Ecological Vineyards Governance Activities for Landscape's Strategies

Deliverable T1.4.1

Shared approach for the transition of viticultural farms and wine-growing areas towards progressive degrees of agroecological intensity and safeguarding of ecosystem services

Responsible Partner

Autonomous Province of Trento

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DOCUMENT INFORMATION

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1 PU = Public document; PP = Partnership document

Project Summary

ECOVINEGOALS promotes sustainability and resilience in the winemaking industry by encouraging the transition of intensive viticulture towards agroecological management systems that protect natural habitats and landscapes, while reducing chemical and fossil fuel inputs and harmful emissions. The project aims to enhance stakeholders' skills in participatory local governance, to strengthen transnational cooperation and provide specific transnational instruments to promote, support and manage the agroecological transition.

Expected results

- Sharing between partners in the ADRION countries of fundamental concepts and practices necessary for the transition from intensive viticulture management systems, towards agroecological management methods.
- Improvement of the participatory local governance skills of decision makers and all other viticulture stakeholders, both public and private, to jointly develop and define strategies and plans aiming to protect natural habitats and rural landscapes.
- Transnational communication, cooperation, and exchange between regional authorities and civil society organizations concerning common objectives to protect vulnerable environments, to promote ecosystem services, to prevent or mitigate climate change, and to avoid social conflicts in land use.
- An increase in the number and quality of tools and strategies available to support the planning and management of the agroecological transition of viticulture systems in the region.

Partnership:

PP1- LP	**LAG EASTERN VENICE, VEGAL (IT)**
PP2	Autonomous Province of Trento, PAT (IT)
PP3	Chamber of Agriculture and Forestry of Slovenia, KGZS-Zavod GO (SI)
PP4	Research Centre of the Slovenian Academy of Sciences and Arts, ZRC SAZU (SI)
PP5	Agency for Rural Development of Istria Ltd Pazin, AZRRI (HR)
PP6	Association for the promotion of employment, vocational training and education, INFORMO (HR)
PP7	Business Development Center Kragujevac, BDCKG (RS)
PP8	Foundation Business Start-up Center Bar, BSC BAR (ME)
PP9	Municipality of Bar, BAR (ME)
PP10	Mediterranean Agronomic Institute of Chania, CIHEAM MAICh (EL)

Associated Partners (APs):

General Union CISL Cultivators Venice (IT)
Bio district of production and biological community of central-eastern Venice - BIO VENICE (IT)
IAL - Innovation Learning Work S.r.l. - Social enterprise (IT)
AIAB-Italian Organic Agriculture Association (IT)
Agroecologiki SP (EL)
Municipality of Topola (RS)
Šumadija winemakers association (RS)
Ministry of Agriculture and Rural Development (HR)
Agroecology Europe (BL)

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1 INTRODUCTION

1.1 OBJECTIVE OF THE DOCUMENT

For the purpose of the Ecovinegoals project, this document represents the effort to draft a shared approach for the transition of viticultural farms and wine-growing areas towards progressive degrees of agroecological intensity and safeguarding of ecosystem services. On the other side, it has the ambition to be a "stand-alone" document aiming to improve the level of commitment towards the agroecological transition in the vineyards by raising the knowledge of agroecological practices among the farmers and the other stakeholder involved directly or indirectly in the wine production industry. The eight pilot areas of the Ecovinegoals project – settled in Croatia, Greece (2), Italy (2), Montenegro, Serbia and Slovenia - represent both a heterogeneous picture of the current starting point on the road of the agroecological transition, and they could be seen also as a laboratory for imagining possible future efforts and common strategies at the level of the Adriatic-Ionian geographical area and, to some extent, at the European level.

1.2 METHODOLOGY AND STRUCTURE OF THE DOCUMENT

The document will firstly present the road map towards agroecological transition, as designed by the 5 Gliessman levels and connected with the 13 principles individuated by FAO High Level Panel of Expert (HLPE). This will help to set the long term goal and trace the road map towards agroecological transition in vineyards for the eight pilot areas of Ecovinegoals project.

The third chapter will briefly review the European policies of potential support for the transition – in particular what is explicitly stated in the CAP, in the European Green Deal and in the Instrument of Pre-Accession dedicated to rural development (IPARD) – by selecting objectives and measures useful for the vineyard in particular.

The heart of the document, the fourth and the fifth chapter will highlight which are the steps that already have been taken and those that are needed towards the agroecological transition levels in the vineyard according the FAO principles and the Gliessman 5 levels. In particular, these two chapters include the analysis of the Pilot Areas (laboratories of transition), the results collected from the multi-criteria analysis and the description of the good practices already identified and from the local Action Plans. The sixth chapter, following the analysis of the previous ones, will propose seven possible and different "paths" to climb the different levels of Gliessman, focusing mainly on the first three levels, i.e. those relating to the agrosystem.

The last chapter, the conclusions, will try to sublimate the considerations of the previous ones, to provide the reader with indications and possible approaches to amplify the agroecological transition.

2 DRAFTING THE ROAD MAP TOWARDS THE AGROECOLOGICAL TRANSITION

Addressing the issue of agroecological transition exclusively as a series of technological practices to be put in place, or on the contrary with an overly philosophical approach that does not take into account the needs of those involved in the food production chain, would return a document that is not very useful for the objectives set by the project.

Agroecology is an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems. It seeks to optimize the interactions between plants, animals, humans and the environment while taking into consideration the social aspects that need to be addressed for a sustainable and fair food system.

Agroecology is not a new invention it is a combination of science, practice and movement[2] (Wezel et Al, 2009). As science it appears in scientific literature since the 1920s, and has found expression in family farmers' practices, in grassroots social movements for sustainability and the public policies of various countries around the World.

For the purposes of this document, that is meant to provide indications for the implementation of practices and policies useful for the transition towards the sustainability of wine production, Gliessman's assumptions will be used, which have contributed to defining the approaches to agroecology enunciated by FAO. In fact, Gliessman's work[3], which defines 5 levels of the agroecological transition, can be related to the 13 principles underlying agroecological practices set out in the FAO HLPE (High Level Panel of Experts) Report in 2019[4].

2.1 THE 10 ELEMENTS AND THE 13 PRINCIPLES OF AGROECOLOGICAL TRANSITION

In 2018 FAO[5] defined 10 elements of agroecology to stimulate the transition towards sustainable agriculture and food systems.

The 10 elements of agroecology

Source: FAO (2018)

These 10 elements, result of the work of scientists (in particular Altieri[6] and Gliessman[7]) and multi-stakeholder dialogue at different level (local, regional, national and global) which took place since the first the first FAO International Symposium on Agroecology held in September 2014, allow FAO HPLE to

2 *Wezel A., Bellon S., Dore T., Francis C., Vallod D., David C. (2009) - Agroecology as a science, a movement and a practice. A review.*
3 *Gliessmann S.R. (2016) - Transforming food systems with agroecology.*
4 *HLPE (2019) - Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition.*
5 *FAO (2018) - The 10 Elements of agroecology: guiding the transition to sustainable food and agricultural systems.*
6 *Altieri M.A. (1995) - Agroecology: the science of sustainable agriculture.*
7 *Gliessman S.R. (2007) - Agroecology: the ecology of sustainable food systems.*

elaborate 13 principles for agroecological transition (FAO, 2019). These are organized around the 3 operational principles for sustainable food system (improve resource efficiency, strengthen resilience and secure social equity/responsibility). Each agroecological principle was allocated to the operational principle to which it most clearly contributes and to the 10 elements, as presented in the following table. In the last column of the table is reported the scale of application of each of the 13 principles: field level, farm (or agrosystem) level, food system level.

The 13 agroecological principles and the 10 agroecological elements individuated by FAO

Principles	Elements	Scale of application
Improve Resource Efficiency		
1. Recycling. Preferentially use local renewable resources and close as far as possible resource cycles of nutrients and biomass.	Recycling	Field/Farm
2. Input reduction. Reduce or eliminate dependency on purchased inputs and increase self-sufficiency.	Efficiency	Farm
Strengthen resilience		
3. Soil health. Secure and enhance soil health and functioning for improved plant growth, particularly by managing organic matter and enhancing soil biological activity.	Diversity	Field
4. Animal health. Ensure animal health and welfare.	Diversity	Field/Farm
5. Biodiversity. Maintain and enhance diversity of species, functional diversity and genetic resources and thereby maintain overall agroecosystem biodiversity in time and space at field, farm and landscape scales.	Diversity	Field/Farm
6. Synergy. Enhance positive ecological interaction, synergy, integration and complementarity among the elements of agroecosystems (animals, crops, trees, soil and water).	Synergy	Field/Farm
7. Economic diversification. Diversify on-farm incomes by ensuring that small-scale farmers have greater financial independence and value addition opportunities while enabling them to respond to demand from consumers.	Diversity	Farm/Food System
Secure social equity/responsibility		
8. Co-creation of knowledge. Enhance co-creation and horizontal sharing of knowledge including local and scientific innovation, especially through farmer-to-farmer exchange	Co-creation and sharing of knowledge	Farm/Food System

Principles	Elements	Scale of application
9. Social values and diets. Build food systems based on the culture, identity, tradition, social and gender equity of local communities that provide healthy, diversified, seasonally and culturally appropriate diets.	Human and social values and Culture and food traditions	Farm/Food System
10. Fairness. Support dignified and robust livelihoods for all actors engaged in food systems, especially small-scale food producers, based on fair trade, fair employment and fair treatment of intellectual property rights.	Human and social values and Culture and food traditions	Farm/Food System
11. Connectivity. Ensure proximity and confidence between producers and consumers through promotion of fair and short distribution networks and by re-embedding food systems into local economies.	Circular and solidarity economy	Farm
12. Land and natural resource governance. Strengthen institutional arrangements to improve, including the recognition and support of family farmers, smallholders and peasant food producers as sustainable managers of natural and genetic resources.	Responsible governance	Farm/Food System
13. Participation. Encourage social organization and greater participation in decision-making by food producers and consumers to support decentralized governance and local adaptive management of agricultural and food systems.	Responsible governance	Food System

Source: derived from Nicholls et al. (2016)[8], CIDSE (2018)[9], FAO (2018)[10].

2.2 THE FIVE LEVELS OF AGROECOLOGICAL TRANSITION

Once the objective has been established (the agroecological transition in wine production), and the principles are set, it is necessary to define what the road map is, its intermediate stages and the means to follow it. In his work, Gliessman defines 5 levels which, starting from point 0 – where there is no agroecological system (or agroecosystem) – the road map is scaling up to level 5 where the interrelation between food production and consumption paradigm respects the values of sustainability (environmental, social and economic) on a global horizon. Let's see what are the characteristic of each of the levels, and what it takes to pass from one to the other, combining agronomic, ecologic, social and management approaches, described by the author himself.

Level 1: Increase the efficiency of industrial and conventional practices in order to reduce the use and consumption of costly, scarce, or environmentally damaging inputs.

The primary goal of change to enter this level is to use industrial inputs more efficiently so that fewer inputs will be needed and the negative impacts of their use will also be reduced. Most conventional agricultural research has taken place at this level, through which considerable modern agricultural technologies, inputs, and practices have been developed. This research has helped farmers maintain or increase production through such practices as improved seeds, optimum planting density, more efficient pesticide and fertilizer application, and more precise use of water. So-called "precision agriculture" is a

8 *Nicholls C., Altieri M.A., Vazquez L. (2016) - Agroecology: principles for the conversion and redesign of farming systems.*
9 *CIDSE (2018) - The principles of agroecology. Towards just, resilient and sustainable food systems. https://www.cidse.org/publications/just-food/food-and-climate/the-principles-of-agroecology.html*
10 *FAO (2018) - The 10 elements of agroecology: guiding the transition to sustainable food and agricultural systems.*

recent focus of research at Level 1. Although this kind of research has reduced some of the negative impacts of industrial agriculture, they do not help break its dependence on external human inputs and monoculture practices.

Level 2: Substitute alternative practices for industrial/conventional inputs and practices.

The goal of this level of transition is to replace external input-intensive and environmentally degrading products and practices with those that are more renewable, based on natural products, and more environmentally sound. Organic farming and biodynamic agriculture are examples of this approach. They employ alternative practices that include the use of nitrogen-fixing cover-crops and rotations to replace synthetic nitrogen fertilizers, the use of natural controls of pests and diseases, and the use of organic composts for fertility and soil organic matter management. However, at this level, the basic agroecosystem is not usually altered from its more simplified form, hence many of the same problems that occur in industrial systems also occur in those with input substitution.

Level 3. Redesign the agroecosystem.

At this level, fundamental changes in overall system design eliminate the root causes of many of the problems that continue to persist at Levels 1 and 2. The focus is on prevention of problems before they occur, rather than trying to control them after they happen. Research on whole-system conversions has provided an understanding of key yield-limiting factors. Agroecosystem structure and function is better understood, and appropriate changes in design can be implemented. Problems are recognized, adjustments made in internal site- and time-specific design and management approaches, instead of solely by the applications of external inputs. A good example is the reintroduction of diversity in farm structure and management through such actions as ecologically-based rotations, multiple cropping, agroforestry, and the integration of animals with crops.

Level 4. Reconnect consumers and producers through the development of alternative food networks.

Food system transformation occurs within a cultural and economic context, and this transformation should promote the transition to more sustainable practices. At a local level, this means those who eat must value food that is locally grown and processed, and support with their food currency the farmers who are attempting to move through Levels 1-3. This support becomes a kind of “food citizenship” and can be seen as a force for food system change. Communities of growers and eaters can form alternative food networks around the world where a new culture and economy of food system sustainability is being built. Food once again must be grounded in direct relationships. An important example is the current food “re-localization” movement, with its growing networks of farmers’ markets, community supported agriculture schemes, consumer cooperatives/networks, and other more direct marketing arrangements that shorten the food chain.

Level 5. Build a new global food system based on participation, localness, fairness and justice.

