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Title

Has winegrowing monoculture come to an end?
 SECBIVIT - Why ecological intensification is the key to a successful and sustainable wine production

I want to submit an abstract for:

Conference Presentation

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Keywords

ecological intensification strategy, European viticulture, sustainability, ecosystem services, system dynamic model, stakeholder involvement

Research Question

How do cultivation measures affect biodiversity in vineyards? Can certain ecosystem services and their combination lead to decreasing negative external impacts? What are relevant drivers of management decisions in viticulture?

Methods

system dynamic model - comprehension of mutual causation, multi actor approach, analyzation of ecosystem services and their combination across spatiotemporal scales, qualitative evaluation of narrative interviews with stakeholders, Europe-wide comparison

Results

Europe-wide awareness of biodiversity in viticulture, intensification and thereby high pesticide use is the main issue, landscape elements can increase biodiversity most effectively, no policy solution for all regions

Abstract

Has winegrowing monoculture come to an end?
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Viticulture is one of the most important sectors in the European Union. As wine is the main export good in the European food sector, high revenues and job creation are generated. Viticulture plays a major role for a country's landscape, image and tradition. On the downside, due to specialization and intensification and in their conjunction with climate change, vines become more susceptible to pests and diseases (Micheloni, 2017). As a result vineyards are treated with really high amounts of pesticides compared to other agricultural farmland (Urruty et al., 2016) in order to sustain yields and especially the required quality. Crop failures, decreasing quality of grapes and higher pesticide use can cause serious cost issues for winegrowers. Moreover, these high amounts of agro-chemicals have a severe impact on the environment and human health, such as degradation of soil, soil erosion or contamination of groundwater (Micheloni, 2017; Winter et al., 2018). In order to reduce these external effects to meet the UN Sustainable Development Goals (UN, 2018), it is important to deploy an ecological intensification strategy. This is the only way to find a balance between productivity and biodiversity in viticulture. Within such a strategy external effects will be minimized by providing ecological functions instead. Ecosystem services (ES) promote synergies within a multifunctional agro-ecosystem and generate trade-offs between biodiversity and productivity (Bommarco et al., 2013). Provided biodiversity is urgently needed especially in viticulture, where grapevines are cultivated as a monoculture since crop rotation is made only every 20 years. As part of SEC-BIVIT we investigate the impacts of intensive cultivation on biodiversity in vineyards. Ecological intensification in vineyards can be implemented practically by low tillage frequencies in inter-rows (Winter et al., 2018), low pest management, adapted crop management in inter-rows (Kratschmer et al., 2018; Guzmán et al., 2019) and by conservation of semi-natural landscape elements (Eichhorn et al., 2006). Besides different management measures also other external effects such as climate change and market globalization have an impact on different ES in the production process. In some European regions vines have to deal with drought, erosion and/or new species and diseases (Hannah et al., 2013) like the alien species *Drosophila suzukii* that was exported from Asia to European countries. Due to global warming this novel species finally crossed the Alps in 2011 (Cini et al. 2012) and got to Germany where it caused serious crop failures especially in 2014 (Köppler, 2015; Aspen et al., 2015). *Drosophila suzukii* prefers humid and shady condition so that grapevines create a perfect habitat for this pest. So do hedgerows which are either naturally provided or planted by winegrowers in vineyards. As a result, many German winegrowers tend to remove these hedgerows in order to prevent further infestations in the future. This pattern has a serious effect on biodiversity because these hedgerows are an important habitat for beneficial animals which can provide ES (Landis et al., 2000; Holland et al., 2016).

As one example, crop mixtures are an effective way to provide biodiversity in adaptation to local factors. Extensive inter-row vegetation cover show positive responses to soil loss parameters, pest control, carbon sequestration and soil fertility (Winter et al., 2018). On the downside, crop mixtures can cause competition for water and nutrients between cover crops and vines and thereby impact the grapes' quality (Gómez, 2017). But it is important to consider that cover crops in general can also have a positive effect on soil biota and belowground ES such as nutrient cycle and soil stability. In addition, Benitez et al. (2017) showed that soil diversity can manipulate aboveground biocontrol as well.

