the heat. The push for sustainability goes beyond winemaking; some winegrowers are using regenerative farming methods. Since 2005, Claude de Nicolay has been committed to a fully biodynamic approach. This shows a long-term view on sustainability and shows good results in the face of climate challenges. This focus on sustainability shows that the wine business is aware of how it affects the environment and the need for long-lasting, all-encompassing solutions.

System Thinking

The problems that climate change is causing for the French wine business mean that we need to look at things as a whole. This is clear from the work of winegrowers like Claude de Nicolay.
In various regions, vintners are engaging in systemic approaches to address challenges within their vineyards. They are delving into innovative soil management, adjusting pruning practices, and implementing spatial variations between vines based on microclimates. Additionally, some are adopting agroforestry practices, integrating trees and shrubs into their vineyards. INRAE researchers discovered that the introduction of trees can effectively reduce the temperature of a vineyard by 2–4 °C.

The adoption of agroforestry, seen through a systemic lens, is a strategic, long-term investment. In the initial years post-planting, challenges arise as trees and vines compete for water, demanding significant time and effort from vintners to nurture the saplings. Furthermore, rows of vines may need to be sacrificed, resulting in short-term financial losses. However, over time, as the tree roots establish deep networks and cease competing with vines for water, they contribute to local climate mitigation. This approach, aligned with a systemic perspective, extends to biodiversity enhancement, as evidenced by the planting of fruit trees around the vineyards by de Claude and her colleagues.

Problem Framing

As climate change speeds up, France's wine industry, which is rooted in custom and governed by the appellation d'origine contrôlée system, is in a tough spot. The French wine industry is also at risk because of strict rules, which makes it clear that laws need to be changed. The issue is seen not only as a present danger, but also as a structural problem that needs new rules and regulations. The winegrowers take the initiative to find creative solutions within the rules that are already in place while also pushing for change. This shows a complex problem-solving strategy that addresses both short-term problems and long-term general problems.

Read more about this case study here.

FUTURE TRENDS IN THE WINE SECTOR CONNECTED WITH SUSTAINABILITY

As the global wine industry evolves, sustainability has become a critical focal point. Balancing environmental, social, and economic considerations, sustainable practices are not only beneficial for the planet but also increasingly attractive to consumers and stakeholders. Here we will explore the future trends in the wine sector that are intertwined with sustainability, providing a glimpse into a more eco-conscious and responsible wine industry.

Climate change poses significant challenges to grape-growing regions due to altered weather patterns, temperature increases, and extreme events. In response, vineyards are likely to shift towards cultivating climate-resilient grape varieties.

Sustainable Vineyard Practices

1. Agroecological, Organic and Biodynamic Farming

A surge in consumer demand for agroecological, organic and biodynamic wines is anticipated. Agroecological agriculture is a way of designing production systems based on the functionalities offered by ecosystems, without damaging these resources. Organic and Biodynamic farming methods eliminate synthetic pesticides and herbicides, focusing on soil health, biodiversity, and a closed-loop farming system. Sustainable vineyard practices reduce environmental impact and contribute to healthier ecosystems.

2. Precision Viticulture

Advancements in technology enable precision viticulture, optimizing resource allocation in vineyards. Drones, sensors, and data analytics can monitor vine health, soil conditions, and water usage. By precisely applying resources, vineyards can reduce waste and enhance sustainability.

3. Water Management and Conservation

With water scarcity being a growing concern, the wine industry will increasingly adopt efficient water management practices. These include rainwater harvesting, drip irrigation, and wastewater treatment. Minimizing water wastage not only contributes to sustainability but also helps vineyards adapt to changing climate conditions.

4. Circular Economy and Packaging Innovations and Eco-Friendly Packaging

A shift towards eco-friendly packaging is expected, such as lighter glass bottles, bag-in-box containers, and cans. Wineries will strive to minimize their carbon footprint by optimizing packaging materials and designs, reducing transportation emissions and waste

5. Circular Economy Initiatives

Wineries will embrace the circular economy model, focusing on recycling, reusing, and reducing waste. This approach will involve repurposing byproducts, adopting recyclable materials, and implementing sustainable waste management systems.

