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Part 2. Evaluation of the overall performance of winegrowing systems in the Bordeaux region and of agroecological transition scenarios (Results and Discussion)

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The agroecological transition is an essential issue for vineyards, given the high pressure surrounding the use of pesticides to protect the crop. Major changes are required in winegrowing systems in order to achieve sharp reductions in the use of these inputs. With the aim of providing technical and practical benchmarks on the performance of agroecological systems, we have built and evaluated scenarios using multiple-criteria decision analysis.
The background to the study and methodology are described in Part 1[1].

Results of the performance of the agroecological systems

Analysis of the overall performance of the systems according to the seven criteria and their weighting helps to explain the results obtained, in particular the economic margin of the system, which accounts for 22% of the final result, the significant reduction in crop protection inputs, the presence of agroecological infrastructures and vineyard management that optimizes biodiversity. For example, the score for the economic criterion was based on a margin differential: gross income minus cultivation costs and the cost of using specific equipment, according to a professional costing system. Gross income was evaluated solely on the basis of a lump-sum per hectare, depending on vineyard practices and the wine category (conventional red, white or organic). This was inspired by professional practice in the field in this appellation. For example, the established gross income differential comprised seven references, with a value per hectare ranging from €5,400 (conventional red with minimal quality practices) to €8,000 for organic vines with full shoot thinning, good bunch distribution to limit the development of *Botrytis cinerea* (the vector of botrytis bunch rot), and the grassing of every row or every other row with tillage. The aim here was not to calculate a vineyard's income, but to compare different systems on the basis of common reference baselines. The added value generated by the sale of wines in bottle is thus deliberately not taken into account, as is the case for system SV59.

Table 1. Results of the multiple-criteria performance evaluation of winegrowing systems.

Category	Performance	Winegrowing system	Number
C4	Very good performance	SC3 SC2 SV59	3 (7.3 %)
C3	Good performance	[SC1, SV42] [SV09, SV38, SV62] [SV40, SV56, SV61, SV67] [SV07, SV55] [SV54, SV39]	13 (31.7 %)
C2	Average performance	SV36 SV63 [SV32, SV58, SV65] [SV33, SV50, SV53] [SV10, SV60, SV66, SV68] [SV05, SV52] SV04 SV11 [SV08, SV31] [SV18, SV57] SV51 [SV23, SV64]	23 (56 %)
C1	Poor performance	SV22 SV34	2 (5 %)

Conventional SV / Environmentally certified SV / Organic SV / SC scenario (SC1: Conventional Optimized, SC2: AE, SC3: AE-Organic)

TABLE 2. Average performance values by criterion for each level category.

Criterion	REN	PPS	IRE	PAE	PUL	TRA	SYS
Weight (%)	22	20	15	13	13	10	7
C4	****	****	*	****	***	***	****
C3	***	****	**	***	**	**	***
C2	**	**	***	**	**	***	***
C1	**	*	**	*	**	***	***

Performance level: **** Very good / *** Good / ** Average / * Poor

The results (Table 1) show that scenarios SC2 (Agroecology) and SC3 (Agroecology-Organic), as well as system SV59 (a real-life Agroecology-Organic winegrowing system), employing agroecological methods on a vineyard in the study area, achieved the best overall performance among the evaluations carried out. Systems using integrated conventional farming, which achieve a high level of performance, already optimize their practices, particularly in terms of crop protection, and are quite close to organic systems. However, they do not wish to go for organic certification, as they wish to retain the possibility of using synthetic crop protection products in the event of a very wet year. Table 2 shows the average performance values for winegrowing systems by criterion for each category, so that results can be compared according to these categories. The absolute values are dependent on the study site data and the scoring grids, and are not of great interest to display here.

It is important that winegrowers have a good understanding of agroecological processes, are well informed and devote time to making observations directly in their plots. This also implies a reasonable size for their vineyards, which local professionals estimate at around twenty hectares in the Blaye study area, in order to be able to exercise complete control.

This methodology for evaluating the overall performance of winegrowing systems using multiple-criteria decision analysis is fully applicable to all vineyards. It only requires the descriptors of the chosen criteria to be adapted to local conditions. The criteria themselves can be added to or changed, bearing in mind that seven or eight criteria is the maximum for decision analysis, taking account of their weighting. For example, a 5%-weighted criterion (i.e. one that only comes into play at this level of explanation of the result) would have no impact on the winegrower's choice. These adaptations in no way alter the operation of the multiple-criteria models used (ELECTRE TRI-C and ELECTRE III). ■

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