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THE LIVING AGROECOLOGICAL LABORATORIES IN ROMANIA. CASE STUDY - ECOLOGICAL VINEYARD FROM SCDVV MURFATLAR

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STATIUNEA DE CERCETARE-DEZVOLTARE PENTRU VITICULTURA SI VINIFICATIE
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Abstract: *Within the Era-NET Core Organic - ALL project (Agroecology Living Labs to promote robust and resilient Organic production systems) in the period 2021-2022 in Murfatlar, an innovative system of ecological cultivation of grapevines was experimented, aiming to by increasing the biodiversity of the viticultural ecosystem to improve environmental, economic and social factors. The degree of health of the plants was monitored, carrying out phytosanitary treatments only upon warning. In this way, the frequency of treatments was reduced by up to 40%. With the help of the DEXiPM multifactorial model that allows the evaluation of the sustainability of the culture system according to several objectives, they were comparatively evaluated. the innovative system of increasing biodiversity compared to the classic one, in the ecological vineyard from Murfatlar. All three pillars of sustainability: economic, social and environmental were improved when using the innovative system. We mention in particular, the increase in farmers' "job satisfaction" (from medium to high) despite the increased "operational difficulties" of the proposed techniques. The environmental impact of intercropping on wine plantations is a variable factor that strictly depends on the climate and the area where the wine crops are located. It should not be overlooked that intercropping can compete for resources with vines, both for water and nutrient uptake. From an economic point of view, the "real profitability" of the system is increased from low to medium, while the "viability" of the system is not changed by the introduced innovation.*

Keywords: *viticulture, sustainability, environmental, economic, social impact.*

JEL classification: Q01, Q16, Q57

INTRODUCTION

The concept of ALL - "Agroecological Living Labs" (living agroecological laboratories) is materialized through an initiative recently launched by the European Commission with the aim of accelerating the transition from conventional agricultural systems to sustainable ones, with the help of research in the field (https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en). In this way, the premises are created for the realization of candidate European partnerships in the field of food, bioeconomy, natural resources, agriculture and the environment within the Horizon Europe program (<https://ec.europa.eu/eip/agriculture/en>).

The application of the concept of agroecological system in farms can support the transfer towards resilient agricultural systems, more closely related to the environment and society, which can provide sufficient, safe, nutritious and accessible food, also rewarding the efforts of farmers (https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe/food-bioeconomy-natural-resources-agriculture-and-environment_en).

Through such partnerships, a network of living laboratories and research infrastructures can be created and supported that will accelerate the transition to organic farming in Europe by providing innovative technologies, techniques and products applicable on plots for long-term experimentation or demonstration, specific to the area, involving as many interested parties as possible, including

farmers, the academic and administrative environment, input suppliers, etc. Their priority is to provide validated solutions that support farmers in understanding and implementing agroecological practices to obtain a positive economic, environmental and social impact (<https://op.europa.eu/en/publication-detail/-/publication/edace3e3-e189-11e8-b690-01aa75ed71a1/language-en/format-PDF/source-200108204>).

Agroecological partnerships can be a powerful tool for addressing climate, biodiversity, environmental, economic and social challenges facing the world. The potential of agroecology to reduce the use of pesticides, fertilizers and antimicrobials should be emphasized. Last but not least, agroecology is one of the types of agricultural practices that the future common agricultural policy in Europe could support financially through the so-called eco-schemes (<https://enoll.org/>).

One of the functions of living labs is to accelerate innovation and the adoption of sustainable practices by engaging farmers and other stakeholders in the joint development of solutions to problems they face in their locality or region, taking into account the specifics of agricultural systems and their environment.

Experiments must be coupled with research efforts to increase understanding of the long-term evolution of ecosystems and the effects of adopted agroecological practices (<https://enoll.org/network/living-labs/>).