6. Social Responsibility and Fair Trade

Consumers are becoming more socially conscious, demanding ethically sourced and fair trade products. The wine industry is expected to prioritize fair wages, labor conditions, and community development, promoting responsible production that benefits both workers and local communities.

Sustainability is no longer an option but a necessity for the wine industry. The future trends in the wine sector emphasize the urgent need to adopt sustainable practices, not only to preserve the environment and its resources but also to meet the growing expectations of conscious consumers.

BASIC RESOURCES

- Example of system thinking
- The basics of system thinking
- Introduction to frame creation
- New ESG Regulations Will Impact Every Winery—Here's What to Know
- ESG in the Wine Industry: Navigating Challenges for Sustainable Growth
- Wine Industry Leaders Navigate Roadmap to Robust ESG Performance

LEVEL 2 – LEARNING IN DEPTH

ASSESS THE VALUE OF SYSTEM THINKING IN YOUR WORK

1. How do various factors such as climate, soil quality, and grape varieties interconnect to influence the overall vineyard health?
2. Can you identify feedback loops within the winemaking process that contribute to either positive or negative outcomes?
3. When facing a production challenge, how do you analyze the causal relationships between different stages of the winemaking process?
4. What aspects of vineyard management or winemaking have the most significant impact on the overall quality of the final product, and how can they be leveraged for improvement?
5. How do time delays in processes, such as grape maturation or fermentation, impact decision-making and overall system dynamics?
6. In what ways do interactions with suppliers, distributors, and customers influence the success of the winery as a system?
7. Can you trace the flow of resources, both natural (water, sunlight) and human (labor, expertise), through the entire winemaking process?
8. What are the key boundaries of the winery system, and how do external factors impact these boundaries?
9. How does the winery system consider and assess its environmental impact, including waste management and sustainable practices?
10. How can technology be integrated into the winemaking process to enhance efficiency, quality, and sustainability?

ASSESS THE VALUE OF PROBLEM FRAMING IN YOUR WORK

1. How do you approach identifying the root causes of challenges or issues within the winemaking process?
2. When faced with a problem, how do you consider the broader system of interactions within the winery, rather than isolating individual components?
3. How do you take into account the perspectives of various stakeholders, such as vineyard workers, winemakers, and distributors, when framing a problem?
4. In problem-framing, how do you distinguish between constraints that are inherent to the winery system and those that can be modified or overcome?
5. Can you identify and articulate the interdependencies between different aspects of winery operations when framing a problem?
6. How do you balance addressing immediate concerns with considering the long-term impacts and goals of the winery when framing a problem?
7. When framing a problem, how do you consider the potential environmental impacts and sustainability aspects of proposed solutions?

COMPLEMENTARY RESOURCES

- A Systems Thinking Approach to Community-Based Urban Agriculture

- Systems thinking: a cautionary tale
- Systems Thinking 101
- The Wine Capital of the World Takes the Lead on Sustainability
- Sipping Sustainability: French Wine Pioneers Raise a Glass to Climate Challenges
- Problem framing in design thinking
- Reframing problem
- Problem framing
- Wine's History and its Ecological Future
- Global wine market trends
- The Future of Winemaking Is in High-Tech Robotics

LEVEL 3 – ADDITIONAL RESOURCES

SYSTEM THINKING

In a world increasingly interconnected and complex, understanding systems and their dynamics is crucial for effective problem-solving and decision-making. System thinking is a holistic approach that helps individuals comprehend the intricate relationships, feedback loops, and patterns that characterize various phenomena. This chapter explores the essence of system thinking, its fundamental principles, and ways to cultivate and apply this invaluable mental model.

A system is a collection of interrelated, interdependent components or parts that function as a whole to achieve a common purpose. Systems can range from simple, such as a bicycle, to highly complex, like an ecosystem or a global economy. The behavior of a system is a result of the interactions and relationships among its components.