This shows that links between management measures and biodiversity are multidimensional and very complex. There are still knowledge gaps about the way certain cultivation management measures affect biodiversity and thereby ES in viticulture (Bommarco et al., 2013). In order to fill these gaps we are going to get a better understanding of synergies and trade-offs of ES within a multifunctional agricultural system. We will design a system dynamic model to simulate dynamic economics, social and environmental impacts on different future scenarios by employing negative and positive feedback loops. As a result these problems and links of mutual causation become more comprehensible (Zulkepli et al., 2012). To develop this model, a multi actor approach is applied within our project. We were already cooperating closely and in an inter- and multidisciplinary way with ecologist, scientists and other different stakeholders to identify the most relevant drivers of management decisions in European viticulture. Moreover, we are going to analyze ES and their combination across spatiotemporal scales. We performed the stakeholder-interviews by doing narrative interviews (Lang, 2010) with different employees of agencies and of environmental organizations, scientists and winegrowers either by phone or in person in every case-study region. The sample size was 51 respondents between the age of 21 - 75 years, thereof nine interviewees in Austria, eleven in France, 15 in Germany, six in Romania and eleven in Spain. We asked these stakeholders to give us their opinion and perceptions firstly about issues in viticulture in general. Secondly we requested their evaluation from a scale from 1 - 5 about how important they see biodiversity in vineyards and thirdly about how different cultivation measures, such as mulching and tillage frequency, pest management, crop

mixtures and landscape elements, affect biodiversity. At the end they had to rank these measures concerning their effectiveness to increase biodiversity in vineyards. The qualitatively evaluated results of our research are presented in the following table (Lang, 2010).

Table 1: Ranking of the survey results – stakeholder interviews

According to these interviews, biodiversity in vineyards is seen as (totally) important by the majority of the stakeholders in every participating country. Only two persons, one in Germany and one in Spain, think that biodiversity in vineyards is (totally) unimportant. In conclusion, stakeholders are aware about the importance of biodiversity in viticulture across Europe.

As can be seen in Table 1, In Austria, the main issues in viticulture are the effects of climate change, in particular the novel pest *Drosophila suzukii*, and high pesticide use. In order to increase biodiversity, these stakeholders think that crop mixtures are the most efficient way therefore. According to French stakeholders pesticide usage is one of the main issues, too. Furthermore, decreasing biodiversity in vineyards is seen as problematic, which can be increased most efficiently by landscape elements.

In Germany, stakeholders agree as well that pesticide use is problematic and it is seen as a result of increased intensification in viticulture. They mentioned landscape elements and crop mixtures as the best way to increase biodiversity.

Conversely, Romanian viticulture is hardly confronted with labor shortage and control of pests and diseases. To increase biodiversity low pest management is seen as the most efficient way according to Romanian stakeholders. Spain is the only country where stakeholders mentioned that they have to handle low prices for grapes. They also alluded to decreasing biodiversity as a main issue. In order to prevent that, most stakeholders in Spain mentioned landscape elements as the most efficacious measure.

Overall the results confirm our hypothesis on the bases of our literature review. This illustrates that scientific knowledge is already present in the land users/stakeholders knowledge and that there is an urgent need to translate scientifically based solutions into practical viticulture. To interpret these results properly it has to be taken into account that across the European Union there is not one policy solution that fits for all regions and production systems. E.g. due to high production costs in Romania, for example, winegrowers tend to use a high amount of pesticides in order to reduce the workload of canopy and cover crop management. In Spain, prices for olives are high so that many winegrowers start to give up their vineyards in order to plant olive trees.

Furthermore, because of adverse climatic conditions it is not possible to plant cover crops in Spain and in some parts of France because the competition for water between these crops and vines is too high and irrigation systems in vineyards are expensive (Schütte et al., 2019). The European Union and German government put pressure on organic winegrowers to lower their copper usage although copper is the only active ingredient against *Plasmopara viticola* in organic viticulture (Berkelmann-Löhnertz et al., 2008; Kauer et al., 2014).

Austrian winegrowers also are pressurized by consumers and supermarket chains such as “Spar” to reduce Glyphosate application in vineyards. Spar is not willing to accept a wine-grower’s delivery if the upper limit of Glyphosate residue is exceeded (Neubauer, 2017). Overall, the results demonstrate the complexity of management decisions and sustainability in viticulture.

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