In this context, in the coordination of ARAD - the Romanian Association for Sustainable Agriculture, through the ERA-Net ALL-Organic project with the title: Agroecological laboratories for the promotion of robust and resistant organic production systems, at the Research-Development Station for Viticulture and Vinification Murfatlar was established a demonstrative plot cultivated in an ecological system where new methods of increasing the biodiversity of vineyards were applied, with the aim of better controlling the evolution of diseases and pests and improving the impact of this method on the economic and social environment.

MATERIALS AND METHODS

In an experimental plot planted with the Fetească neagra variety cultivated in an organic system, in the period 2021-2022 two experimental variants were configured, one innovative, using mixtures of plants that formed a vegetal carpet (mix of *Lolium perenne* 50%, *Onobrychis viciifolia* 25%, *Trifolium repens* 25% - semi-permanent, mowed and mulched after flowering), (fig. 1) and another, as a control, with cultivated land - black field. Observations and determinations were made on the health status of the plants and upon these data cumulated with climatic ones was applied the phytosanitary treatments.

The TFI (treatments frequency indice) was calculated for both variantes (TFI reflects the number of applications at full recommended dose), (Gravensen, 2003).

The DEXiPM multifactorial model (Pelzer et al., 2012) was used to assess the environmental, economic and social impact*, which is a hierarchical and qualitative model with several attributes (or criteria) that allow the evaluation of the sustainability of the culture system according to several objectives, sometimes contradictory.



Figure 1: Innovative variant - intercropping

DEXiPM was implemented within the DEXi decision support system to design the culture system, directing it towards sustainability (Alaphilippe et al., 2013). At the same time, its use allows the evaluation of the level of sustainability of innovative systems (Caffi et al., 2017). In short, overall sustainability is broken down into smaller, less complex problems characterized by attributes (or criteria) that are hierarchically organized in decision tree. of data recording, measurements and statistical models, all described clear and synthetic.

* DEXiP model was used with the support of Dr. Tito Caffy from the Università Cattolica Sacro Cuore, Piacenza, Italy

In DEXi, attributes are characterized by their name, a description, and a scale, i.e. possible qualitative values for the attribute (discrete values described in words rather than numbers, e.g. "low, medium, high"). Even though the scales are qualitative, some may be based on quantitative values (eg yield).

The DEXiPM decision tree can be used as a "dashboard": all aggregated criteria are independent indicators, compared to a reference scenario. The analysis of these criteria values provides explanations regarding the final result and performances of the evaluated systems.

RESULTS AND DISSCUSION

The implementation of sustainable viticultural systems balances the ratio between reducing the application of treatments (Table 1) and increasing environmental resources, which leads to increased yield and fruit quality. The application of an innovative system by planting intercrops in grapevine plantations grown in an ecological system, contributes to reducing the number of phytosanitary treatments, suppresses the development of weeds and creates favorable conditions for the development of arbuscular mycorrhizae. At the same time, intercropping can compete for resources with grapevines, both in terms of water and nutrient use (Rossi et al., 2013). To limit this effect, it is recommended that, after flowering, mowing and mulching or incorporation into the soil are carried out.

Table 1. Treatment frequency index (TFI) applied in ecological culture versus innovative ecological culture (SCDVV Murfatlar)

YEAR	2021		2022	
SYSTEM	Organic	Inovative organic	Organic	Inovative organic
TFI	9	5.5	7	4
No. of treatments	9	7	7	6

The economic-social impact - the use of intercropping in a vineyard depends on several factors. Winegrowers must balance the direct benefits of applying this method of organic cultivation (maintaining yields), the indirect benefits (reducing the costs of maintaining the vineyard) and external factors such as social and environmental protection.

From an economic point of view, intercropping comes with both direct and indirect costs. Direct ones include the method of sowing and crop maintenance, indirect ones involve the cost of seeds. The procurement of seeds generates significant acquisition costs, the price of which varies according to the species and can change in the long term through changes in supply and demand. Although the benefits of intercropping are beneficial in terms of soil organic matter, nitrogen fixation and erosion control, the cost of seed can be an impediment.