Core Principles of System Thinking

Interconnectedness

System thinking acknowledges that everything is interconnected. Changes or events in one part of a system can have far-reaching effects on other parts, often in unexpected ways. Understanding these interconnections is essential to grasp the system's behavior and potential outcomes.

Feedback Loops

Feedback loops are fundamental mechanisms in systems. They can be reinforcing (positive) or balancing (negative). Reinforcing loops amplify changes, creating exponential growth or decline. Balancing loops stabilize the system, maintaining a relatively constant state.

Emergence

Systems exhibit emergent properties, where the whole has characteristics or behaviors that are not apparent in its individual parts. These emergent properties often result from the interactions and relationships within the system.

Mental Models

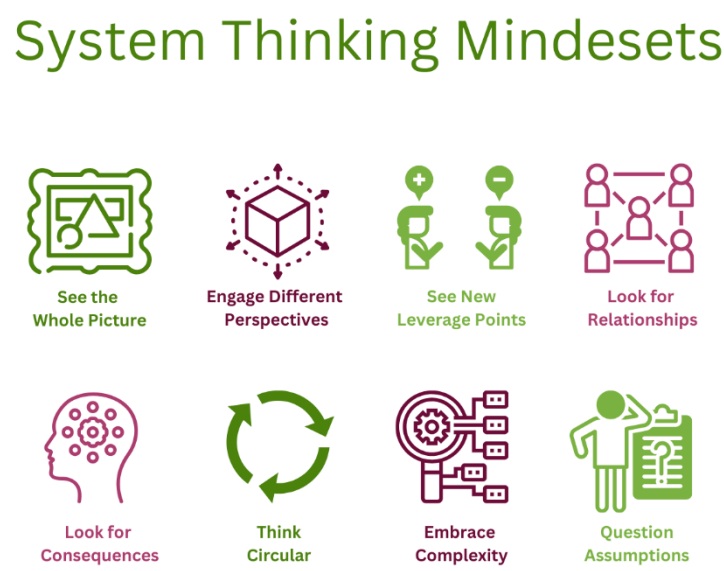
Mental models are the mental representations of how we perceive the world and its systems. System thinkers continually refine and update their mental models based on new information and insights. Being aware of our mental models helps us make more informed decisions.

Video: System thinking

Link: Systems Thinking

Applying System Thinking

System thinking mindsets encompass a set of cognitive habits and approaches that enable individuals to understand and address complex issues within a broader context. Here's a breakdown of the eight elements associated with system thinking mindsets:



Inspired by: https://boxesandarrows.com/activating-change-a-designers-guide-to-systems-thinking/

See the Whole Picture: System thinkers adopt a holistic approach, aiming to comprehend the entire system rather than focusing on isolated components. They recognize the interconnectedness of various elements and understand that a change in one part can have ripple effects throughout the entire system.

Engage Different Perspectives: Embracing diversity of thought is a fundamental aspect of system thinking. Practitioners actively seek out and value input from various perspectives, understanding that a more comprehensive understanding of a system emerges when multiple viewpoints are considered.

See New Leverage Points: System thinkers identify points within a system where interventions can lead to significant changes. These leverage points are areas where a strategic adjustment can yield a disproportionate impact on the system's behavior or outcomes.

Look for Relationships: Understanding the relationships between different components is essential for system thinkers. They analyze how elements interact with and influence one another, recognizing that the strength and nature of these relationships play a critical role in shaping system behavior.

Look for Consequences: System thinkers anticipate the potential consequences of actions within a system. They consider both immediate and long-term effects, recognizing that unintended outcomes may arise from seemingly straightforward interventions.

Think Circularity: System thinkers embrace the concept of feedback loops and circular causality. They understand that events within a system often create feedback that can either reinforce or counteract the initial action. This circular thinking helps in predicting and managing system dynamics.

Embrace Complexity: Rather than shying away from complexity, system thinkers embrace it. They appreciate that real-world systems are intricate and dynamic, and they are comfortable navigating through this complexity to identify patterns, relationships, and emergent properties.

