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Effects of using cover crops in the inter-rows of vineyards. An ex-ante evaluation in France.

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Abstract

The European Union is one of the world's leading wine producers and exporters. European vineyards are smaller than in other wine producing countries and are cultivated more labour-intensively. However, this economic disadvantage can become a benefit for supporting biodiversity and ecosystem services in vinicultural landscapes. Using cover crops in vineyards is a practice to reduce soil erosion and potentially enhance biodiversity. Field trials in VineDivers have shown this across a European transect (France, Austria, Spain and Romania).

We analyzed the competitiveness of French wine from the Layon region on world markets with different field sites scenarios using a Policy Analysis Matrix (PAM). For this purpose we took into account revenues and costs of grape production. Our results show that viniculture in Layon is competitive in the worldwide market but it is under pressure due to regulations to protect the wine production in French wine-regions. The regional value creation in producing high quality wine with a more environmental friendly production enables the vintners to earn higher profits.

Keywords: biodiversity, viniculture, Policy Analysis Matrix, use of pesticides, competitiveness, ecosystem services

JEL Code: Q1 Agriculture

Introduction

Based on its nature as a permanent crop and its capability of relative high profits per hectare, growing vines is a much more intensive cultivation system than commonly assumed. In many vineyards a variety of different herbicides and fungicides are used to achieve high quality grapes for excellent wine. The use of pesticides creates negative externalities. To limit these externalities there is a need for an effective, sustainable measurement that can be easily implemented from vintners. During the past two years, surveys in the vineyards in the region of Layon (Loire Valley; France) have been conducted in an interdisciplinary way to analyze the different effects of using cover crops or spontaneous vegetation species in the inter rows. The use of herbicides is still very common. The vintners in the Loire Valley use herbicide treatment on 92 % of the bare soil area (80 % in France) (Agreste, enquête sur les pratiques phytosanitaires en 2010) and bare soil in the inter rows is still the predominantly method. Therefore it can be summarised that the observed region in Layon is cultivated conventionally. Vineyards that are cultivated conventionally are treated with a variety of different herbicides, fungicides and insecticides to secure the production of excellent wine.

An analysis of the cost structure for viniculture as well as focus groups and interviews with winegrowers and traders were carried out to create different scenarios modeled with the PAM. The question was whether an inter row management could provide ecosystem services to promote biodiversity. In addition, competitiveness had to be taken into account in order to compensate possible negative effects on the quality or yields of the grapes. This paper displays how viniculture could contribute to this goal by reducing the use of pesticides and the impact on the competitiveness of the vineries.

Methodology

To analyse the competitiveness and to show the economic effects of different inter-row management, we use the Policy Analysis Matrix (PAM) (Monke and Pearson, 1989, p. 11). The PAM, based on a simplified partial equilibrium analysis, is often used to analyse competitiveness of agriculture in transition countries (Lakemeyer, 2007).

Possible price policies could change the costs of inputs or the value of output and thus the private profitability of the agricultural production system. With the PAM we compare the private profitability before and after policy changes. The results indicate the influence of these changes on the competitiveness in market prices. A PAM generally consists of three rows, as shown in Table 1.

Table 1: The Policy Analysis Matrix

	Revenues	Costs		Profit
		Tradable Inputs	Domestic Factors	
Private Prices	$A = p_i^p$	$B = \sum_{j=1}^{k} a_{ji} p_j^p$	$C = \sum_{j=k+1}^{n} a_{ki} p_k^p$	$D = \pi_i^p = A - B - C$
Social Prices	$E = p_i^s$	$F = \sum_{j=1}^{k} a_{ji} p_j^s$	$G = \sum_{j=k+1}^{n} a_{ki} p_k^s$	$H = \pi_i^s = E - F - G$
Divergences	$I = A - E$	$J = B - F$	$K = C - G$	$L = D - H = I - J - K$

Source: Monke and Pearson, 1989, p. 11

Notes: *the subscript i refers to outputs and the subscript j to inputs;*

a_{ji} for (j = 1 to k) are technical coefficients for traded inputs in the production of i;

a_{ji} for (j = k + 1 to n) are technical coefficients for domestic inputs in the production of i;

P_i^* is the price of output i, evaluated privately ("$*$" = p) or socially ("$*$" = s);

P_j^* is the price of traded input j, evaluated privately ("$*$" = p) or socially ("$*$" = s);

V_j^* is the price of domestic input j, evaluated privately ("$*$" = p) or socially ("$*$"=s);

I measures output transfers; J measures input transfers;

K measures factor transfers; D(= A − B − C) measures net private profits;

H(= E − F − G) measures net social profits; and

L measures net transfers.