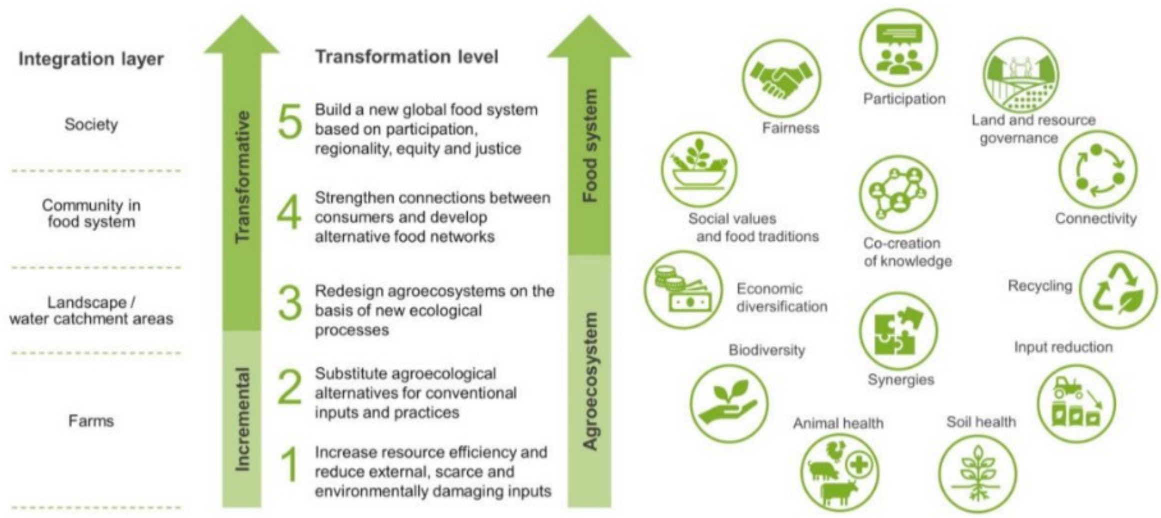
On the foundation created by the sustainable farm-scale agroecosystems achieved at Level 3, and the new relationships of sustainability of Level 4, build a new global food system, based on equity, participation, democracy, and justice, that is not only sustainable but helps restore and protects Earth’s life supporting the systems upon which we all depend. By thinking beyond Levels 1-4, Level 5 involves change that is global in scope and reaches beyond the food system to the nature of human culture, civilization, progress, and development. The depth of change is more than mere conversion or transition, and enters into the realm of full reform or transformation. With Level 5 thinking and action, agroecology provides ways to build upon farm-scale and farmer-driven change processes to a full re-thinking of how we all relate to each other and to the earth that supports us. Basic beliefs, values, and ethical systems change. The expanding awareness that is part of this process then extends to other facets of environmental and social relationships beyond food, bringing about a paradigm shift focused on how the agriculture and food systems of the future can help reduce our ecological footprint, recognize that there are limits to growth, and what it really means to live sustainably. The important role that food systems can and must play in mitigating and adapting to climate change as a global issue is one example of the value of Level 5 thinking. The growing food justice movement, where everyone in the food system enjoys the benefits of equity, justice, security, and sustainability, is another.

These 5 levels therefore represent the process to follow, which, as it seems obvious, cannot be achieved through a three years project like Ecovinegoals. On the other hand, however, they indicate the horizon to which a transnational strategy must aim. The agroecological transformation of agrifood systems takes place gradually across five interlinked levels. Transformation in the first two levels happens within farms. The third one includes the whole agroecosystem. Levels four and five expand the scope to the entire agrifood system (up to global level).

As the first three levels focus on the agrosystem (the farm), the farmer is the main protagonist. Only moving from the third level to the fourth the relations with the consumer come into play, and the transition process pass gradually from the agrosystem to the food system. The scale of intervention also gradually widens, starting from the level of the field, of the farm, then moving on to the level of the territory and the local, regional, national community, up to the global level.

The transnational strategy that this document is trying to outline will focus on the agrosystem, and therefore on the first three levels, trying to imagine, starting from the results of the project, what actions could be taken to move from the current level to the next level. Looking at the 13 HLPE agroecological principles, the analysis and therefore the strategy will focus on the first 8 principles, according the general objective of this document.

Five levels of Agroecological Transition



Source: Gliessman (2016)[11]

11 *Gliessman S.R. (2016) - Transforming food systems with agroecology.*

3 THE EUROPEAN POLICIES TO FOSTER THE AGROECOLOGICAL TRANSITION

The Common Agricultural Policy (CAP) and the European Green Deal, together with the strategies Farm to Fork and Biodiversity, provide the support instruments through which the Member States have to design the national strategic plans outlining how they intend to reach the European green targets. On the other hand, the Instrument for Pre-Accession Assistance in Rural Development (IPARD) and the Green Agenda for the Western Balkans offer assistance at European Union (UE) candidate countries. Through these tools, the UE aims to a sustainable economic model in order to become the first climate neutral continent by 2050.

3.1 COMMON AGRICULTURAL POLICY (CAP)

On 23rd November 2021 the European Parliament approved the new Common Agricultural Policy (CAP) 2023-2027[12]. The policy focuses on nine specific objectives, linked to community, environment and economy, for the purpose of increasing sustainability in agriculture and rural area. They are the following:

a) to support viable farm income and the resilience of the agricultural sector across the Union in order to enhance long-term food security and agricultural diversity as well as to ensure the economic sustainability of agricultural production in the Union;
b) to enhance market orientation and increase farm competitiveness both in the short and long terms, including greater focus on research, technology and digitalisation;
c) to improve the farmers' position in the value chain;
d) to contribute to climate change mitigation and adaptation, including by reducing greenhouse gas emissions and enhancing carbon sequestration;
e) to foster sustainable development and efficient management of natural resources such as water, soil and air, including by reducing chemical dependency;
f) to contribute to halting and reversing biodiversity loss, enhance ecosystem services and preserve habitats and landscapes;
g) to attract and sustain young farmers and new farmers and facilitates sustainable business development in rural areas;
h) to promote employment, growth, gender equality, including the participation of women in farming, social inclusion and local development in rural areas, including the circular bio-economy and sustainable forestry;
i) to improve the response of Union agriculture to societal demands on food and health, including high-quality, safe and nutritious food produced in a sustainable way, to reduce food waste, as well as to improve animal welfare and to combat antimicrobial resistance.

Each Member State must develop a national strategic plan, considering its necessities derived from a context analysis. The strategic plan includes specific goals achievable trough CAP instruments and approved by European Commission. These plans should facilitate the spread of sustainable agriculture practices, such as precision agriculture (PA), organic farming, agroforestry and agroecology, as wells as the adoption of strict rules related to animal health, and will be evaluated according to environmental and climate indicators.

The so-called "new green architecture" of the CAP is based on three main complementary actions: enhanced conditionality, eco-schemes and higher green ambitions. As regards this, eco-schemes are one of the novelty introduced by CAP 2023-2017, that provide for direct funding for farmers that adopt climate- and environment-friendly farming practices and approaches, including organic farming and agroecology.

A list of potential agricultural practices that eco-schemes could support was published on January 2021 by the European Commission[13]. The large part of these practices are useful for viticulture, such as mechanical weed control, increased use of pest-resistant crop, maintenance of organic farming, cover crops between

12 *https://agriculture.ec.europa.eu/common-agricultural-policy_en*

rows, and are included in the 29 best practices developed by the ECOVINEGOALS project. These agroecological practices must meet several requirements to be founded by CAP:

- to include actions regarding climate, environment, animal health and antimicrobial resistance;
- to be defined according to needs and priority described in national strategic plans;
- to have a lofty goal beyond the specific obligations required by the enhanced conditionality;
- to contribute to achieving European Green Deal objectives.

Moreover, they will be proposed by Member States and each eco-scheme must cover at least two of the following areas of actions:

a) climate change mitigation, including reduction of greenhouse gas emissions from agricultural practices, as well as maintenance of existing carbon stores and enhancement of carbon sequestration;
b) climate change adaptation, including actions to improve resilience of food production systems and animal and plant diversity for stronger resistance to diseases and climate change;
c) protection or improvement of water quality and reduction of pressure on water resources;
d) prevention of soil degradation, soil restoration, improvement of soil fertility and of nutrient management and soil biota;
e) protection of biodiversity, conservation or restoration of habitats or species, including maintenance and creation of landscape features or non-productive areas;
f) actions for a sustainable and reduced use of pesticides, in particular pesticides that present a risk for human health or environment;
g) actions to enhance animal welfare or combat antimicrobial resistance.

The complete list of agroecological practices detected by the European Commission is reported below[14]:

- crops rotation using legumes;
- intercropping and crop diversity;
- cover crops between rows of permanent crops;
- winter cover cropping and catch crops;
- extensive farming using primarily grass;
- using resistant/resilience crops more adapted to climate change;
- permanent grassland characterized by variety of species and enhanced biodiversity, in order to promote pollination, nesting habitats and natural reserves of wildlife;
- improving rice cultivation to decrease methane emissions;
- standards established and practiced by organic farming.

3.2 Green Deal

On 11 December 2019 the European Commission undertook a challenging process, the European Green Deal[15], to substantially reduce carbon footprint, aiming to decouple economic growth respect to resources exploitation. The European Green Deal provides that the 40% of the CAP funding is intended for environmental friendly actions and considers the agroecology among the most valuable practices. Moreover, the UE Commission drew up an ambitious timetable according to many targets will be reached by 2030:

- reduction in nutrient losses by 50%;
- reduction in fertilizer use by 20%;
- reduction in pesticide use by 50%;

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13 *List of potential agricultural practices that eco-schemes could support (https://agriculture.ec.europa.eu/system/files/2021-01/factsheet-agri-practices-under-ecoscheme_en_0.pdf)*

14 *Wezel A., Casagrande M., Celette F. et al. (2014) - Agroecological practices for sustainable agriculture. A review. (https://doi.org/10.1007/s13593-013-0180-7)*

15 *https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en*

- reduction in sales of antimicrobials by 50%;
- increase in organic farming to 25% of utilized agricultural area (UAA);
- increase in high-diversity landscape features to 10% of UAA.

In the face of these major challenges, the solution is to adopt policies consistent with each other with repercussion both locally and globally. New technologies, such as precision farming or nutrition-sensitive agriculture (NSA), offer a potential solution to improve agri-food sustainability. Furthermore, the Circular Economy Action Plan, The Covenant of Mayors for Climate and Energy, the From Farm to Fork strategy and the Biodiversity strategy for 2030 include many actions to promote environmental sustainable practices, such as organic farming, precision agriculture, agroforesty, agroecology and stricter standard to ensure animal welfare, aiming to reward farmers for their lower impact on the environment and climate.

3.3 The Instrument for Pre-Accession Assistance in Rural Development (IPARD) and Green Agenda for Western Balkans (GAWB)

The EU pre-accession assistance for rural development[16] aims to improve agricultural sustainability countries in the process of joining the EU – such as Montenegro and Serbia where two of the eight pilot areas of the project are settled – and to align them with the EU's common agricultural policy. Through this intervention, appropriate assistance shall be offered along the way of the green transition, including the adoption of innovative practices, such as the 29 best agricoecological practices developed by the ECOVINEGOALS project. In particular, the measure 4 “Agri-environment, climate and organic farming” should be dedicated to financing specific actions in order protect natural resources and enhance biodiversity.

The Green Agenda for the Western Balkans (GAWB)[17] constitutes instead a strategic plan, endorsed by representatives North Macedonia, Montenegro, Serbia, Albania, Bosnia and Herzegovina and Kosovo, in order to align with European Green Deal objectives. They will adopt:

- a strict climate policy to achieve target of a carbon-neutral continent;
- a circular economy to improve environmental protection and minimize the amount of waste;
- a long-term strategy for preserving biodiversity and finally;
- efforts to make more sustainable the agriculture sector, also thorough the transfer to innovative and environmentally friendly technologies, including agroecological practices.

16 https://agriculture.ec.europa.eu/international/international-cooperation/enlargement/pre-accession-assistance/overview_it

17 https://www.rcc.int/greenagenda

4 THE ECOVINEGOALS PROCESS TOWARDS SUSTAINABILITY: FOCUS ON ADRIATIC-IONIAN VITICULTURE

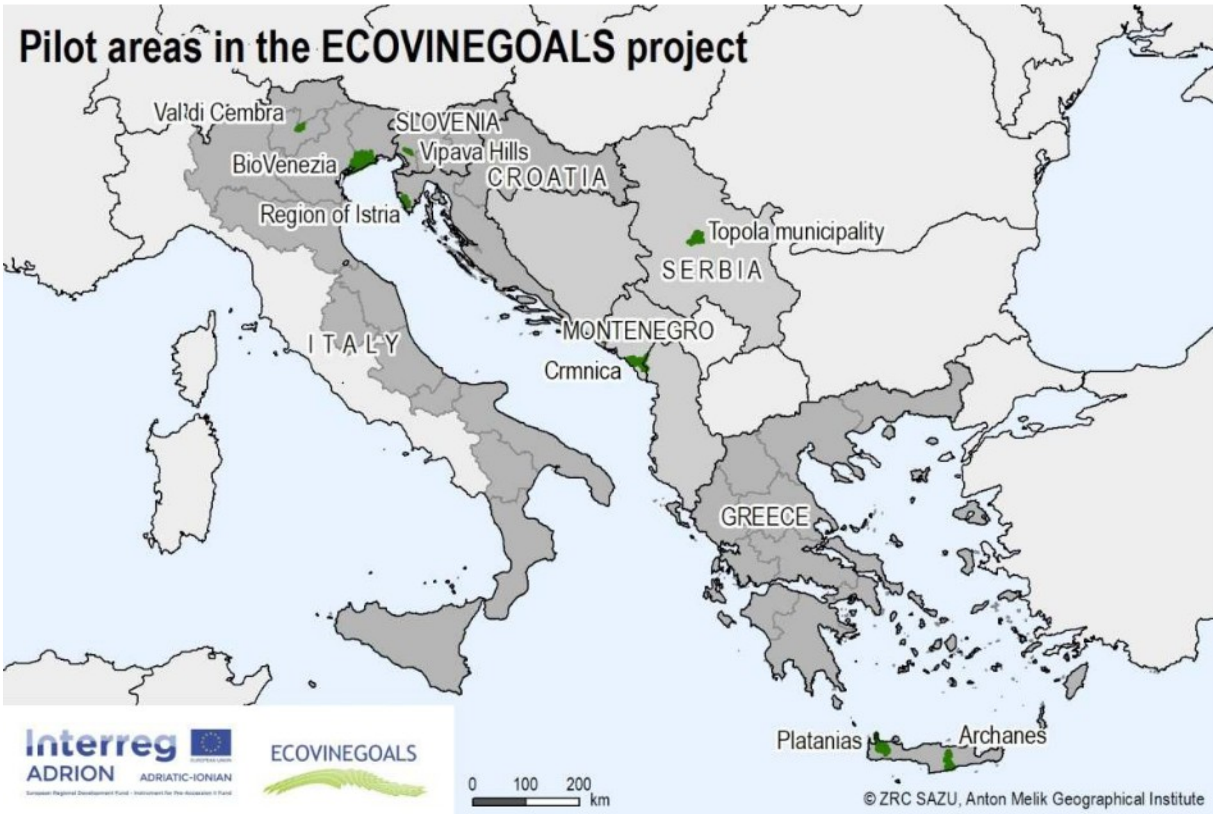
In this chapter, we will try to draft the contribution to the agroecological transition in the vineyard, in the context of the Ecovinegoals project. The first project activities focused on describing the structure of the eight pilot areas involved, to then go into detail and, through a multi-criteria analysis based on the model proposed by L. Sicard (2018), try to better understand what the conditions of the development of the agroecological fundamentals of farms (Main Agroecological Structure). Taking Gliessman's 5 levels as a basis, it will be possible to understand at what level the eight pilot areas are.