Question Assumptions: System thinkers challenge assumptions and question underlying beliefs. They recognize that assumptions shape how we perceive and interact with systems, and by examining and challenging these assumptions, they uncover new insights and perspectives.

Adopting these system thinking mindsets enhances an individual's ability to analyze, understand, and address complex challenges by considering the intricate web of relationships and interdependencies within a system. This approach is particularly valuable in navigating the complexities of today's interconnected and rapidly changing world.

PROBLEM FRAMING

"Frame Innovation" by Kees Dorst is a concept of problem framing as a crucial aspect of innovative thinking. The author argues that traditional problem-solving approaches often focus on finding solutions to predefined problems without adequately examining the framing of the problem itself. Dorst suggests that by critically assessing and reframing problems, individuals and organizations can uncover fresh perspectives and identify innovative solutions.

Design thinking plays a crucial role in problem framing, encouraging a shift from a problem-solving attitude to a problem-finding mindset. He introduces several framing tactics and strategies to assist people comprehend the context, stakeholders, and underlying assumptions of a situation. One can open up new possibilities and produce creative solutions by changing the problem's bounds and investigating different framings.

Dorst also emphasizes the need of teamwork and interdisciplinary methods in problem framing, acknowledging that different points of view contribute to a more complete understanding of complicated challenges.

In the "Frame Innovation," the process of making a frame is made up of several important steps:

Archaeology: Look into the problem and the ways that it has been tried to be solved in the past. Learn more about the problem owner's past to see what other options are available and how the company has changed over time. You should look at both the problem's moving and fixed edges.

Paradox: Find the main paradox or deadlock in the first description of the problem. Explain why the problem is hard to solve and describe the paradox as a clash of logics.

Context: Put the paradox aside for now and look into the actions of important people involved in the problem. Learn about their influences, strategies, and what they might be able to do to help find an answer.

Field: Expand the situation by making people to meet and talk, called openly. Make a list of all the possible people who could be involved in the problem or answer. Think about their power, interests, values, and habits.

Themes: You can find out more about the wants, motivations, and experiences of people by doing a theme analysis. Find the universals that apply to the problem and bring out the shared values that lie beneath the surface.

Frames: Find themes that are common in the field as a whole, taking into account those that many people share. Come up with new frames that can be used to build appealing solutions. Come up with frames that mean that following certain patterns of relationships will lead to good results.

Futures: Use the suggested framework on the broader problem and change its shape through coevolution. Think ahead to see if the frame can help you find answers that are both realistic and workable. Playfully exploring the frame will give you feedback on its possibilities.

Transformation: Check to see if frames and solution frames will work in the near and far future. Make a business plan, an agenda for change, and a method for putting it all into action. Get rid of frames and ideas that aren't useful.

Integration: Make sure that new frames and their developments fit in well with the bigger picture of the organization. Look into how the patterns of connections in the new frames can be used in different parts of the business.

Inspired by Dorst, K. (2015). Frame innovation: Create new thinking by design. MIT press.

Let’s see an example on how to use this method:

Château Green Vineyards in the Tikvesh Region, North Macedonia

Archaeology: Château Green Vineyards, a quaint winery in the Tikvesh region, has been grappling with the challenge of irregular water supply affecting grape quality. Past attempts involved traditional methods of irrigation based on historical patterns, yet the vineyard faces recurrent water shortages. Understanding the vineyard owner's past decisions and exploring alternative irrigation methods will be essential.

Paradox: The main paradox revolves around the clash between relying on traditional irrigation practices and the necessity to adapt to water scarcity. The traditional logic of depending on seasonal rainfall clashes with the need for sustainable irrigation practices to ensure consistent grape quality.

Context: Exploring the vineyard owner's past reveals a commitment to preserving the unique characteristics of Tikvesh terroir. Influential figures, including the owner and the viticulturist, have traditionally followed inherited agricultural practices. Understanding their influences and strategies is crucial in exploring innovative solutions to water scarcity.

Field: Engaging a diverse group of stakeholders, including local hydrologists, agricultural experts, and neighboring farmers, is crucial for a comprehensive approach. Analyzing their power dynamics, interests, values, and habits will contribute to a more holistic understanding of water scarcity in the Tikvesh region.