Intercropping requires special equipment that is not usually found on a vineyard. If the planting areas are reduced, the use of labor at the expense of the purchase of machinery can represent a cost-reducing factor. The use of fertilizers can generate additional costs. Although it is not necessary to apply them to all intercrops, the addition of fertilizers can increase the yield and production of these crops and implicitly, their ability to suppress weeds (Sainju et al., 2018).

In most cases, intercrops remain unharvested due to the benefits brought to the soil by the decomposition of their biomass. Inadequate management can lead to an uncontrolled growth of intercrops that can compete with the vines. Although the application of herbicides is a solution, the costs of this practice generate negative economic and social effects on the producer.

So, the economic and social impact depends equally on the winegrowers, through managerial decisions, the selected species or plantation maintenance methods, and on external factors such as soil type, climate, etc. (Pannell, 1999).

The environmental impact of intercropping on wine plantations is a variable factor that strictly depends on the climate and the area where the wine crops are located. Monitoring soil properties and the quality of the finished product can provide the necessary data in the selection of plant species capable of providing sustainable ecosystem services in a plantation (Gattullo et al., 2020).

By applying the innovative system of increasing biodiversity in organic vineyards, all three pillars of sustainability: economic, social and environmental have been improved (Figure 2). We mention in particular, the increase in farmers' "job satisfaction" (from medium to high) despite the increased "operational difficulties" of the proposed techniques (Figure 3). From an economic point of view, the "real profitability" of the system is increased from low to medium, while the "viability" of the system is not changed by the innovations introduced for vineyard management (Figure 4). In the environmental pillar of sustainability there is the greatest improvement of the innovative viticultural system: it increases by two points in both environmental quality and "aerial biodiversity" (above ground), confirming that the innovative approach has a positive impact on the environment (Figure 5).

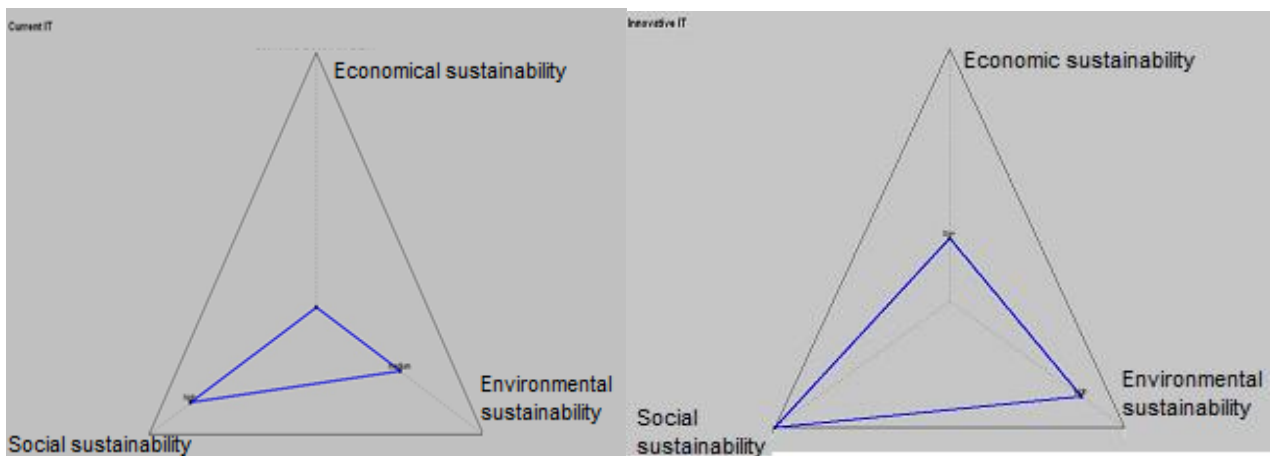


Figure 2: Indicators of economic, social and environmental sustainability provided by post-ante analysis in current (left) and innovative (right) Murfatlar ecological vineyards.