This disaggregation process allows the classification into four categories: „tradable inputs, domestic factors, transfers (like taxes or subsidies that are set aside in the social evaluations), and non-tradable inputs (which have to be further disaggregated so that all the costs will be classified under tradable inputs, domestic factors and transfers)“ (Abdul Fatah and von Cramon-Taubadel 2015).

The first two rows in the matrix display the private and social prices. The third row shows the divergences between the first two. These divergences are the results of either market-distorting policies or market failure (Monke and Pearson, 1989, p. 14).

In this matrix, the competitiveness of a production system can be spotted easily. The private profit, if not positive, should at least be equal to zero. Otherwise the producer (vintner) will probably quit the production (Monke and Pearson, 1989, p. 12). If the social profit (H) is negative, the production system is only operating due to the protection of the government (Monke and Pearson, 1989, p. 17).

The private prices for inputs and outputs in the first column are obtained from farm budgets, divided in tradable and non-tradable amounts. The revenue and cost categories in social prices are estimations based on world prices (FAOSTAT 2016). Therefore, we use national and regional statistics about the import prices for final goods (e.g. grapes or bottled and bulk wine) and the export prices for commodities that are used for the production process (e.g. plant protection, technical equipment, fertilizer) to estimate the efficiency prices for the input factors. For domestic factors of production (land, labor and capital) we calculate the social (efficiency) prices by application of the social opportunity cost principle (Pearson et al., 2003, p. 19 f). The domestic factors are characterized by the fact that they are not tradable and therefore no data is available for "the world prices". Therefore, we estimate the social opportunity costs by observing the rural factor markets for labor and capital. The land market price is also available from market observation. However, Van Schalkwyk et. al (1994) argue that "non-farm factors such as policy distortions may get capitalized into market values and thus, land values tend not to reflect the true economic value to the society". That's why Monke and Pearson (1989) recommend the use of the rental value instead of market value that reflects the opportunity cost to use land. Based on this recommendation we use rental value for land.

After modelling with the PAM there are some indicators and ratios available. First of all, the Private Cost Ratio (PCR) and the Domestic Resource Cost Ratio (DRC), which make it possible to compare different commodity systems or countries. The Private cost ratio (PCR=C/(A-B)) implies the margin between cost of domestic factors and value added, calculated with private prices (in the domestic market) (Monke and Pearson, 1989). Domestic firms try to minimize PCR by reducing B and C to maximize their profit. Calculating and comparing the DRC (G/(E-F)) provides a closer focus on the policy and market analysis of the wine

producing countries. If 0<DRC<1 the coefficient indicates comparative advantage: the social cost of domestic resources used is smaller than the corresponding social gain (value added). The opposite is true if DRC>1. In case of a DRC that is smaller than 0, the denominator must be negative. In this case revenue does not even suffice to cover tradable input costs. In this case, production of the good in question is clearly not competitive (World Bank 2008). As Masters and Winter-Nelson (1995) indicate, the DRC is influenced by the amount of domestic factors which are used by a commodity system and therefore the SCB is a more suited alternative. The advantages and disadvantages of these two indicators have also been discussed by von Cramon-Taubadel et al. (2008).

With the PAM it is also possible to calculate private (social) cost benefit ratios (PCB (SCB)). PCB (SCB) shows the competitiveness of the grapevine production from a private (social) perspective. The ratio is the sum of costs of tradable inputs and domestic factors in private (social) prices divided by total revenue of the good in private (social) prices (PCB=(B+C)/A; SCB=(F+G)/E). PCB and SCB never fall below zero. Hence, the value of them between zero and one indicates that the commodity is efficient and competitive. That is plausible because it means that the costs are less than the benefits.

