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▶ **To cite this version:**

Marie Thiollet-Scholtus, Bruno Striffler, Julie Wohlfahrt. Low input innovation in vineyard system, multi-scale, multi-criteria analysis. 6th International Symposium for Farming System Design, Universidad de la República Uruguay. Montevideo, URY., 2019. hal-02737165

HAL Id: hal-02737165
https://hal.inrae.fr/hal-02737165

Submitted on 2 Jun 2020

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6th International Symposium for Farming Systems Design

Low input innovation in vineyard system, multi-scale, multi-criteria analysis

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1 – Introduction

Vineyards are perennial cropping systems with high expectations of product quality and profitability. In many regions of the world, wine is one of the most profitable agricultural product (Butault et al., 2010). Considering the need to decrease pesticide uses and therefore environmental impact of agricultural production, wine production is facing a great challenge as it is one of the biggest consumer of pesticides (AGRESTE and Simonovici, 2019). Winegrowers often manage diverse activities of the wine value chain, such as grapevine growing, wine making and wine trading. Winegrowers operate at various scales and deal with a high number of heterogeneous issues: they are managing grapes at the field scale, wines at the cellar scale, bottles at the market scale. We assume that, drastically reducing pesticide and more generally external input i.e. pesticides would greatly influence the management of these activities (Metral et al., 2015). In this study, we propose to analyze existing various wine production systems designed by winegrowers with very low input.

2 – Materials and methods

To reach these objectives, **a sample of 43 winegrowers** was built. 26 wineries were located in Alsace, France and 17 located in Bad-Wurtenberg, Germany, two Upper-Rhine river areas. Soil and climate are homogeneous in both areas accross the border. Legislative and market context are heterogeneous accross the border. The sample is divided into 19 organic winegrowers, 21 conventional winegrowers and 3 references.

The **winegrowers sample was bilt** thanks to recommendation of stakeholders from the wine sector, such as chamber of agriculture, Alsatian wine interprofessional council and local winegrowers' associations from both Upper-Rhine river areas.

In order to characterize wine production systems and innovations, **semi-structured interviews** were organised between March 2018 and March 2019. Questionnaires contained openned and closed questions, which addressed the major practices involved in the wine production process from vine winter pruning to wine bottles selling.

Questionnaire also included innovation at farm scale. A focus was made on the locks and levers regarding the reduction of inputs for surveyed system. Based on a quantitative and a qualitative analysis of each system surveyed, we were able (i) to compare the surveyed systems with a system of reference; (ii) to characterize the innovations in surveyed systems with Efficiency-Substitution-Redesign (ESR)

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framework; (iii) to highlight the changes between the low input systems and the reference regarding management complexity.

3 – **Results – Discussion**

We describe the nature of the innovations identified in the winegrower sample. Innovations are technical or organisational. Innovations are introduced at field scale or at farm scale depending on the nature of innovation (tab.1). the wine growers apply the field scale innovations in all the fields of the farm. Most of innovations are technical, but it is remarquable that winegrowers, either in France and in Germany, do not innovate in reaping, pesticide spraying nor soil tillage. These latter practices are very strategic to acheive yield and quality objectifs of the farm. Indeed, the famrs sample sell most of their wines under Protected Designation of Origin, which could be one explaination. The innovation "PIWI variety" is also an indirect pesticide spraying innovation because it is drastically reduce pesticide spraying by the presence of fungi resistant genes in the vines.

Table 1: Innovations identified in the survey, classified according to input reduction type and innovation nature.

Practice	Innovation	reducing herbicides	reducing fongicides	reducing fertilizers	reducing fuel	Type of innovation	Scale
Planted variety	PIWI variety		X		X	Technical	Field
Row weeding	Kress rubber stars	X			X	Technical	Field
	Rollhacke (hoeing stars)	X			X	Technical	Field
Inter-row weeding		X			X	Technical	Field
Inter-row sowing	Inter-row direct seedling	X		X		Technical	Field
	Inter-row plant cover	X		X		Technical	Field
Fertilization	Collective spreading of organic amendment				X	Organisational	Farm
Reaping		_	_	_	_		
Pesticides spraying		_	_	_	_		
Tillage		_	_	_	_		
Triming	No trimming: "r olling up"				X	Technical	Field
Harvest		_	_	_	_		

4 – **Conclusions**

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We conclude on the extent of the changes and the conditions of the implementation of innovations that reduce drastically external inputs, and especially pesticide uses in vineyards.

Several innovations to reduce inputs in vineyard exist on both side of the upper Rhine River. Some of innovations are not long lasting according to geographical, political or business context. Some innovations seem to be implemented in several vineyards.

This approach, applied in study areas, could then be used for various purposes. The interest for the winemaker is to determine the utility of changing the farming practices, about fungi resistant vine varieties (i.e. PIWI). Results integration in a model will be used to contextualize the farmers' behavior, in order to determine the effect of policies, for example adaptations in French Protected Designation of Origin regulation.

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