Moreover, the project identified 29 good agroecological transition practices in the vineyard. These practices will be interlinked to the 13 agroecological principles identified by FAO, which have been already presented in the first chapter of this document. Some of these practices are already being used by winegrowers in the pilot areas of the project. During the survey conducted in each pilot area, the winemakers indicated which of the proposed and not yet used practices could be of interest to them. The good practices were classified by strategic project axis (Agroecological Transition in the Vineyard, Landscape Management and Territorial Governance). For the purposes of this document, only those affecting the "agroecological transition in the vineyard", and especially the level of application of the field and the agrosystem, will be taken into account.

Starting from this information base, the chapter will then focus on the analysis of what emerged from the Local Action Plans for the Agroecological Transition in Vineyard.

4.1 THE ECOVINEGOALS PILOT AREAS: LABORATORIES OF TRANSITION

To fully understand the point from which the transition path can start, the project partners have carried out a structural analysis – including a survey with winegrowers of the territory – of the respective pilot areas, briefly reported below.



4.1.1 Biodistrict of Central-Eastern Venice (I)

The pilot area is located in North-East of Italy and precisely in eastern part of Venezia Province, the district extends from Cavallino-Treporti to San Michele al Tagliamento and from the border with the province of Treviso to the Adriatic Sea; it includes seventeen municipalities, two of which fall within the province of Treviso, for a total area of just over a thousand square kilometers. The territory, and the soil composition, can be geographically divided in two macro-areas, separated by a strip of springs: the upper plain and the lower plain.

The "Biodistrict of the production and of the organic community of central-eastern Venice" (BIO VENEZIA) was born in 2016 from the union of 19 founding members, including producers, associations and consortia, who thus decide to respond to the growing sensitivity of the community towards the protection of health and the environment. In its constitution, BIO VENEZIA confirms its commitment to promoting the organic production method, enhance the local identity and support research, training and information involving a large part of the community. Currently BIO VENEZIA has about 50 registered organic farms.

Vineyard landscape in BioVenezia

Source: BioVenezia

The structural analysis enlightens the following characteristic:

a) the flat lay of the central-eastern Venice area has favored a gradual increase in the mechanization of agronomic practice in the last two decades;
b) the agricultural area used went from 115,745 hectares in 2008 to the current 133,224 hectares, with an increase of 15%;
c) viticulture, with its 9,300 hectares, occupies approximately 7% of the cultivated agricultural area;
d) the geographical area of the Biodistretto hosts some wine production areas, including DOCG Lison, DOC Lison-Pramaggiore, DOC Piave, DOC Venezia and DOC Prosecco, from which wines of national and international fame come;
e) the good fertility of the soils and the distribution of rainfall throughout the year have ensured the maintenance of the spontaneous flora in the unworked areas, the constant presence of a vegetation cover on the ground limits erosion and the leaching of nutrients in conjunction with intense rain events, as well as preserving the fertility of the soil;
f) an increasing number of winemakers have been adopting physical-mechanical solutions (mowing, processing) for the management of spontaneous vegetation in the sub-row, limiting the use of chemical herbicides in conventional farms;

g) fertilization is mainly based on the use of products of mineral or organo-mineral origin, with the exception of organic farms where mainly organic pelleted fertilizers are used;
h) irrigation is carried out with mobile sprinkler systems above the canopy, drawing water typically from surface sources, or with micro-irrigation systems, almost always underground, fed most of the time by groundwater.

4.1.2 Cembra Valley (I)

The Cembra Valley covers an area of approximately 135 km^2 (2.2% of the surface of the Autonomous Province of Trento), and extends along the lower part of the Avisio river. Located in north-eastern Trentino, close to the border with Alto Adige, which follows almost the entire right slope, connects the provincial capital and the Piana Rotaliana with the valleys of Fassa and Fiemme. Near Segonzano and Doss Venticcia, the Avisio gorge forms a narrowing that flexes slightly the course of the valley and which in fact denotes its division into two sections: the lower one and the upper one. The right side that borders the Adige Valley has several convenient mountain passes that once, crossed by ancient paths, were valid opportunities for communication, commerce and culture.

Vineyard landscape in Cembra Valley

Source: Agenda 21 consulting srl

The main findings of the analysis are:

a) vineyards cover an area of 1.054,78 ha and the surface managed as organic amount at 139 ha in the year 2020;
b) vineyards are settled on steep slopes (in some area more than 30% of inclination), mainly facing South-West, with an average altitude of 550 meters above sea level;
c) the surface non-irrigated represent the 35% of the total area, and mainly is covered by woodlands;
d) important characteristics of viticulture in the pilot area are the high fragmentation of the agricultural areas divided in many land parcels, and the high slope of the cultivated surfaces that led to the need to build terraces: 728 km of dry stone wall that deep influenced the valley landscape;
e) the needed water supply is coming in more than 67% cases through the distribution of the irrigation district (local consortium) and irrigation occurs almost exclusively through the "dropping" system, the quality of the water is evaluated as good by all farmers;

f) the control of weeds is carried out mechanically and the use of chemical agents is limited (generally) to a single autumn treatment;

g) more than 20% of the farmers are certified organic or are in the process of transition, the rest apply an "integrated" management system (minimizing inputs harmful to the environment).

4.1.3 Vipava Hills (SI)

Pilot area "Vipava Hills" covers an area of 6.860 ha with an average altitude 206 m (from 59 to 556 m). It is part of the Vipava Valley wine growing district which belongs to one of the three Slovenian wine growing regions, called Primorska. The wine-growing region takes its name from the Vipava Valley, settled in the Western part of Slovenia bordering with Italy, and covers almost the entire geographical unit. It is the largest district in the Littoral region in terms of area and yield. The pilot area is a well-rounded unit within the Vipava Valley, bounded in a significant part by the Vipava River with its tributary Močilnik and on the other side by the Branica River. Between these watercourses, the rugged hilly terrain is inhabited by about 5,500 inhabitants living in 23 villages and hamlets. There are more than 800 farms in the pilot area, of which 360 are farms that submit aggregated applications, and thus declare themselves as active farms. According to the data of the register of grape and wine producers maintained by the Ministry of Agriculture, Forestry and Food, the area today comprises 2,300 ha of vineyards, which represents more than 15% of Slovenia's 16,000 ha of vineyards.

Vineyard landscape in Vipava Hills

Source: Maja Topole

The main characteristics emerged are:

a) half of Vipava's vineyards are on flat and gently sloping land with a slope of up to 15%, more than a third is on slopes of 16-30%, and 12% are on steeper slopes;

b) vines are grown in evenly spaced rows in medium and high spur vineyards, with only a few laths remaining in the Branik area;

c) most of the work in the vineyards is done by machine, with winter pruning and harvesting mainly done by hand;

d) today, about 65% of white varieties and 35% of red varieties are planted. In the Vipava Valley, we have preserved many old local grape varieties. The largest share belongs to the indigenous Rebula, a long-established variety from the Littoral region, while vine-growers also cultivate and produce the Vipava varieties Zelen, Pinela and Klarnica;

e) almost half of the pilot area is covered by forest (49%), with extensive grassland and pastures accounting for 17% and land under overgrowth 2.1%. Only 21% of the land is cultivated - arable, vineyards, orchards and berries, the rest is built-up land (4.4%) and for other uses (4.4%);
f) there are almost 600 wine growers cultivating 1,846 vineyards, which shows the high fragmentation of agricultural land.

4.1.4 Istria County (HR)

Istria is located on the largest peninsula of the Republic of Croatia in the northern part of the Adriatic coast and it covers an area of approx. 2.813 km^2. Relief of this area is characterized by rolling hills and positions that come right down to the seashore along the western coast of the peninsula.

Due to the exceptionally favorable climate, the wine-growing positions are found at all elevations. Western coast of Istria descends gradually to the sea, and the soil is fertile and deep, so that vineyards are found at higher elevations (about 100 m) in deep red soil and the eastern coast of Istria is steep, and the vineyards are positioned in the steep karst terrains, often planted on the terraces facing the sea.

Vineyard landscape in Istria County

Source: istria-gourmet.com

According to the survey realized in the 2 pilot vineyards through Ecovinegoals project:

a) 80% of the farm area is covered in vineyards, where the MalvazijaIstarska is the variety that most all of surveyed viticulturalists reported growing in the largest share, and the Istrian varieties are Teran and MalvazijaIstarska including international varieties Muskat, Merlot, Cabernet Sauvignon, Chardonnay and Pinot;
b) in 2021 in Istria County were registered 2,715 winemakers and wine-farms;
c) most viticultural farms in the Istrian region are managed conventionally – in the sense that they are not certified organic, integrated or biodynamic;
d) in the control of weeds, herbicides have not been used for years, but only mechanical elimination (rotary harrows, mowers);
e) ecological means are already used in the protection of plantations from plant diseases, and minimally systemic fungicides are used in the protection of white varieties, exclusively based on observations and prognostic models;

f) in the fertilization of vineyards, organic fertilizers (pelleted or mature manure) are primarily used, with limited fertilization with mineral fertilizers (superphosphates and NPK);

g) the whole area suffer of severe problem of drought and accessibility to water source, this heavily affects the costs of production and so the profitability of winemaking

4.1.5 Crmnica (MNE)

Crmnica subregion lays in the south-eastern part of Montenegro, in the bordering area with Albania. About 63% of the area is located at an altitude between 100 m and 400 m. The climatic properties of Crmnica subregion are strongly influenced by the presence and vicinity of Skadar Lake, the largest lake at Balkan Peninsula. Crmnica field area expands to the lake coast and it is surrounded by the mountain range that separate this area from the Adriatic Sea.

Registered producers of grapes and wine in Crmnica are predominantly distributed within the most fertile part of Crmnica, following the coastal line of Skadar Lake. Out of the 24 ha of registered vineyards, 34% of them (8.20 ha) are located in the flat area, even though some of the most important vineyards, in terms production tradition, are located from 150 to 199 meters above sea level (around 2.6 ha), and from 250 to 300 m (around 4.16 ha). This implies the conclusion that the grapevine growing and viticulture is moderately developed in the lower and upper part of Crmnica, while the flat areas are developed more intensively due to the higher quantities of water available for irrigation, existence of road and infrastructure, highly fertile soil.

Vineyard landscape in Crmnica

Source: project team of BSC Bar

Some bullet points to describe the wine-growing sector:

a) viticulture in Crmnica is characterized by the dominance of small family owned vineyards and so-called “boutique vineries”, where autochthonous cultivars assortment is present;

b) properties and cultivated land are fragmented and production are often used for family consumption rather than for market selling (difficulty to reach quantity and quality standards);

c) almost 80% of vineyards is located in the protected area of National Park “Skadar Lake”;

d) the predominant soil types are: red soil - Terra Rossa (cca 66%) and brown soil - Cambisol (cca 16%). Furthermore, there are other soil types that are less frequently present, such as Rendzinas, alluvial soils, black soils (Calcomelanosol) and gray soils (Eugley);

e) taking in consideration that there is no irrigation water supply network in the most of the villages, winegrowing is predominantly rain-fed;

f) soil and water pollution main concerns inadequate usage of mineral fertilizers and large use of chemical pesticides, not just in wine-growing sector, but in agriculture in general in the area.

4.1.6 Topola Municipality (RS)

The Topola municipality is located in Šumadja region (Central Serbia), laying in a hilly belt where the forests of pedunculate oak, ash, willow, poplar, cer and malt oak, as well as beech forests predominate. The main feature of the landscape of this region are hilly and undulating terrains that are often forested, especially on higher terrains, slopes of Mount Rudnik, as well as numerous orchards and plots with field crops. The landscapes of this region are influenced by the river valleys, where mainly field crops are represented. The municipality of Topola mostly consists of agricultural land, 81.5% (29093.56 ha) of the area. Most of the area is located at altitudes of 80 to 400 m, but the areas where the vineyards are located at altitudes of 150 to 350 m. The altitude of the region is gradually decreasing from the southwest to the northeast of the region.

Vineyard landscape in Topola Municipality

Source: Zoran Dragoljevic

Main findings of the structural analysis are:

a) Topola is one of the most important viticulture areas in Serbia, with 19 vineries and almost 300 ha of vineyards;
b) 81.59% of the total territory is agricultural land, and about 0.55% are vineyards;
c) the most represented autochthonous and regional varieties by area are Prokupac, Smederevka, Vranac, Tamjanika (group Tamjanika) and international grape varieties by area are Merlot, Cabernet Sauvignon, Chardonnay Riesling, Sauvignon blanc, Cabernet Franc, Pinot Blanc, Muscat Hamburg, Sangiovese, Palava;
d) the number of grape producers is 164, and that these numbers have doubled in the last 5 years, speaks of the good development of viticulture in this area;
e) vineyards are 100% managed as conventional production, no organic farming is present;
f) the great influence of phytosanitary advisers on farmers is very often in a wrong way, with the aim of consuming expensive chemical means that will ensure their safe production and farmers have a great confidence towards them because there is insufficient knowledge.

4.1.7 Archanes-Asterousia and Platanias Municipalities (EL)

The Archanes Asterousia Municipality (335 sq. km) is located in the central southern part of Crete Island, in the Prefecture of Heraklion, the administrative area in which is concentrated the 80% of the vineyards of the island. The Platanias Municipality (491 sq. km) is located in the Prefecture of Chania, on the western end of the island.

The island consists of three basic zones: the high zone, with altitude of 400 m, the middle zone with altitude of 200 m to 400 m and the low zone with altitude from the sea level to 200 m. The areas chosen present a wide diversity of landscape features, including steep mountainous areas, hills, flat areas, coastal areas, natural grasslands, sclerophyllous vegetation, bare rocks and soils, forests and agricultural land.

Vineyard landscape in Archanes-Asterousia Municipality

Source: CIHEAM-MAICh

The analysis conducted on the two Greek pilot areas shows:

Archanes - Asteorusia

a) total area under vines is 3,777 ha;
b) vineyard plots are small, with almost 80% of them ranging in size from 3000 m^2 or below;
c) only 125 vineyards have been officially registered as organic cultivation;
d) issues facing viticulture in the region include: land fragmentation, shortage of water and vine diseases like Eutypalata.