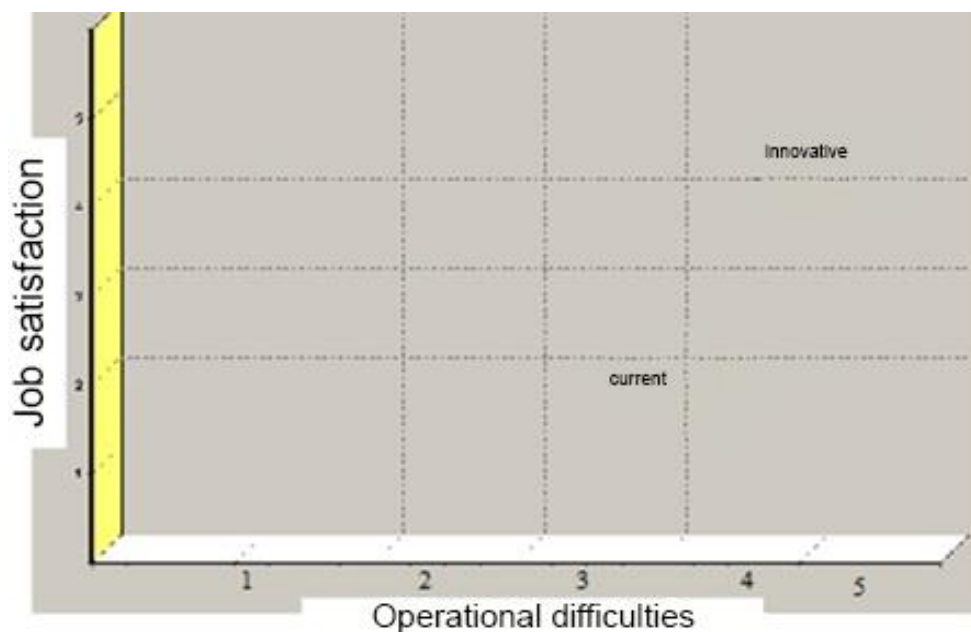


Figure 3: Social sustainability indicators for farmer "job satisfaction" and for "operational difficulties" of the innovative viticultural system, for Murfatlar ecological vineyards, provided by the ex-post evaluation

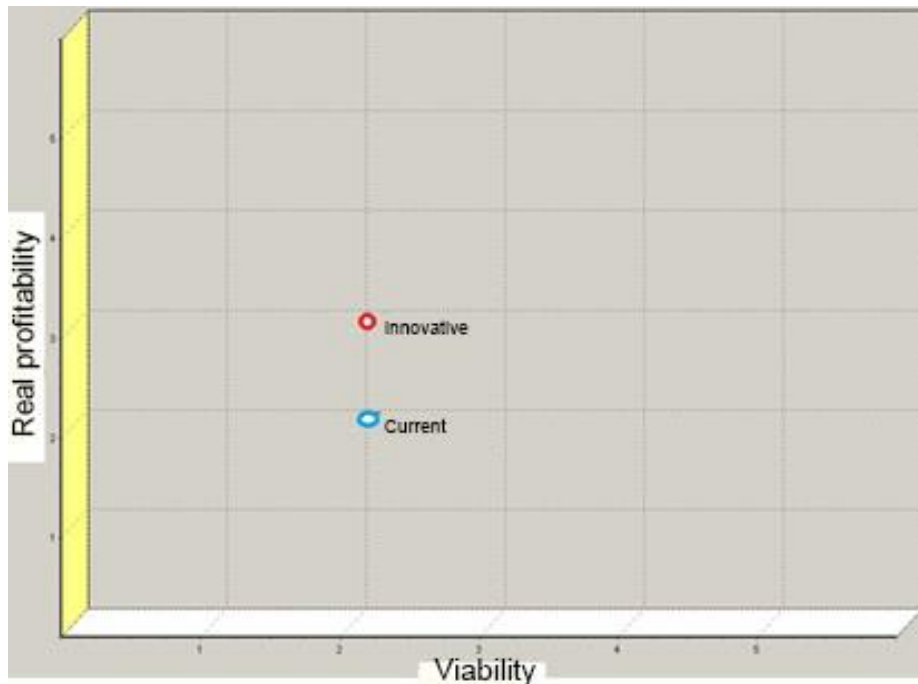


Figure 4: Indicators of economic sustainability of the "real profitability" and "viability" of the innovative viticultural system for Murfatlar ecological vineyards, provided by the ex-post evaluation.