Additionally, the nominal protection coefficients for output (NPCO) and input (NPCI) reveal price distortions in the respective markets. The effective protection coefficient (EPC) combines the NPCO and the NPCI and shows overall effects of price distortions (Lakemeyer, 2007, p. 94 f). EPC is measured as a ratio between the value added in the French market and the value added in the world market prices. In this model EPC>1, that indicates positive commodity policies for vintner who receive an implicit output subsidy (e.g. planting rights and financial support for new planting). The EPC and the NPC are helpful indicators to detect subsidies or taxes, but they ignore the effects of transfers in the factor market and therefore they do not reflect the full extent of incentives to vintners (Pearson et al 2003). Therefore we use these indicators to get a better understanding of the market for grapevines, but we concentrate on the domestic resource cost analysis.

The average DRC results, such as those summed up here, should be interpreted with caution. A weakness of the DRC method as it is usually applied is that it is based on average or 'typical' data for a sector or industry. For this reason, the statistical data we use is complemented with data from focus groups to get more detailed information about the

different production structures for wine through the countries. Furthermore, we collect disaggregated farm-level data.

Our results are based on aggregated data from vineyards that most certainly disguise possible variation and the underlying distribution of competitiveness across a set of heterogeneous vintners. This can have far-reaching implications for policy conclusions based on our PAM results. Therefore, only careful conclusions based on average DRC are drawn. A further analysis of DRC distributions is required to determine if reducing the use of herbicides and increasing the use of cover crops influence whether vintners are competitive.

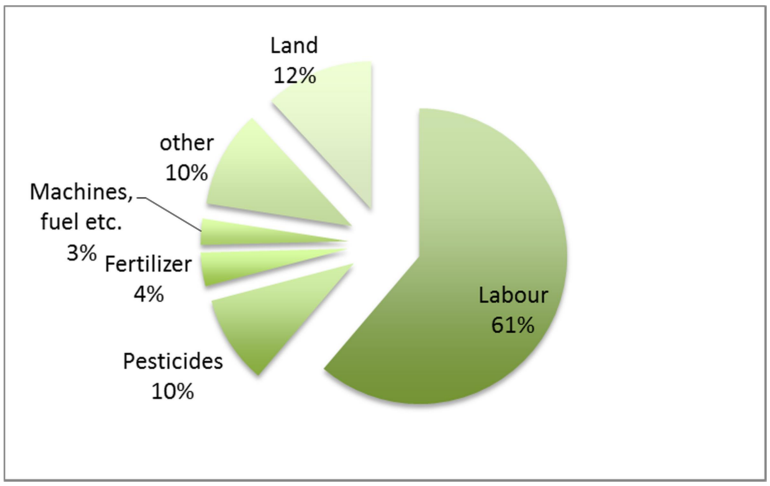
Results

In France there are three types of grape growers. First off there are grape growers which are farmers with comparatively small vineyards. They are not specialised in producing wine themselves but sell their grapes to winemaking cooperatives or wine trading firms. According to Traversac et al (2011), in France nearly 50 % of grapes are harvested by wine producers who also crush their own fruit. In contrast to other wine producing countries like the US, Australia or South Africa also in the second group of winegrowers wine is exclusively bound to the vineyards and the vintner. The on-farm produced wine is sold in bulk, bottles or containers to a trading company, retailers, caterers or direct marketing. The third type are winegrowers who are vertical fully integrated. There are also wine producers-traders who "adopt a strategy of full vertical integration, extending from grape growing through to marketing and including the bottling and packaging of wines with their own brand." (Traversac 2011, p. 2).

Based on this differentiation between wine producers there are different prices for traded grapes (for wine production), bulkwine (for brand) and bottled wine (for direct marketing). The prices per litre of wine differ here only in the considered region from 0,30 EUR (focus groups) up to an average price of 6,10 EUR (Franceagrimer 2015).

As can be seen in Figure 1 the labour costs are the largest share of all production costs per ha and costs for pesticides or fertilizer are relatively small. The grape production is very labour intensive (Traversac et al 2011) with all those activities like vine training, pruning, thinning and finally the harvest (which is done by hand for high quality weine (Coteaux de Layon) in this region).