Platanias

a) total area under vines is 452 ha;
b) only 12 vineyards have been officially registered as organic;
c) the wine-cultivation consists in small plots and scattered land ownership, as almost all of the vineyards (93.1%) range in size from 3000 m^2 (0.3 ha) and below;
d) issues facing viticulture in the region include: economic dependency on tourism and a lack of coordination between the touristic and primary sector, land fragmentation.

As can be understood from the characteristics presented, the pilot areas present important differences between them. This heterogeneity allows for a broader spectrum of evaluation of what could be the good practices of agroecology applicable for the development of the transition process. In fact, the production contexts range from mountain or hill areas, where both the altitude and the extreme slopes strongly condition the viticulture practice, to more mechanized plain areas, where, however, other different problems aruse, such as harsh drought or the pollution from other agricultural or industrial sector.

Added to this it is important to take in consideration the influence of the anthropic dimension, both in terms of the traditions of the relationship between man and nature, both in terms of “how wine is made”, and in terms of production quantities and the relationship with the market, to conclude with the dimension of territorial administration, availability of technical and financial support to viticulture. It therefore seems more interesting to look at the pilot areas without looking for common traits, which may emerge, but more like eight different laboratories, which aspire to the same goal (the sustainability in wine production), possibly following different paths.

Vineyard landscape in Platanias Municipality

Source: CIHEAM-MAICh

For this reason, a multi-criteria analysis of the pilot areas was carried out, in order to be able to compare the starting conditions of the "eight laboratories" and thus be able to identify the possible paths of agroecological transition.

4.2 THE EVALUATION OF THE MAIN AGROECOLOGICAL STRUCTURES OF THE PILOT AREAS (MULTI-CRITERIA ANALYSIS)

The multi-criteria analysis proposed by Leon Sicard (2018) makes it possible to evaluate the fundamentals of the development of the Main Agroecological Structure (MAS). For the purposes of this document, it therefore seems useful to report the results of this methodology applied to the eight pilot areas. Therefore, the methodology is briefly presented below and then, in the following paragraph, the results of the surveys conducted in the 8 pilot areas.

4.2.1 The MAS methodology

The hypotheses underpinning the different methodologies of multi-criteria analysis is laying on the assumption that the object of the study (in our case the agroecological practice) can be divided into different analytical factors, single elements, or analysis criteria, which fully describe it. Moreover, that these different analysis criteria can be described and evaluated separately.

The steps through which multi-criteria analysis traditionally develops can be summarized schematically in the following 5 ones:

1. the definition of the evaluation matrix and the consequent choice of indicators;
2. the "standardization" of the evaluation matrix;
3. the attribution of "weights" to each indicator;
4. the calculation of the orders (multiplication between "standardized" matrix and weight vector) and

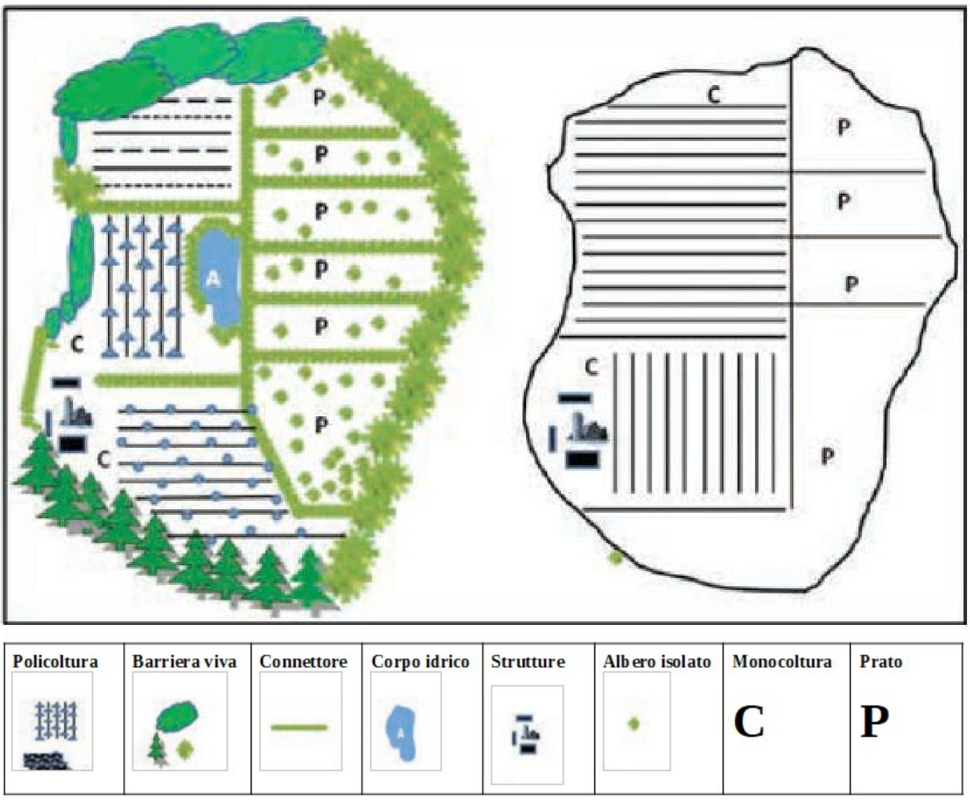
consequent definition of the impact matrix from which is possible to extrapolate the order of the preferences;

5. sensitivity analysis (optional).

In this sense, it is proposed to focus the analysis of the agroecosystems of the different pilot areas of Ecovinegoals project, through the introduction of the concept of Main Agroecological Structure (MAS). The concept of MAS, resumed from the researches of Leòn Sicard[18], has some elements (qualificable, quantifiable, measurable and comparable) that facilitate the adoption of a simplified system of multi-criteria analysis.

So the MAS can be defined as the "*the internal configuration or spatial arrangement of the farm and the connectivity between its different sectors, patches and corridors of vegetation or productive systems and the exchange with the external environment*". Taking in consideration the internal configuration of the farm, in particular, the observation focuses on the degree of openness and on the exchange relationships (between the different living species and between the different cultural contaminations) that the same farm maintains with the environment in which is included. The more the farm presents an articulated arrangement of its spaces, able to alternate different crops, preserve the presence of trees and hedges, keep functional small ditches and water bodies, the more will be able to offer vital connection systems, both internally and externally, with the surrounding environment.

Comparison between two farms with (left) and without (right) Main Agroecological Structure



Source: Leon-Sicard, 2018

18 *León-Sicard TE, Toro Calderón J, Martínez-Bernal LF, Cleves-Leguízamo JA (2018) - The Main Agroecological Structure (MAS) of the Agroecosystems: Concept, Methodology and Applications.* https://doi.org/10.3390/su10093131

The chance to describe qualitatively and quantitatively these characteristics lays on the identification of certain indicators that can be populated as they are based on data that can be easily detected in the field, through observations and interviews. These indicators, combined each other, will be used in order to create an index (a pure number) useful for introducing and explaining comparative analysis as well as for guiding a process of transition from conventional agriculture models, towards virtuous models partly inspired by organic farming, up to subsequent modifications and reorganizations of production systems and spaces as foreseen by a complete agroecological transition.

The MAS, and the relative index that will be described below, represents the parameter, actually one of the possible parameters, able to evaluate the degree of agroecological transition both of a single farm and, with a wider perspective, of a larger area dedicated to the primary sector.

The first essential prerequisite to describe, parameterize and standardize any agroecological transitions in progress, in order to "build" the aforementioned MAS index, is given by the definition of the evaluation matrix.

In this sense, the MAS index presents 10 indicators as shown in the following table: 5 indicators describing the structure and connection of the farm and its capability to exchange "energy", and 5 examining aspects related to farm management.

The indicators necessary for the construction of the MAS index

	Indicator	Acronym	Description
1	Connection with the main ecological landscape structure	CMELS	Assesses the distance of the farm in relation to the nearby fragments of natural vegetation, mainly forest covers and bodies of water.
2	Extension of external connectors	EEC	Evaluates the percentage of the linear extension of live fences located in the perimeter of the farms.
3	Extension of internal connectors	EIC	Evaluates the percentage of the linear extension of the rows of vegetation but internally.
4	Diversification of external connectors	DEC	Evaluates the diversity of live fences or hedges located in the perimeter of the major agroecosystem.
5	Diversification of internal connectors	DIC	Evaluates the diversification of internal living fences.
6	Use and Soil Conservation	USC	Evaluates the distribution percentage of different covers within the farm and the conservation of the soil (evidences of erosion).
7	Management of Weeds	MW	Evaluates the management practices and systems of weeds control.
8	Other management Practices	OP	Evaluates the types of production systems (ecological, conventional or in transition) of each farm.
9	Perception - Awareness	PA	Evaluates the degree of conceptual clarity and awareness of producers regarding agrobiodiversity.
10	Level of Capacity of Action	CA	Evaluates the capacities and possibilities of farmers to establish, maintain or improve their MAS.

Source: Leon-Sicard, 2018

Adding all 10 values obtained on each row of the "evaluation matrix" it is possible to calculate the MAS for each farm/agrosystem. In other words, the final calculation of the MAS is obtained by adding the resulting value of each of the aforementioned indicators, according to the following formulation:

$$MAS = CMELS + EEC + EIC + DEC + DIC + USC + WM + OP + PC + CA$$

The scale of interpretation of the MAS is indicated in the following table.

Scale of MAS interpretation

MAS development	Value
High developed	80 - 100
Moderately developed	60 - 79
Slightly developed	40 - 59
Weakly developed, with cultural potential	20 - 39
Weakly developed, without cultural potential	10 - 19
No agroecological structure	1 - 9

Source: Leon-Sicard, 2018

With these methodological premises, the partners proceeded with the field investigation. A sample of 10 winegrowers was selected, through statistical stratification, for each of the pilot areas. The survey was carried out through a questionnaire shared by the partnership, the same for all the pilot areas of the project. This activity took place in two rounds, 18 months apart from each other, to allow for a glimpse of a minimum development trend of the Main Agroecological Structure.

It is important to read the results of the multicriteria analysis nor as a merit ranking between agrosystem of the Pilot Areas, nor as a ranking between the single farms inside the same Pilot Area. It should represent an indication for the implementation of local and regional policies and a suggestion for the selection of the most suitable agroecological practices to be activated, according the specific geographical, productive and socioeconomic contexts. To do so it is possible to look to each indicator as a field of action to enhance the agroecological transition.

Moreover, the picture coming out from each multicriteria survey, should underpin the construction of affordable and useful Local Action Plans. Periodical multicriteria surveys (for example one each three years) – beyond the conclusion of the Ecovinegoals project activities – should be done to update the picture and by that verify the efficacy of the action plans proposed, and possibly correct the strategies and the related actions.

4.2.2 The evaluation of the MAS in the 8 pilot areas, starting point of the transitional path

Even if, as mentioned, the time between the two surveys of the development of the Main Agroecological Structure was not sufficient to be able to appreciate a significant change, what emerges is a well-defined picture of the starting point of the different pilot areas on the road to the agroecological transition in the vineyard.

The data collected from the second round of survey confirm above all, as seems evident, the relationship between the crops with the natural elements that surround the vineyards (indicators CMELS, EEC and DEC), and the natural connectors that divide the different portions of vine production within the fields (indicators EIC and DIC). Some changes, albeit limited, have instead occurred in the other five MAS development indicators (USC, MW, OP, PA, CA). For the scope of this document, these small changes as to be evaluated as a first little step on the road to sustainability in vineyards.

In any case, the multi-criteria analysis has made possible to establish the peculiarities (weaknesses and strengths) of the agrosystems of the pilot areas of the Ecovinegoals project, our 8 laboratories, for each of the MAS indicators.

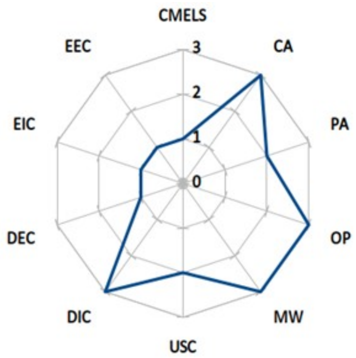
Considering the average of the 10 farms (per pilot area) for each of the indicators, it is possible to establish whether that fundamental of agroecology has a low, medium or high value.

Starting from this point, it is easier to identify those good practices in the vineyard to be activated to improve that fundamental and consequently climb Gliessman "pyramid".