Themes: Thematic analysis uncovers shared values among stakeholders, such as a commitment to sustainable farming practices and preserving the unique qualities of Tikvesh grapes. Identifying these commonalities provides a foundation for collaborative solutions to address water scarcity.

Frames: Introducing new frames involves challenging the conventional mindset of relying solely on seasonal rainfall. Exploring frames that emphasize water-efficient irrigation techniques, rainwater harvesting, and community-driven water management may open up innovative solutions for sustainable grape cultivation.

Futures: Applying the suggested framework to the broader problem involves coevolution with changing water availability. Playfully exploring these frames unveils possibilities such as implementing drip irrigation systems, creating rainwater reservoirs, and establishing a community-led water-sharing initiative.

Transformation: Evaluating the viability of frames and solution frames in the near and far future involves crafting a business plan and change agenda. This includes transitioning to water-efficient grape varieties, adopting modern irrigation technologies, and collaborating with neighboring vineyards for shared water resources. Frames and ideas that do not align with long-term water sustainability goals are discarded.

Integration: Ensuring alignment with the bigger picture of the vineyard involves integrating new frames seamlessly into existing practices. The patterns of connections established through sustainable water management and technological integration are explored for potential applications in different facets of the grape cultivation process.

Château Green Vineyards, armed with a multifaceted approach informed by system thinking and problem framing, is poised to transform its grape cultivation practices, ensuring sustainability and resilience in the face of evolving water availability challenges in the Tikvesh region of North Macedonia.

Additional Resources

- System thinking for a better world
- Sustainable Vineyards and Wineries: A Getting Started Guide For Businesses

- Sustainable wine roundtable
- Nymphe bioremediation strategies
- Karagiannis, D., & Metaxas, T. (2020). Sustainable wine tourism development: Case studies from the Greek region of Peloponnese. Sustainability, 12(12), 5223.
- Germany | Traditional Wine-Making Feeling The Heat of Climate Change
- How Germany adapts to climate change?
- Sustainability and growth: Evidence from Spanish wine industry
- Rioja with a conscience: Spain's super-sustainable winery
- The Economic, Social, and Environmental Value of the Spanish Wine Industry (book)
- Business growth and sustainability in the spanish wine industry
- The Spanish wine sector joins the trend of sustainability with organic wines
- Bodegas Beronia: Sustainability Is In Our DNA
- How climate change is impacting the wine and spirits industries
- How California Wine Country is "Growing Futures"
- Freedman, B. (2022). Crushed: How a Changing Climate is Altering the Way We Drink. Rowman & Littlefield.
- Mozell, M. R., & Thach, L. (2014). The impact of climate change on the global wine industry: Challenges & solutions. Wine Economics and Policy, 3(2), 81-89.

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SELF-ASSESSMENT

In this self-assessment quiz, some questions may have more than one correct answer.

1. What is system thinking?
    a) **System thinking is a holistic approach that helps individuals comprehend the intricate relationships, feedback loops, and patterns that characterize various phenomena.**
    b) System thinking refers to the practice of considering only isolated components within a larger system, ignoring their interdependencies and relationships.
    c) System thinking involves focusing solely on linear cause-and-effect relationships, neglecting feedback loops and dynamic interactions within a system.
    d) System thinking is a rigid and inflexible approach to problem-solving, where predefined solutions are applied without considering the uniqueness of each situation and its context.

2. What are the core principles of system thinking?
    a) Interconnectedness
    b) Feedback Loops
    c) Emergence
    d) Mental Models

3. What of the following is not part of applying system thinking?
    a) **Complaining**
    b) Problem-Solving
    c) Decision-Making
    d) Planning and Strategy

4. How to apply system thinking?
    a) Embrace Complexity
    b) Look for simplicity
    c) See the whole picture
    d) Focus on details

5. What is the first step of problem-solving?
    a) Framing
    b) Analysis
    c) Integration
    d) **Archaeology**

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