Figure 1: Share of different grape production costs per ha



Source: Own calculations with data from Chambre d'agriculture (2014) and information from the focus groups in Loire Valley (2016)

The reduction of herbicide costs will be opposed by more working hours which are needed for cultivating cover crops in the inter-row. Some of the vintners pointed out that they would need other machines for sowing and mowing[1] the cover crops, which they not necessarily own. This hypothetical change of management would in this case lead to a small increase in production costs. However, it appears quite work that could be economically acceptable.

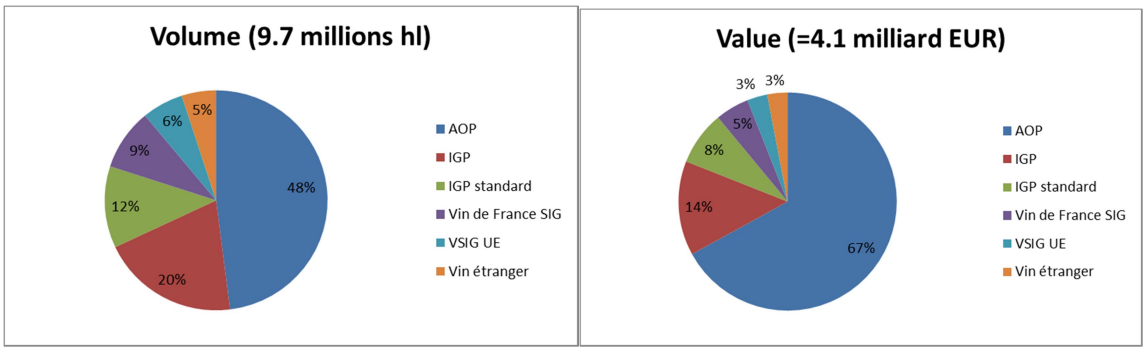
There is a significant relationship between the prices payed for wine and the kind of retail store. The share of wine sold in discounters' increases in many countries and a large share of wine is traded on a low priced segment. As can be seen in Figure 2 the share of volume of red wine in France is 48 % for AOP wine (highest category Appellation d'origine protégée) and 20 % for IGP wine (intermediate category Indication géographique protégée) in 2013. The share in value is 67 % for AOP wine and only 14 % for IGP wine. This reflects the consumer behaviour in France that most wine is sold in bottles in a middle price segment.

Gaining sustainability is an important key element for vintners who work since generations in the vineyards and "for practitioners in the wine industry, priority number one is leaving the land in better shape for the next generation" (Gilinsky et al 2016). In the focus groups and interviews with the vintners in the Loire Valley we have discussed whether an inter row

[1] For reducing the competition between cover crops and vine during the summer period and to prevent the seeding of weeds between the rows it is useful to mow the cover crops in the early summer. This is what Austrian Focus group members told us about using cover crops (2015).

cultivation with cover crops is possible. Most of the winegrowers agree that it is possible, but they have to use mechanical weed control instead of herbicides and pay special attention in dry seasons.

Figure 2: Share of Volume and Value of red wine in France in 2013



Source: illustrated based on data from FranceAgriMer (2015)

In the first scenarios we decided to concentrate on the First type of winegrowers, the "Plain grape growers". The results of our model show, that in all scenarios the DRC are smaller than one. This indicates the competitiveness of producing grapes in this region in France. Nevertheless it is difficult to define one unified average price for bottled wine produced in the region of Loire Valley. We have the same challenge for the world market prices. Of course there already exists some statistical data about average wine prices, but the price range for a bottle of wine has no limits. Does it really make sense to compare average prices for red wine in this case? Therefore we analysed different scenarios to estimate the influence of different production factors and the price of grapes and the bottled wine. In this paper we present three scenarios: Basic scenario, cover crop scenario and cover crops and marketing scenario. The coefficients are illustrated in the following table.