Kiviat Map of the MAS development status

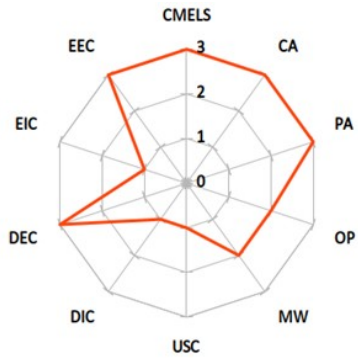
Biodistrict of Central-Eastern Venice (I)

Moderately developed



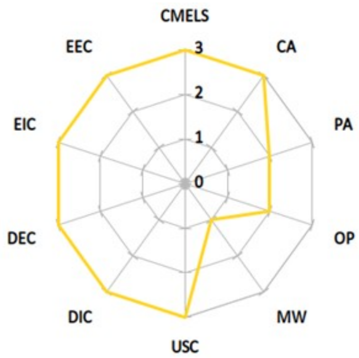
Cembra Valley (I)

Moderately developed



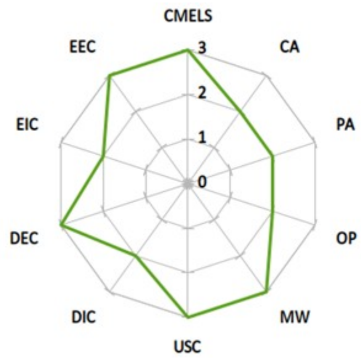
Vipava Hills (SI)

High developed



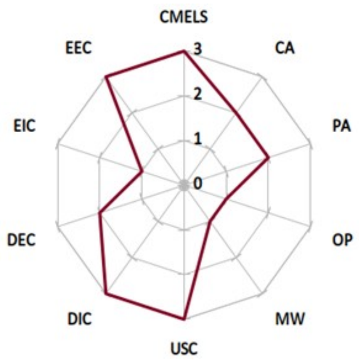
Istria County (HR)

Slightly developed



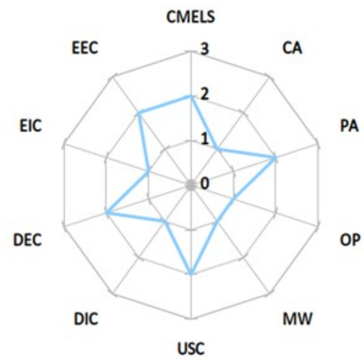
Crmnica (MNE)

Moderately developed



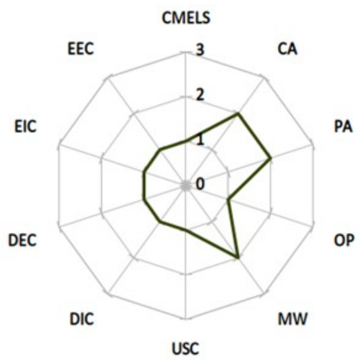
Šumadja District - Topola Municipality (RS)

Slightly developed



Archanes-Asterousia and Platanias Municipalities (EL)

Slightly developed



Source: elaborated by Agenda 21 consulting srl

The pilot areas where biotic exchanges with the natural elements external to the farm are more intense are those where viticulture has developed in more marginal contexts, from the point of view of the antropization/industrialization of the territory, and where the surfaces used are set in a landscape dominated mainly by woodlands. They are the Vipava Valley (SI), the Cembra Valley (I), the Crmnica sub-region (MNE) and the Istria pilot area (HR). Not by coincidence, they are mountain or hill contexts, where it has not been possible to develop extensive agriculture as in the plains. The agrosystems in these areas enjoy the ecosystem services of the natural element that surrounds them. For the same reason, on the contrary, in the pilot areas at lower altitudes and less impervious orography, the presence of extensive and diversified natural elements is more difficult. The example above all is the territory of the Biodistrict of Central-Eastern Venice (I), where, beyond the presence of important watercourses, woods, marshes, heaths and other natural elements have a pinpoint and residual presence, completely surrounded by the agricultural matrix of the landscape if not by the urban one or industrial. A separate discussion should be made for the case of the two pilot areas located on the island of Crete, where, although the landscape and the orography appear more "sinuous", the arboreal vegetation is scarce and very limited, both due to the climatic conditions and the human activity. In any case, this absence, or sporadic presence, of the "living" perimeters around the vineyard, does not allow a relevant biotic exchange in these areas, negatively influencing the relative fundamentals of the Main Agroecological Structure (**CMELS**, **EEC** and **DEC** indicators).

Distance between the external "living" connectors and the vineyards in Cembra Valley (I)

Source: Agenda 21 consulting srl

Looking inside the structure of the farms, the survey tried to detect the presence of "living" connectors (**EIC**) and their degree of diversification (**DIC**). The more important this presence is, the more biotic exchanges between the different portions of crops and natural elements are facilitated. Also in this case can be noted some typical farm's structures characteristics, which influence the agroecological development. As in the case of the Cembra Valley (I), and partially in the pilot area of Istria (HR), there is an almost total absence of "living" internal connectors, where the viticultural tradition has literally ripped the cultivable surface from the mountain and its steep slopes. Every minimal cultivable portion is planted with vines and the different plots are separated just by "dry stone walls". These structure, recently recognized among the intangible UNESCO heritage, have a pivotal role in regulating the hydrological cycle, increasing the rainwater storage in soil and reducing soil erosion, increasing the diversity of habitat and species of the vineyard as well as aesthetic appearance of viticultural landscape. Even if the extent and integration of supporting of the regulatory and cultural ecosystem services produced should be further investigated, it is clear that these elements are more "alive" than a simple concrete divider and are thus included as agroecological best practice in vineyard, as it will be presented in detail later in this chapter. In other cases, such as the agrosystems analyzed in the pilot areas of Topola (RS) and Crmnica (MNE), or in Eastern Venice (I), the presence of internal connectors is not very widespread, but where it does exist it is very diversified: few but good. For the reasons already explained, the situation on the island of Crete (HR) returns a picture that is completely similar to what was recorded on the naturalness outside the properties: sporadic, and irrelevant presence from an ecosystem point of view, of living separators between the different portions of the farm.

Management of the weed in the vineyards

Source: Agenda 21 consulting srl (photo taken in Cembra Valley)

Let's now shift the focus from the connection between the agrosystem and the natural elements to field and crop management, and therefore to Use and Soil Conservation (**USC**) and Management of the Weed (**MW**) indicators. The first indicator (USC) investigates two partially interconnected aspects.

The first aspect concerns the degree of "poly-colturality" of the agrosystem. The higher the level of diversification of the crops in the field, the more the structure of a "biodiverse" ecosystem is facilitated, capable of increasing exchanges and synergies between the different species present inside the farm, and by that positively influencing the development of the MAS. Best scores emerge in contexts where the properties are larger, such as in Istria (HR), or in the Eastern Venice (I), or where historically the grapevine has been alternated with other crops, also used for the subsistence of farmer's family, rather than for the market (in Montenegro and Serbia). On the other side of the coin, it is much more complex to move away from the mono-culture where the plots are small (under 5 ha), fragmented and with difficult accessibility, as in the case of the Cembra Valley (I) and, for some extent, the two pilot areas of Archanes-Astrousia and Platanias (EL). The second aspect on which this indicator focuses concerns the presence and diffusion of soil erosion phenomena. In part, therefore, it is linked to the diffusion of poly-culture. Where more species are present, the impoverishment and consequent erosion of the soil is less. From this point of view, the best situations are still found in the most accessible and "workable" contexts, and therefore in the plains, while the contexts where the slopes are more accentuated, it is easier to find phenomena of hydrogeological instability. However, it is useful to consider that the sensitivity to soil impoverishment is also determined by the mineral composition of the same and by the possible lack of nutrients.

The Management of Weed (MW) is one of the most complex issues to address on the road to sustainability in viticulture. Intentionally leaving parts of the arable land to non-productive species and potentially in competition with the crops themselves, presupposes a cultural paradigm shift. The awareness that we are no longer dealing only with a field where the goal is only maximizing profitability, but with an ecosystem (an agroecosystem) capable of developing resilience and sustainability, and by that making room for elements unrelated to productivity, is not a simple step, if not accompanied properly by institutions at all levels. The highest values recorded in this indicator come in fact from those pilot areas where there is more access to information, technologies and support (both scientific and economic) to the winegrower. In this sense, the pilot areas located outside the European Union recorded the lowest values, with a widespread use of chemical herbicides and an almost total absence of areas or strips of weed species.

The aspect investigated by the eighth indicator (Other management Practices, **OP**) actually takes the form of evaluating the degree of adherence of the winegrower to the least invasive and least harmful to the environment in management practices, and in particular in the fight against diseases and organisms harmful to the grapevine. Decisions often intervene here that go beyond the will of the individual winegrower: local, national or European legislation, regulations at the level of the network of producers committed to sustainability (e.g. biodistricts), agreements with distributors (e.g. wineries), and so on. For example, in Cembra Valley(I), local legislation does not allow conventional practices and pushes farmers to at least an integrated management system. Even more, to be part of the Eastern Venice Biodistrict (I) it is necessary to start the transition practices towards organic certification. Also in this case, the more you move away from the more tight legislations, such as those of the European market, the more the choice to adopt more sustainable practices is left to the good will of the winemaker, not adequately supported by the regulatory context.

The last two indicators are closely related to each other. One (Perception and Awareness, **PA**) measures the degree of awareness of the winemaker around environmental issues, and the consequent willingness to opt for a more sustainable management of the farm; the other (Capacity of Action, **CA**) measures the actual ability to follow up on the expressed will: what the company is actually able to do to improve or at least maintain its MAS. The eight pilot areas all show good PA values, i.e. it seems that sensitivity to environmental sustainability issues is widespread among the majority of the winegrowers interviewed. The situation, on the other hand, seems more stratified when we move from words to deeds. Where tools, technologies, knowledge and resources are more present and accessible, investing in the path of sustainability seems more realistic.

4.3 The Good Practiced identified in the project

The 29 good agroecological transition practices in the vineyard identified by the project were classified by strategic project axis (*Agroecological Transition in the Vineyard, Landscape Management and Territorial Governance*) and, for the purposes of this document, only those affecting the "agroecological transition in the vineyard" will be taken into account.

For better ease of reading, the 21 Best Practices that refer to *Agroecological Transition in the Vineyard* have been categorized according to Gliessman's 5 levels of Agroecological Transition, focusing the attention on the first three: **efficiency**, **replacement** and **redesign** of production systems. The following table provide a brief division of the Good Practices:

Categorization of the Good Practices according to Gliessman's 5 levels of Agroecological Transition

ID	Description	Efficiency	Substitution	Redesign
BP01	Agro forestation			X
BP03	"Biodiversity friend" certification			X
BP04	Use of biostimulants in viticulture	X	X	
BP05	Canopy management		X	X
BP06	Grassing of the vineyard		X	X

ID	Description	Efficiency	Substitution	Redesign
BP07	Maintaining the vineyard landscape - Dry stone wall		X	X
BP08	Green manure		X	
BP09	Manual harvest			X
BP10	High Nature Value (HNV) agricultural areas		X	X
BP11	Mechanical processing of the under-row	X		
BP12	Sustainable management of irrigation	X		
BP14	Sexual confusion	X	X	
BP15	Mulch	X	X	
BP17	Land use maintenance systems		X	X
BP18	Tecniques for the protecting of birds and beneficial insects		X	X
BP19	Pyro-weeding	X		
BP20	Decision support system for the reduction of treatments in viticulture	X		
BP21	Resistant varieties			X
BP23	Soil fertility monitoring		X	X
BP25	Wooden poles	X	X	
BP27	Erosion prevention		X	X

Source: Agenda 21 consulting srl

4.3.1 Increase the efficiency, from recycling to input reduction

The goal of this level is to use industrial inputs more efficiently so that fewer of them will be needed and the negative impacts of their use will also be reduced. The Good Practices included in this category therefore refer to all those actions that can be implemented by the winegrower to improve the efficiency of the wine production:

- from the use of biostimulants to increase the absorption of nutrients supplied with fertilization to mulching or flame weeding as an alternative to chemical weeding by exploiting the heat or covering the soil under the vines to prevent it from being irradiated by the sun;
- from mechanical weed control in the under-row (tamping up, weeding and mowing) to reduce herbicides, to precision irrigation to reduce water waste by monitoring soil moisture status and available water, passing through the use of pheromones for the management of harmful insects;
- from the use of wooden poles to reduce the environmental and visual impact of the vineyard, to the integration of decision support systems to simplify the complex agronomic choices and the management of the cellar processes.

All these are examples of practices that allow a reduction in the need for nutrients from synthetic fertilizers, chemical weeding, insecticides and water waste to achieve a lower impact on the environment, an improvement in the qualitative characteristics of the products and the maintaining production targets with lower costs.

4.3.2 Substitute alternative practices, the health of the natural resources

The goal of this level is to replace external input-intensive and environmentally degrading products and practices with those that are more renewable and environmentally sound. The Good Practices included in this category therefore refer to all those activities that concern a better use of the soil, attention to the health of the ecosystem and a particular care for biodiversity:

- from the management of the foliage to improve the microclimate of the vine, up to the insertion of beehives in the vineyards to favor the presence of bees as sentinels of environmental quality and importance for agriculture;
- from the grassing of the vineyard with spontaneous essences or mixtures of herbs to improve the soil conditions, up to the cultivation of annual plants in the inter-row to use them as green manure;
- from the promotion of low-intensity agricultural systems with the presence of semi-natural vegetation or a "mosaic" agriculture, up to the enhancement of dry stone walls for their hydrogeological, agronomic, ecological, cultural and historical value;
- from the introduction of systems for the maintenance of soil use to the control of its qualities to prevent its degradation, up to the prevention of runoff and erosion.

These are practices that aim to optimize yield, improve soil structure and management, increase biodiversity and provide some secondary products to supplement the winegrower's income.

4.3.3 Redesign the agrosystem, from economic sustainability to social awareness

The goal of this level is to promote changes in overall system design to eliminate the root causes of many of the problems that continue to persist at Levels 1 and 2.

The Good Practices included in this level refer to the improvement of the environmental and productive interaction of trees and shrubs grown together with herbaceous crops and/or animal breeding and the manual harvesting of the grapes to improve the quality of the wine characteristics. In addition to these "in the field" practices, there is also talk of investments towards experimentation for a resilient and resistant vine, through the inclusion of piwi varieties, and towards greater guarantees and communication for the market, with the introduction of certification standards who evaluate the environmental impact of agricultural transformation activities and processes. Activities that aim to obtain a productive diversification, a better management of the territory and the landscape and a potential in terms of sustainable communication/marketing.

5 AGROECOLOGICAL PRACTICES IN THE ECOVINEGOALS PILOT AREAS

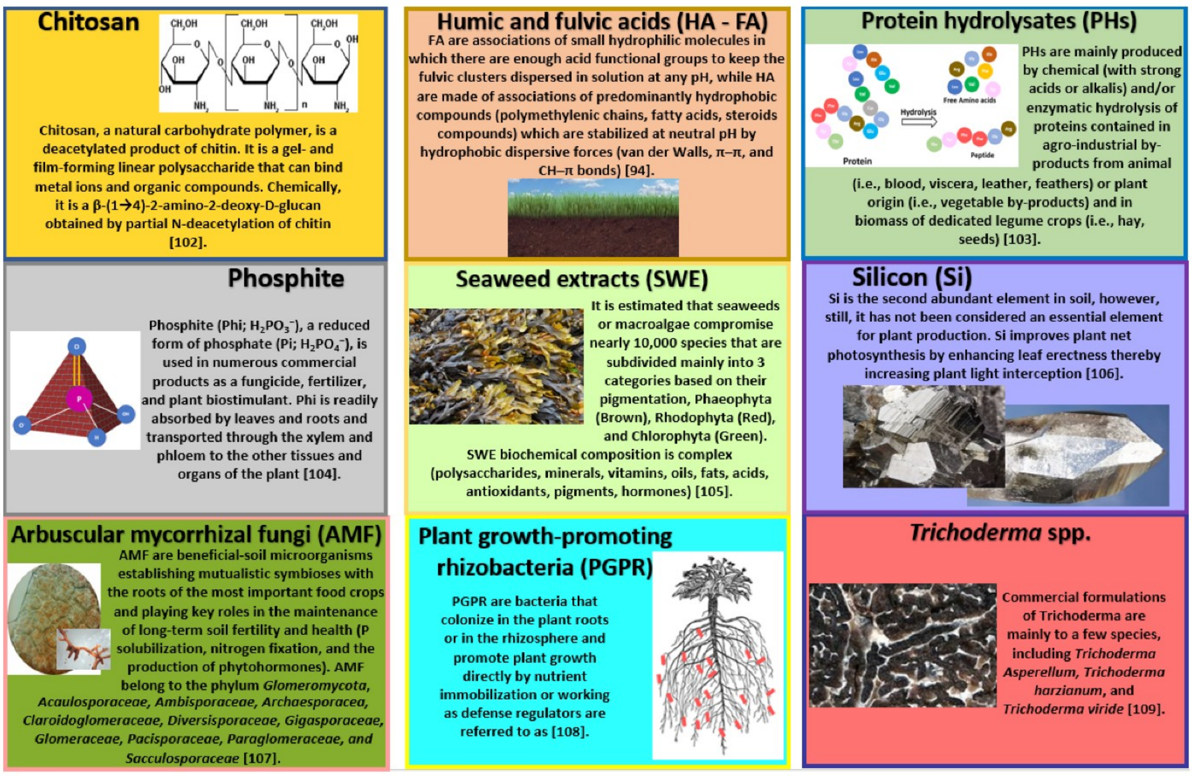
Thanks to the Local Action Plans for the agroecological transition in the vineyard designed by each project partners, is possible to identify which of the good practices – the one linked to efficiency, replacement and redesign of production systems – are already present in the eight Ecovinegoals laboratories (the pilot areas) and which are the ones that the stakeholders (including the farmers) intend to apply in the near future.