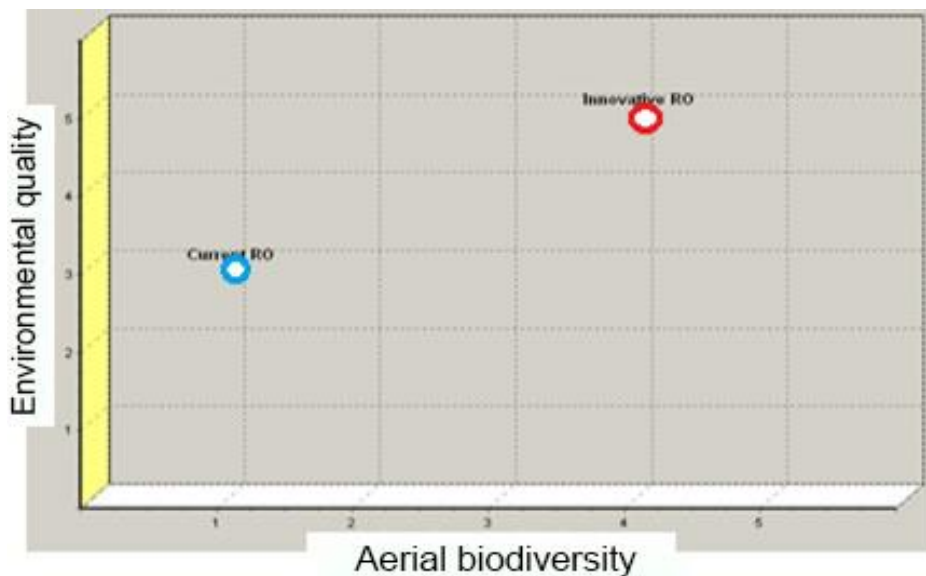


Figure 5: Sustainability indicators regarding "environmental quality" and "aerial biodiversity" (above ground) of the innovative viticultural system for Murfatlar ecological vineyards, provided by the ex-post evaluation

CONCLUSIONS

The study to determine the economic-social and environmental impact of the application of the innovative system of ecological cultivation of the vine that exploits the biodiversity of plants, reveals the need to know and respect the specificity of the viticultural ecosystem where this system is applied. Several key points were identified in the implementation of the innovative system adapted

to the zonal scale. These key points can provide guidance for evaluating an existing method or designing a new method for regional environmental impact assessment of viticulture.

The key points that depend on the scale of implementation and apply both at the farm scale and at the wine region scale are:

- The inclusion of economic and social objectives in the management of the farm that can balance the environmental value of the new innovative system;
- The time period used to analyze the environmental impact must be a compromise between the precision of the analysis and the practicability of the innovative system;
- From a spatial point of view, the knowledge of the application area must be sufficiently precise to allow a weighting of the effects according to the vulnerability of the environment;
- The implementation of sustainable viticultural systems balances the discrepancy between reducing the application of treatments and increasing yields;
- Applying an innovative system by planting intercrops can increase the amount of organic matter in the soil, reduce nutrient loss, prevent water runoff, limit the erosion process, suppress weed development, improve soil permeability;
- At the same time, intercropping can compete for resources with vines, both in terms of water use and nutrient uptake, so different methods of intercropping are used to prevent this process.
- The environmental impact of intercropping on wine plantations is a variable factor that strictly depends on the climate and the area where the wine crops are located.

By applying the innovative system of increasing biodiversity in organic vineyards, all three pillars of sustainability: economic, social and environmental have been improved. We note in particular the increase in farmers' "job satisfaction" (from medium to high) despite the increased "operational difficulties" of the proposed techniques. From an economic point of view, the "real profitability" of the system is increased from low to medium, while the "viability" of the system is not changed by the innovations introduced for vineyard management.

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