Table 2: Coefficients from the PAM scenarios in Layon:

coefficient	Basic scenario	Cover Crop scenario	CC and marketing
NPCO	0.62	0.94	1.87
NPCI	1.26	1.24	1.24
EPC	0.57	0.92	1.92
DRC	0.59	0.49	0.49
SCB	0.62	0.52	0.52
PCB	0.57	0.33	0.17
PCR	0.49	0.27	0.13

Source: own calculations based on dataset for 2014 from Focus Group (2016), Interviews (2016), Chambre d'agriculture (2012,2013, 2014, 2015), franceagrimer (2014), OIV 2015, AAWE 2015, KTBL 2015, FAO 2016,

The basic scenario:

In the basic scenario we assume an average production of wine in the years 2013 and 2014 and a low price for wine (0,30 EUR/l). This is the price vintners who participated in the French focus group (2016) indicated for those two years. At first sight this seems to be too low, but it is equal to an average retail price for a bulk supply of wine for further processing. This is a very common type of production in France. In the basic scenario vintners earn profit, which is lower than profit in other wine producing regions in the world. A DRC=0.59 indicates that the production of grapes in Layon is still competitive.

The cover crop scenario (with experience from the field sites)

The second PAM Scenario "Cover Crops" reduces the use of herbicides and vintners sow a special mixture of plants that have positive effects on the environment (clover, lupin, gras species etc.). Those seeding mixtures are well-tried in some European regions like Austria. Flowers provide nectar for wild bees and other insects and there can be seen a positive effect on the earthworm abundance (Zaller, J. et al 2016). Our analysis shows that the competitiveness is not negatively affected by this change (DRC=0.49). Higher costs for seeding and mowing are compensated by lower costs for the use of herbicides (which are not necessary in the inter-rows anymore).

The participants in the focus groups pointed out, that the use of cover crops leads to a higher risk in hot and dry summers for water scarcity which has negative effects on the grapes. It depends on the year and the rainfall and vintners prefer a flexible system to have the possibility to mow the inter-rows in case of water scarcity.

The cover crop and marketing scenario (based on the field sites results but hypothetical)

In this scenario we analysed on a hypothetical basis that vintners in Layon use cover crops and they are concentrating on a new type of marketing for their end product. The DRC is still smaller than 1 which verifies the comparative advantage. The EPC changes in the third scenario and with EPC>1 it normally indicates that producers are protected through policy interventions. But in this scenario it is not the reason: due to a hypothetical increasing wine price the profitability rises and changes this coefficient. A survey of French consumers concludes, that consumers have a higher willingness to pay for wine from the rural region

and “green vineyards” (Herve, M. 2016) from an environmental friendly production. Therefore, in the third scenario “Cover crops and marketing” we assume that vintners make use of this and would sell more wine in direct marketing from regional vineyards to a higher price for this ecosystem service.

Our analysis shows that the competitiveness in the second and third scenario is not negatively affected in comparison to the basic scenario. The analysed measures would lead to additional labour demand in the vineyard as well as to a more sustainable production system. This could have positive effects for the upcoming changes regarding climate change and adverse weather conditions. The DRC in all three scenarios is smaller than one which indicates that the production of grapes in France and especially in Layon is competitive with the wine production in other countries.

Discussion and Conclusion

The first results of three PAM scenarios (“basic”, “cover crops” and “cover crops and marketing”) show, that with these environmentally friendly changes in the production system an increase in social and ecological status can be found. Furthermore, private profitability is achieved in all scenarios and the domestic resource cost indicate comparative advantage in all scenarios.

We calculated three different scenarios for grape production in Layon. Overall we assessed which changes to European regulations could be envisaged to ensure that viniculture has a sustainable future and that European viniculture remains competitive on the world market. The first results of the field site experiments of the BiodivERsA-project VineDivers show, that with these environmentally friendly changes in the inter-row management an increase in social and ecological status can be achieved. In the PAM scenario “Cover Crops” we analyse that the production of French grapes for wine production in Layon is still competitive while using the environmental friendly tool of cover crops. The reduced cost for herbicides is opposed by additional labour demand in the vineyard for managing the cover crops. Nevertheless, the use of cover crops will lead to a more sustainable production system which is fit for the upcoming changes regarding climate change and adverse weather conditions.

This analysis provides evidence that biodiversity enrichment in viniculture in Layon

generates synergies between economic and ecological functions under the assumptions that are mentioned before. However, these are first results for one region in France. In connection with the BiodivERsa VineDivers project, further research will identify more diversified strategies in using cover crops to provide ecosystem services in more European vine producing countries.

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