5.1 INCREASE THE EFFICIENCY, FROM RECYCLING TO INPUT REDUCTION

Biostimulants include many different formulations of compounds, substances and micro-organisms with positive effects on crop nutrition and protection. They could be applied directly on plants or could be added to soil to improve crop vigour, yields, quality and stress tolerance. By acting on the pant's vigour without any direct action against pathogens, they could represent a complementary practice to reduce the input of conventional crop nutrition and crop protection.

The UE Commission and Parliament itself recognized the importance of biostimulants use in agriculture, by introducing the biostimulant definition in the Regulation (EU) 2019/1009 laying down rules on the making available on the market of EU fertilising products.

Categories of plant biostimulants



Source: Cataldo et al. (2022)[19]

19 *Cataldo E., Fucile M., Mattii G.B. (2022) - Biostimulants in Viticulture: A Sustainable Approach against Biotic and Abiotic Stresses.*

Biostimulants application agroecological practice, despite having a scarce spread in the ECOVINEGOALS pilot areas: few farms in Cembra Valley, in Istria County, Archanes-Asterousia and Platanias Municipalities, it is absolutely attractive for the resilience enhancing capability and for providing added value to the wider environment and biodiversity. Therefore, the large part of winegrowers of the studied regions is willing to enhance the use of biostimulants in their vineyards in the next years. In addition to this, the Ministry of Agriculture, Forestry and Water Management and the University of Montenegro are implementing a plan to manage the natural resources in a long-term sustainable manner that is harmonized with environmental protection principles. The aim is to substantially decrease the usage of chemical fertilizers and pesticides, also through the promotion of preventive mechanisms and alternative options, such as biostimulants.

A similar initiative is being launched by the Administrative Department for Agriculture, Forestry, Hunting, Fisheries and Water Management of Istria County that set up standard analysis of soil and plant material as a basis for calculating precise fertilization and possible application of biofertilizers in individual vineyards. They established protocols for samples collecting and laboratory analysis, as well as practical recommendations for fertilization, promoting the usage of biostimulants in spite of conventional fertilizers.

More in general, organic fertilization should be encouraged as a practice that meets several elements of agroecology, such as: recycling the already available nutrients, create synergies among different production cycles and improve the resilience of the agro-systems by increasing the organic matter content of soil. Furthermore, the Administrative Department for Agriculture, Forestry, Hunting, Fisheries and Water Management of Istria County and the Ministry of Agriculture of Croatia are developing a long term program to grassing the inter-row spacing as a measure of weed control, forms of green fertilization and increasing the overall biodiversity of wine-growing areas; the so called green manures.

Herbicides application in agriculture is subject to continuous debate both between public opinion and European institutions, especially with regards to Glyphosate, which is currently allowed to be used as long as its license is valid in the European Union. Mechanical tillage of the vine-row could be a suitable alternative for weed control in vineyards although it is of difficult application in mountain conditions and could foster the mineralization of soil organic matter. This agroecological practice is widespread among winegrowers of Venice biodistrict, Cembra Valley, Crmnica, Istria County, Topola Municipality and Vipava Hills. In fact, it is fundamental in organic farming, but at the same time, it could be helpful to decrease the use of chemical weed management in the conventional and integrated agricultural production systems. The efficiency of different practices to control weed competition along vine-rows were tested in an experimental trial that was conducted under the Ecovinegoals project in Cembra Valley. The effect of using synthetic herbicide (glyphosate), an herbicide based on pelargonic acid, the mulching with sheep wool, the mechanical tillage and a grassed control periodically mowed, on plant vigour and soil microbiota were evaluated along one growing season to provide evidence on their practical applicability.

Consequences of climate change are becoming particularly alarming, since droughts are getting more frequent and intense, posing a considerable threat to viticulture. Among different abiotic stresses, water deficit is the factor that has the worst influence on plant physiology with a drastic impact on grape production. To overcome the deleterious effects of drought, the development of strategies to reduce water consumption and to improve water-use efficiency (WUE) in vines is crucial. Sustainable irrigation represents an agroecological practice that could limit water waste without affecting the grape yield. Winegrowers of the Venice biodistrict and Cembra Valley just adopted precision irrigation systems, monitoring the real time soil moisture and soil-water balance through probes, that allow to irrigate vineyards at the right time and with a reasonable amount of water. For example, winegrowers of the Venice biodistrict will exploit satellite images capable of detecting the water stress of plants in the next few years. On the other hand, the adoption of sustainable irrigation practices is certainly of great interest by growers of the other ECOVINEGOALS studied regions.

Water stress in the vineyard

Source: Damiano Zanotelli

For instance, the Administrative Department for Agriculture, Forestry, Hunting, Fisheries and Water Management of Istria County has planned to perform systematic research in several pilot vineyards in order to determine the parameters and dynamics of deficit irrigation, which will ensure reliable recommendations for sustainable grape production in different climatic situations. At the same time they are improving the distribution water supply network and promoting the introduction of precise irrigation systems in vineyards. Beside irrigation, vineyard could be improved adopting several agronomic practices aimed to increase the water holding capacity of the soil (increase soil organic matter), reduce soil evaporation (mulching), increase rainfall water harvesting (reduced slopes, use of cover crops), reduce canopy transpiration (proper canopy management, use of hedges as wind barriers, selection of appropriate varieties, rootstocks and training system).

As regards biotic stresses, decision support systems (DSS) represent good agroecological practices that can simplify agronomic management, in particular to reduce the use of pesticides. These diseases and pest forecasting models are based on monitoring interaction between pathogen and plant. In fact, there are some stringent conditions for the development of the disease, such as favourable pedoclimatic conditions, pathogen presence or plant phenological stage. The goal of these devices is to reduce the number of treatments and increase their effectiveness, through apps that can be used directly from smartphones in vineyards. Many farmers of the ECOVINEGOALS pilot areas are already using DSS, for example in the Venice biodistrict, Cembra Valley or in the Vipava Hills. Moreover, a determined implementation of these devices is expected for the next future. Farmers of the Venice biodistrict are intent on adopting a shared DSS to optimize the performance of phytosanitary treatments, gradually decreasing the amount of pesticides.

Sexual confusion in the vineyard

Source: www.champagne-forget-chemin.fr

Other threats that affect the grapevine production are the phytophagous insects, *Lobesia botrana* and *Eupoecilia ambiguella*. Their larvae feed on the grapevine flowers and fruit causing substantial yield losses. Mating disruption is an agroecological practice adopted to successfully defeat these harmful insects. This technique is based on use of sexual pheromones, reproduced artificially in the laboratory, that interfere with communication between individuals. Therefore, this disorientation prevents insect reproduction. Also in this case, the practice is spread only in the Venice biodistrict and Cembra Valley, but it has a high potential for further improvement in the other ECOVINEGOALS studied regions, because it represents an environmental sustainable solution for invasive pathogens common in all the areas.

Furthermore, Venice biodistrict is determined to set up a local monitoring network of the main phytophages of the vine, aiming to improve the knowledge of wine operators regarding the risks associated with the main phytophages of the vine. As reported, the threat varies according to species, eg: moths, leafhoppers or scale insects and their phenological stages. Therefore, it is fundamental to monitor their presence and communicate the best methods of intervention. Moreover, homogeneous vineyard areas will be detected to introduce a control on vine moths based on sexual confusion.

Wooden poles in the vineyard

Source: Vinarija Mašanović

Landscape is surely an important aspect to be considered in viticulture. The use of wooden poles is an agroecological practice environmentally sustainable that could improve natural landscape. Therefore, despite the coming of cement poles about thirty years ago, wooden poles are still widely used in all the ECOVINEGOALS pilot areas.

5.2 SUBSTITUTE ALTERNATIVE PRACTICES, THE HEALTH OF THE NATURAL RESOURCES

Some agroecological practices are so common in the studied territories vocated to wine production, that they are jointly considered as part of tradition and good vineyard management. This is the case of vineyard canopy management, a practice adopted to optimize yield, enhance fruit quality, reduce the risk of disease, and facilitate other vineyard operations. It includes many simple actions, such as shoot positioning, shoot thinning, hedging, leaf removal, and cluster thinning. The main goal is to improve the vine's microclimate in terms of sunlight exposition, temperature, humidity, air movement, canopy density and vigour. Nevertheless, the large diffusion of this practice does not require actions to promote its adoption.

Mulching could be considered an excellent agroecological solution that provide the dual function of limiting the growth of weeds and preserving soil moisture, therefore reducing the water demand. Furthermore, mulching with organic materials, rather than plastic films, could improve soil organic matter and recycling subproducts of other activities such as the sheep wool. Almost all of the farmers of the ECOVINEGOALS pilot areas applied some types of mulches for maintaining and improving soil conditions or otherwise are interested in implementing this practice. In this perspective, winegrowers of Vipava Hills will use composted grape wine winter pruning residues to improve soil fertility. Their goal is to exploit the characteristics of beneficial aerobic microorganisms through hot composting, in order to limit the growth of weeds and harmful organisms.

Futhermore, other innovative solutions for weeds control are emerging, even though they are not very widespread yet. "Pyro weeding" maintains a clean area around the plants applying instantaneous heat with burners while. Obviously, the dangerous flames make this technique less attractive for dry regions, such as Greece. In this cases, alternatives exists such as applying hot water vapor or highly pressurized water.

Green manure in the vineyard

Source: Damiano Zanotelli

On the other hand, even though green manure is an agroecological practice, just applied in almost all the ECOVINEGOALS pilot areas, many local action initiatives including the promotion of green manure. For instance, the Venice biodistrict is ready to launch a multi-year program to protect soil fertility, which provides for continuous analysis of soil parameters to determine the exact amount of available nutrients. For at least 6 years, vineyards will be monitored and the impact of annual sowing of green manure species and/or organic fertilizers on the well-being of the vines in general will be evaluated. Another example is represented by the project of the Institute of agriculture and forestry Nova Gorica that aims to maintain the soil fertility through short-term inter-row greening. The activity will consist of sowing different plants or a mixture of different plants in the inter-row space of the vineyard at different times of year, also in order to identify plants more adapted to the soil and natural conditions of Vipava Hills. In fact, a lot of plant families could be used as green manure to provide several ecosystem services, such as Legumes for nitrogen fixation and flowering, Gramineous for increasing carbon capture and storage, and Cruciferous for a biocontrol of soil pests, improve soil structure and flowering. The latter being further improved with the introduction of Boraginace (such as Phacelia) particularly appreciated by honey bees.

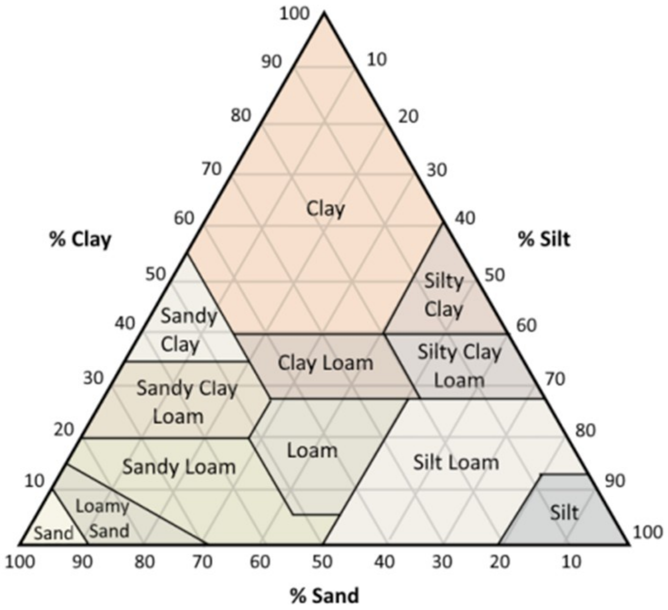
Soil analysis

Source: Damiano Zanotelli

The soil quality control is another fundamental practice to prevent degradation, contamination and loss of fertility. The availability of GIS databases is a necessary pre-condition for the development of a soil monitoring system. Using these databases with appropriate processing, it is possible to derive information on the risk of erosion, the content in organic matter, diffuse contamination, compaction, and salinization. For instance, the Institute of agriculture and forestry Nova Gorica is conducting a study to identify the characteristics of vineyard soil. The scope is to maintain healthy, fertile soils and favourable conditions for vine growth, in particular by managing the organic part of the soil. This includes constant soil sampling of the vineyards, analysis and expert interpretation of the results, including advice for farmers and follow-up action on soil care.

As regards soil, other important agroecological practices involved soil erosion prevention and the composting of grapevine winter pruning residues. Soil erosion is due to the movement of parts of the soil from one area to another caused by wind and water, limiting the grape production and the fertilizers efficiency. To reduce this phenomenon many methods are effective: planting crops, shrubs or trees that prevent soil erosion with their roots, positioning geotextile cloth, mats or grids and installing permanent, solid barriers that channel excess water around the vineyard. Instead, the winter pruning of the vines could be composted, spreading in the vineyard rows and finally shredded with appropriate machinery and integrated with the soil. Alternatively, grapevine pruning biomass can be chopped in a shredder and composted alone or in combination with other agricultural residues and the resulting compost can then be applied as organic fertilizer. For example, the Venice biodistrict is planning a study to enhance the organic substance contained in the by-products of viticultural-oenological activity, such as shoots, stalks, lees and pomace, through a composting process on a company scale, from which to obtain a more stable and safe organic matrix.

Soil texture triangle



Source: USDA

The presence of dry stone walls, characteristic of vineyards in the Cembra Valley, Crmnica, Istria County, Municipality of Archanes – Asterousia and of Platanias and Vipava Hills, surely improves the natural landscape. The maintenance of traditional elements of winescape plays a fundamental role for agroecology. Dry stone walls are traditional masonry works, which are built with materials found locally.

Dry stone wall in the vineyard

Source: Agenda 21 consulting srl (photo taken in Cembra Valley)

They can have multiple agroecological functions, such as hydro geological (slope stabilization, water flow regulation), agronomic (cultivation of steeply sloping land), ecological (proliferation of spontaneous flora and fauna) and historical-cultural (heritage of technical, material and natural characteristics of places, local identity). As regard the maintenance of traditional elements, the Government of Montenegro is elaborating a project that aims to preserve the traditional ambient arrangement and authenticity of the sub-region in the function of rural tourism development. The final goal of the project is to obtain the status of "Ambient units'' for various parts of Crmnica project area, that will enable restoration of old houses and other cultural-historical objects in the area in homogenous way that incorporates well with the landscape and habitat, including dry stone walls.

5.3 Redesign the agrosystem, from economic sustainability to social awareness

Among the agroecological practices, which aim for sustainable land use, agroforestry is definitely one of the more distinctive. It could be considered as an integrated crop that combines traditional agriculture with forest management, integrating perennial plants with herbaceous crops and farm animals. Agroforestry pretends to create a more efficient, productive and healthy land use system, characterized by biodiversity and environmental sustainability. Hedges are planted as natural barriers, trees and shrubs provide protection against soil degradation and erosion, and animals grazing in the vineyard remove weeds. This practice is just adopted, as traditional practice, by few winegrowers of the Cembra Valley, Crmnica, Topola Municipality and Vipava Hills. Unfortunately, also the local action plans conceived during the ECOVINEGOALS project rarely take into account this agroecological practice. Nevertheless, winemakers of the Venice biodistrict, in collaboration with the University of Padua, are developing an agroforestry system that integrates the cultivation of the vine with shrub or arboreal species. They aim to promote a rational and sustainable diversification of the agro-ecosystem both from an environmental and an economic point of view, also through the identification of shrub and tree plant species of commercial interest that do not involve health risks or unwanted competition for the vines.

Agroforestry system in the vineyard

Source: Angela Llop / Flickr (CC BY-SA 2.0)

Cover cropping is another agroecological practice strongly diffused among European winegrowers. Crops are planted between the rows of vines, in order to improve the management of the vineyard, reduce the herbicide usage and protect the soil from erosion maintaining its structure. Moreover, cover cropping has a beneficial effect on soil, increasing the organic substance and improving the water storage capacity. For these reasons, farmers could choose crop species more adapted to their needs. For example, the Administrative Department for Agriculture, Forestry, Hunting, Fisheries and Water Management of Istria County will support actions related to grassing the inter-row spacing as a measure for weed control, forms of green fertilization and increasing the overall biodiversity of wine-growing areas.

Conversely, the manual harvest, as well as the vineyard canopy management, is an agroecological practice applied by all the farmers of ECOVINEGOALS studied regions. Despite the higher costs in comparison with mechanical harvest, the manual harvest permits to select bunches and to obtain wines of higher quality. Therefore, this practice could be considered fundamental for the tradition and the good vineyards management.

To preserve the rural employment and the cultural heritage these wine-growing areas are also characterized by a high nature value (HNV) farmland, which defines regions where agricultural activities support and are associated with exceptionally high biodiversity. In contrast with intensive production these farmlands are aimed at preserving natural values and high quality agricultural production. The Development Agency ROD Ajdovščina of Slovenia is promoting an educational trail through the vineyard, in order to find out the diverse habitats that host many species of flora and fauna. The aim is to draw up a map of the paths along the vineyards and natural adjacent areas, which will be a major educational innovation and an incentive for discovering the biodiversity in and around the vineyard.

Cover cropping in the vineyard

Source: Agenda 21 consulting srl (photo taken at Foradori Winery)

Birds, bees and other beneficial insects are also crucial in order to improve vineyard biodiversity. For this reason, the placement of bird nests and shelter for bees and pollinating insects near vineyards represents an agroecological practice that is fairly widespread between winegrowers of the Venice biodistrict, Cembra Valley, Istria County and Vipava Hills. Furthermore, other farmers involved in the project are highly interested in adopting this practice. Venice Biodistrict is starting a project that involves the monitoring of pollinator insects as bioindicators for the ecosystem. Sentinel hives will be placed in the densely planted areas and periodically monitored for the presence and health status of pollutants and for the detection of pesticide residues.

Biotic agents, such as the fungus downy mildew (*Plasmopara viticola*) and powdery mildew (*Erysiphe necator*), pose a threat to the sustainable viticulture with serious economic consequences for producers. Therefore, there is a pressing need to understand the mechanisms of infection and the nature of tolerance in grapevines. Breeding grape varieties for resilience to these pathogens is an achievable strategy in alternative to multiple and repeated pesticide treatments. In the last 40 years many resistant grape varieties were obtained through cross breeding programs, conducted by research centres, universities or private companies.

Moreover, the introduction of molecular genetic tools, such as molecular markers, genetic mapping and genotype-phenotype association analysis, considerably improves breeding research. Therefore, winegrowers now have the possibilities of planting many different grape resistant varieties that require the application of much less pesticides.

Fungus downy mildew in the vineyard

Source: www.agric.wa.gov.au

Several action plans developed for ECOVINEGOALS pilot areas are based on resistant vines. For example, VeGAL, in collaboration with the universities of Padua and Udine, is promoting a technical support in the construction and management of vineyards with grapevine resistant varieties, in order to prevent possible unexpected consequences related to adversities other than downy mildew and powdery mildew. On the other hand, the Institute of agriculture and forestry Nova Gorica is carrying out a project to increase the share of resistant varieties. The main goals are to improve the sustainability of Slovenian viticulture and to protect the natural environment, thanks to a higher proportion of the area planted with resistant varieties which have a higher tolerance to diseases and require fewer pesticide treatments. Moreover, the Administrative Department for Agriculture, Forestry, Hunting, Fisheries and Water Management of Istria County is encouraging clonal selection projects of Istrian autochthonous varieties, as well the introduction and systematic testing of grape resistant varieties from modern breeding programs. Likewise, the universities of Montenegro and Donja Gorica are conducting an activity that aims to maintain autochthonous grapevine varieties and at the same time provide for a limited introduction of resistant varieties.

In 2010, the World Biodiversity Association (WBA) conceived the trademark "Biodiversity Friend" related to a certification standard, which evaluates the impact of agricultural activities on the environment, especially in terms of ecosystem quality and biodiversity loss. Only few winegrowers of Venice biodistrict join this standard, but some farmers of the other ECOVINEGOALS pilot areas are interested in this practice that could improve the touristic appeal of the area, protecting natural landscape and biodiversity. For instance, the local self-government of Topola Municipality is conceiving a promotional campaign on agroecological grape production, specifically focusing on its environmental and economic benefits. The main goal is to create awareness amongst grape and wine producers, local authorities and general population about agroecology and ways of its valorization, establishing Topola wine region as a leading agroecology region in Serbia also through the "Biodiversity Friend" certification and the institution of a biodistrict.

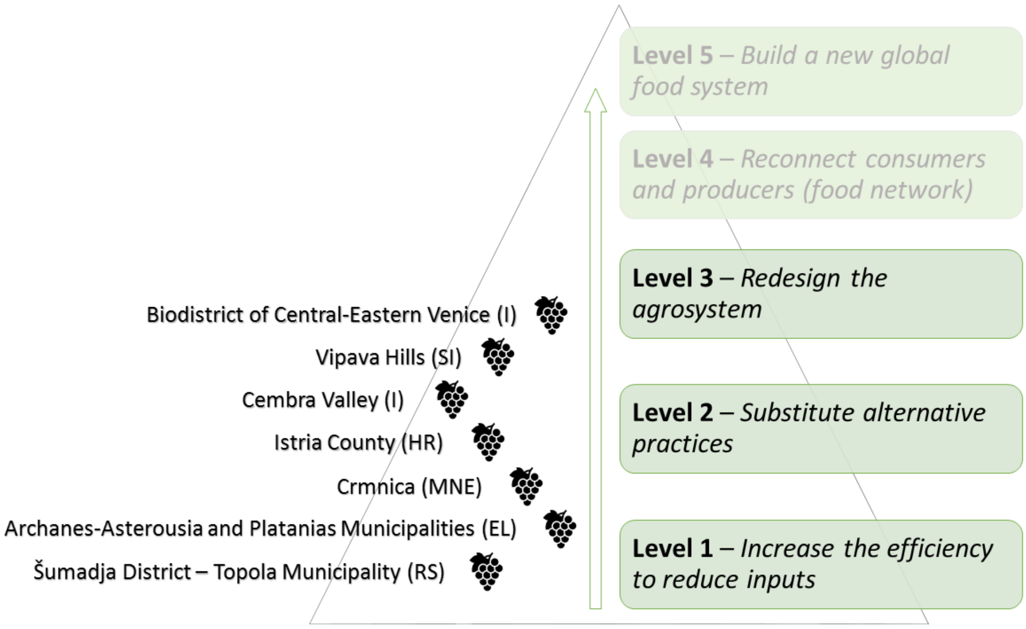
A dutiful citation must be made for the biodistrict. The biodistrict itself is indeed a good agroecological practice (included in the 29 identified by the project), but not strictly focused on the transition into the vineyard/agrosystem, as it is more linked to the good governance of the dynamics of one defined territory committed to sustainability in agricultural production. In fact, in addition to farmers (or farmers' associations), in many European countries regulations, such as the Italian one, to establish a biodistrict it is necessary to involve local administrations and other territorial policy management bodies too. Reaching the biodistrict status can represent an important step, even if not sufficient, for the scaling up from the agrosystem (level 3, if we look at Gliessman) to the food system (level 4). In this sense, therefore, it is right to mention it as a possible "umbrella good practice" that could help the development of other agroecological practices in the field/farm mentioned above, and by that contribute to improve the fundamentals of the Main Agroecological Structure (MAS) of each farm. In Ecovinegoals pilot areas (excluding the case of Veneto one, which is already a biodistrict), almost all the stakeholders involved express the will to establish a biodistrict in their territory. The real capacity of each community to reach that status has to be investigated, starting from the analysis of the national/local regulatory frameworks.

6 SEVEN PATH TO SCALE THE GLIESSMAN PYRAMID

Taking a cue and completing the analysis reported in the previous chapters, the information gathered from the various *Local Action Plans for the Agroecological Transition in the Vineyard* (agroecological Good Practices already implemented and practices not yet used that could be of interest to winegrowers) and the conditions of development of the agroecological foundations of farms (Main Agroecological Structure) have been synthesized for each Pilot Areas of the Ecovinegoals project.

In this way it was possible to identify an indicative position with respect to Gliessman 5 levels and to provide some initial indications and suggestions to amplify the level of commitment towards the agroecological transition in the vineyards.

Level of the Gliessman pyramid for the Pilot Areas of the Ecovinegoals project



Source: Agenda 21 consulting srl

As observed, the eight *agroecological transition laboratories* in the vineyard are located at different levels of the Gliessman pyramid. This result, as we have seen, depends on numerous factors, most of them exogenous to the will of the winemaker. First of all, the geographical and natural contexts where the agrosystems are located covers a wide range of playgrounds, passing from alpine valleys, to high mechanized alluvial plains, from hilly woodlands, to the perilacustrine areas, down to islands in the center of the Mediterranean basin. Even from the point of view of territorial policies and regulatory frameworks, there are many differences: being a winemaker inside or outside the European Union has a significant influence on agricultural practices, both in terms of resources and in terms of rules and terms of availability of technologies for the agroecological transition.

To these factors are added other aspects of diversity among the pilot areas of Ecovinegoals – including the wine production traditions, the reference markets and the length of the distribution chains, the extensions of the properties, the management of the farms, the cultural level of the winemakers, the presence of collective subjects to deal with, just to name a few some – which in fact do not allow identifying a single "path" to climb the pyramid.

Although it is true that there are some common critical issues – including ageing of the agricultural population; poor relations between farmers and civil society representatives; difficulties in finding agricultural labour; lack of knowledge and qualifications particularly in soil science and fertility management, lack of knowledge of autochthonous varieties – it is suggested to look at each laboratory as a reference pilot area for all those similar contexts present on our continent, even beyond the Adriatic-Ionian Region. Alpine viticultural agrosystems will be able to recognize themselves in the transition path identified by the Val di Cembra or in Vipava laboratories. Lowland areas with a high agricultural density and with a good level of mechanization should mirror their critical issues and potential in the path traced by the Bio-district of Central-Eastern Venice. Albanian, Macedonian or Bosnian winegrowers could find their fundamentals in the pilot areas of Topola and the Crmnica sub-region. A wine company from the Balearic Islands, the Aeolian Islands or Rhodes will find inspiration from what emerged from the two pilot areas located on the island of Crete. An area with potential viticulture that wants to relaunch itself beyond the difficulties of supplying water resources could look to the experience identified in Istria County.

Eight laboratories (the Ecovinegoals pilot areas, already described in the previous chapter), which, as we have said, can represent the starting point of seven "paths" to climb the different levels of Gliessman, focusing mainly on the first three levels, i.e. those relating to the agrosystem. The source from which the following considerations are drawn are the Local Action Plans edited by the partners of the Ecovinegoals project.

6.1 PATH 1: BIODISTRICT OF CENTRAL-ESTEARN VENICE - BIOVENEZIA (I)

Both for the degree of development of the MAS of each farm analysed, and for the quantity of good practices activated, in addition to the fact that a Biodistrict already exists as a guarantee of commitment to the sustainability of local agricultural production (not only wine), the pilot area is already in a phase of transition from the second to the third level in the agroecological transition process.

Nonetheless, some critical issues and some opportunities have stimulated a new commitment and set some goals, mainly focusing on soil fertility and decrease of harmful inputs in the agroecosystem.

6.2 PATH 2: VIPAVA HILLS (SI)

In the case of the Slovenian pilot area – the steep hills of the Vipava River Valley – the main concern is related to soil fertility and its potential impoverishment (and consequential erosion), in the meantime trying to reduce the usage of mineral fertilizer. Equally important is the will to maintain and, if possible, increase the degree of biodiversity present inside and outside agrosystems.

6.3 PATH 3: CEMBRA VALLEY (I)

The terraces sustaining the viticulture practiced in Val di Cembra, provide some intrinsic agroecological functions such as those regarding the regulation of the hydrological cycle (increase in water harvesting, reduction of soil rill erosion, drainage of excessive water), the increase in diversity of habitat and species, adding an additional aesthetic value to the landscape. If the fragmented properties reduce the possibility of applying internal connectors, a better management of the hedges could increase the connection between cultivated and natural land use. At the farm level, most of the soil is permanently covered by grasses and initiatives to foster the practice of green manure are ongoing to increase soil health and the provision of other related ecosystem services, as well as to reduce the use of synthetic fertilizers. Most vineyard are already equipped with a drip irrigation system, and a sensor-based detection of plant water status could help guiding irrigation more efficiently. The patchy nature of cultivated areas ensures a good level of complexity at the landscape level and the awareness about the functional role of non-productive areas should be increased also by local governance to move toward step 4 of agroecological transition.

6.4 PATH 4: ISTRIA COUNTY (HR)

The agroecological transition path identified in the Istrian laboratory passes through the overcoming of the water supply criticality of the agrosystems (and of the whole territorial context) and, also in this case, through the maintenance of the agroecosystem in good health, contrasting its erosion and loss of biodiversity. Added to this is the desire to focus on the diversification and recovery of authoctonous grape varieties, more resistant to stress caused by climatic changes.

6.5 Path 5: Crmnica Subregion (MNE)

If on the one hand the Montenegrin pilot area has a good level of naturalness, which guarantees a high level of biodiversity, thanks to the presence of a vast protected area (Lake Scutari National Park), on the other hand this same richness is in danger from the negative externalities of human activities (overbuilding and pollution). For this reason, the long-term goal is to create a management system for agriculture, and for viticulture in particular, that is more harmonious with the natural matrix of the territory and with the related environmental protection principles. This objective summarizes the activities related to the incorporation of environmental protection principles into viticulture and wine making industry.

Furthermore, it is focused on the comprehensive protection of natural resources, such as: prevention of soil degradation and desertification, prevention of water eutrophication and other means of pollution; prevention of risks related to the loss of biodiversity and genetic resources in viticulture; valorization of preserved landscapes throughout the development of certified organic agriculture; preservation of traditional and extensive, but effective and sustainable production technologies etc.

6.6 Path 6: Municipality of Archanes-Asterousia and the Municipality of Platanias (EL)

Looking at the two Greek laboratories, the first action to be implemented, according to what has been identified in the local action plans, is to involve all the stakeholders, and therefore not only the winegrowers, in the process of a sustainable renewal of the wine sector. The practices to be put in place first of all form part of the actions to contrast the loss of biodiversity of the agrosystem (valorizing the existing but threatened ecosystem services), the phenomena of erosion and desertification and therefore to support soil fertility (through the usage of bio-stimulants for example). In particular, therefore, the aim is to make the use of resources, above all water, more efficient and sustainable. Secondly, it becomes essential to enhance the authoctonous and resistant varieties, also to increase the added value produced by the production chain and make the business of sustainable viticulture more attractive. By that is possible, in a long-term perspective, to approach other agroecological good practices and speed up the transition process.

6.7 Path 7: Topola Municipality (RS)

Of all the “paths” identified, the one that the wine-growing area of the Municipality of Topola, in Central Serbia, intends to take, seems to be the one that starts from the furthest away. Before implementing any good practice in the agrosystem, it is necessary to create the knowledge base among winegrowers, who can thus consider the option of agroecology as a new development paradigm for their business. Therefore, the first priority objective is to create awareness amongst grape and wine producers, local authorities and general population about agroecology, its benefits and ways of its valorisation, with an overall purpose of establishing Topola wine region as a leading agroecology region in Serbia. The level of awareness on agroecology is still very low, especially in the context of joint effort and creation of products with added value. Topola region, as one of the most well-known grape growing and wine making areas has a great potential to be the first one in the country to promote this approach, especially having in mind that many of agroecology practices identified by the project are embedded into the traditional grape and wine production.

7 CONCLUSION: AMPLIFYING AGROECOLOGICAL TRANSITION

The reflections and the practices presented in the previous pages suggest some considerations on making viable, at large scale, the agroecological transition. Agroecology, as integrated combination of empirical science, real practices on the field and social movement, has developed a pragmatic of transition in five steps to review existing achievements and to design and implement new proposals (Gliessman, 2016[20]).

The multitudes of agroecological experiences in many part of the world, despite specificity, suggest some interesting approaches in weaving the change, also in viticulture (Giraldo, 2022[21], Aoudai et al., 2021[22], Romero et al., 2022[23]). These multitudes, built from below (as the cases presented in this work), can be activated starting from four possible entry points: responsible governance, co-creation of knowledge, circular and solidarity economy, promotion of diversity (Wezel et al., 2020[24]; HLPE, 2019[25]). If from a didactic point of view, the separation of the entry points can be easy, in the real word the combination of elements is more the rule than exception.

Responsible governance is a fundamental entry point. For agroecological transition territory matters, the practices are place based and a multiscale approach, from field to landscape, is necessary to reconstruct the alliance between ecosystems and social needs. Agroecological practices, levels of transition and geographical scale require a combined design and management, coordinated by multilevel governance. At field scale it is possible just to reach level one or two of transition (efficiency or substitution) by managing tillage, fertilization and irrigation. However real agroecological transition starts at level three (redesign) at two scale: the cropping system and the landscape. In the first case the management focus on the choice of crops, the spatial and temporal distribution of crops and the management of weed, pest and disease. At landscape level the management deal with the interactions among farms and landscapes between the biodiversity created and managed in the farm and the biodiversity of a region (Landis, 2017[26]). Responsible governance is required to facilitate connections between farmers and citizens (level four of transition), to promote participatory guarantee systems, community supporting agriculture, peasant markets, and for deepen changes in food systems starting from land tenure and achieving rights to food and healthy environment.

Co-creation of knowledge, an agroecological combined approach of principles and practices can be facilitated by promoting and diffusing the agroecological lighthouse farms (McGreevy et Al, 2021[27]). Discovering and visiting lighthouses is an interesting participatory multi-actor process to amplify the spreading of agroecological principles and practices. Sharing the lighthouse experiences can support farmer movements and facilitate scaling-out of agroecological transition, as horizontal process from farmer to farmer, to amplify agroecology in a geographical area.

Another contribution on knowledge co-creation and sharing can arrive from an appropriate technological transfer into the agroecological production system (Fuentes e Gago, 2022[28]). Drones (Pappalardo, Andrade, 2022[29]), multispectral and hyperspectral imageries, GIS and web GIS, light positioning systems, are easily

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20 *Gliessman S. R. (2016) - Transforming food systems with agroecology.*

21 *Giraldo O.F. (2022). Multitudes Agroecológicas.*

22 *Aouadi N., Macary F., Delière L., Roby J.-P (2021) - New Scenarios for a Shift towards Agroecology in Viticulture.*

23 *Romero P., Navarro J.M., Ordaz P.B. (2022) - Towards a sustainable viticulture: The combination of deficit irrigation strategies and agroecological practices in Mediterranean vineyards.*

24 *Wezel A., Gemmill Herren B., Bezner Kerr R., Barrios E., Rodrigues Gonçalves A.L, Sinclair F. (2020) - Agroecological principles and elements and their implications for transitioning to sustainable food systems.*

25 *HLPE (2019) - Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition.*

26 *Landis D.A. (2017) -Designing agricultural landscapes for biodiversity-based ecosystem services.*

27 *McGreevy S.R., Tamura N., Kobayashi M., Zollet S., Hitaka K., Nicholls CI., Altieri M.A. (2021) - Amplifying Agroecological Farmer Lighthouses in Contested Territories: Navigating Historical Conditions and Forming New Clusters in Japan.*

28 *Fuentes S., Gago J. (2022) - Modern approaches to precision and digital viticulture, Improving Sustainable Viticulture and Winemaking Practices.*

29 *Pappalardo S. E., Andrade D. (2022) - Drones for Good: UAS Applications in Agroecology and Organic Farming.*

available and low costs and cannot be remain trapped into the paradigms of precision farming or smart sustainable agriculture (De Marchi et al., 2022[30]; Altieri et Al., 2022[31]).

Amplification of agroecology is a process of implementing new practices from farm to communities and regions. Amplification results from a combination of many processes as: social interactions, technology sharing, knowledge co-creation, activation of networks among people and communities. But amplification require the creation of polices and markets supporting agroecology (McGreevy et Al, 2021) and promoting the scaling up to reach the highest institutional levels. Circular and solidarity economy in agroecology ask for reshaping markets into a framework of ecological economics, in which nature is not an externality.

Diversity is a key word in agroecology from social to ecological diversity. Diversity deals also with the use of a wise menu of practice at multiscale level to manage transition from actual farming systems to new agroecological landscapes (Wezel, 2017[32]). Some practice can easily be introduced now and represent a stepping stone for the future as, for example, alternative fertilization, biological pest control, irrigation, reduced tillage. Landscape integration and management, agroforestry, instead, require more attitudes to change, deep analysis of institutional context and actor alliances. These practices cannot be postponed, but rely on a combination of a multiplicity of interactions among policy makers, farmers, citizens, researchers.

Agroecology represents a way of dealing with three challenges of our times: food insecurity, climate change and biodiversity collapse; as stated at Nieleny (2015[33]) "*agroecology nourishes the earth, cultivates biodiversity and cools the planet*".

United Nations declared the period 2021-2030 the decade for ecosystem restoration. The Kunming-Montreal Global biodiversity framework approved in Montreal (18/12/2022) during the last day of the Conference of parties on Convention on Biological Diversity (COP15), adopt ambitious and challenging targets: restore 30% of degraded land and sea ecosystems by 2030; increase protected areas to 30% by 2030; manage climate adaptation with nature based solutions; green urban spaces.

For all this ventures agroecology is equipped to amplify the transition toward the nature matrix (Perfecto et Al. 2009[34]), combining biodiversity conservation, healthy agroecosystems and food sovereignty.

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30 *De Marchi M., Diantini A., Pappalardo S. E. (2022) - Drones and Geographical Information Technologies in Agroecology and Organic Farming; Contributions to Technological Sovereignty.*

31 *Altieri M. A, Diantini A., Pappalardo S.E, De Marchi M. (2022) - Agroecological Transitions in the Era of Pandemics: Combining Local Knowledge and the Appropriation of New Technologies.*

32 *Wezel A. (2017) - Agroecological Practices for Sustainable Agriculture. Principles, Applications, and Making the Transition.*

33 *Declaration of the International Forum for Agroecology, Nyéléni, Mali: 27 February 2015.*

34 *Perfecto I., Vandermeer J. H., Wright A. L. (2009) – Nature's matrix: linking agriculture, conservation and food sovereignty.*

8 References

- Altieri M.A. (1995) - Agroecology: the science of sustainable agriculture.
- Altieri M. A, Diantini A., Pappalardo S.E, De Marchi M. (2022) - Agroecological Transitions in the Era of Pandemics: Combining Local Knowledge and the Appropriation of New Technologies.
- Aouadi N., Macary F., Delière L., Roby J.-P (2021) - New Scenarios for a Shift towards Agroecology in Viticulture.
- Cataldo E., Fucile M., Mattii G.B. (2022) - Biostimulants in Viticulture: A Sustainable Approach against Biotic and Abiotic Stresses.
- CIDSE (2018) - The principles of agroecology. Towards just, resilient and sustainable food systems. https://www.cidse.org/publications/just-food/food-and-climate/the-principles-of-agroecology.html
- De Marchi M., Diantini A., Pappalardo S. E. (2022) - Drones and Geographical Information Technologies in Agroecology and Organic Farming; Contributions to Technological Sovereignty.
- Declaration of the International Forum for Agroecology, Nyéléni, Mali: 27 February 2015.
- FAO (2018) - The 10 Elements of agroecology: guiding the transition to sustainable food and agricultural systems.
- Fuentes S., Gago J. (2022) - Modern approaches to precision and digital viticulture, Improving Sustainable Viticulture and Winemaking Practices.
- Giraldo O.F. (2022). Multitudes Agroecológicas.
- Gliessman S.R. (2007) - Agroecology: the ecology of sustainable food systems.
- Gliessman S. R. (2016) - Transforming food systems with agroecology.
- HLPE (2019) - Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition.
- https://agriculture.ec.europa.eu/common-agricultural-policy_en
- https://agriculture.ec.europa.eu/international/international-cooperation/enlargement/pre-accession-assistance/overview_it
- https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
- https://www.rcc.int/greenagenda
- Landis D.A. (2017) -Designing agricultural landscapes for biodiversity-based ecosystem services.
- León-Sicard TE, Toro Calderón J, Martínez-Bernal LF, Cleves-Leguízamo JA (2018) - The Main Agroecological Structure (MAS) of the Agroecosystems: Concept, Methodology and Applications. https://doi.org/10.3390/su10093131
- List of potential agricultural practices that eco-schemes could support (https://agriculture.ec.europa.eu/system/files/2021-01/factsheet-agri-practices-under-ecoscheme_en_0.pdf)
- McGreevy S.R., Tamura N., Kobayashi M., Zollet S., Hitaka K., Nicholls CI., Altieri M.A. (2021) - Amplifying Agroecological Farmer Lighthouses in Contested Territories: Navigating Historical Conditions and Forming New Clusters in Japan.

- Nicholls C., Altieri M.A., Vazquez L. (2016) - Agroecology: principles for the conversion and redesign of farming systems.
- Pappalardo S. E., Andrade D. (2022) - Drones for Good: UAS Applications in Agroecology and Organic Farming.
- Perfecto I., Vandermeer J. H., Wright A. L. (2009) – Nature's matrix: linking agriculture, conservation and food sovereignty.
- Romero P., Navarro J.M., Ordaz P.B. (2022) - Towards a sustainable viticulture: The combination of deficit irrigation strategies and agroecological practices in Mediterranean vineyards.
- Wezel A., Bellon S., Dore T., Francis C., Vallod D., David C. (2009) - Agroecology as a science, a movement and a practice. A review.
- Wezel A., Casagrande M., Celette F. et al. (2014) - Agroecological practices for sustainable agriculture. A review. (https://doi.org/10.1007/s13593-013-0180-7)
- Wezel A. (2017) - Agroecological Practices for Sustainable Agriculture. Principles, Applications, and Making the Transition.
- Wezel A., Gemmill Herren B., Bezner Kerr R., Barrios E., Rodrigues Gonçalves A.L, Sinclair F. (2020) - Agroecological principles and elements and their implications for transitioning to sustainable food systems.