What brings an adapted ESR-based integrated approach of the farm to support conversion to organic farming?

A. Merot[1], JM. Barbier[2], B. Del'Homme[3], A. Alonso-Ugaglia[3]
1. INRA, UMR System - 2, place Pierre Viala, 34060 Montpellier cedex 2
2. INRA, UMR Innovation - 2, place Pierre Viala, 34060 Montpellier cedex 2
3. Bordeaux Sciences Agro Bordeaux / ENITA, USC GAIA - CS40201 - 1 cours du Général de Gaulle, F33175 Gradignan cedex

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Abstract

Concerned by the impacts of agriculture on the environment, an increasing number of farms move to organic agriculture. This change in their evolution is more or less easy to manage, depending on their biophysical and economic context but also on their specific dynamics. In fact, some observers are worried about the survival of farms which convert without being sufficiently prepared, especially as the knowledge and tools needed to monitor such a change are not all operational. Numerous studies have been made on the multiple dimensions of the process of change occurring during the conversion, but few analyzed it with an integrated approach. Based on the adapted ESR framework (Hill and MacRae, 1995), we present in this article the preliminary results of a multi-scale integrated analysis of the changes occurring during the conversion to organic farming and highlight the diversity of these changes.

1. Introduction

Faced with the economic difficulties associated with the viticulture crisis and pressure from the public for environmental and health safety, many wine-growers are looking for solutions to maintain or develop their activity (Clerc et al., 2010). For some farmers, organic farming appears to be the solution. As a matter of fact, conversions to organic farming have been very numerous in viticulture in recent years. In 12 years, from 1995 to 2007, the area of grapes grown organically has increased 4.6-fold (Agence bio, 2010). Differing from one farm to another, the conversion to organic farming can be a rupture or a continuous process of adaptation. Some observers are worried about the survival of farms which convert without being sufficiently prepared, especially as the knowledge and tools needed to monitor such a change are not all operational. Numerous studies have been made on the multiple dimensions of the process of change occurring during the conversion (Lamine et Bellon, 2009), but few analyzed it with an integrated approach. A study carried out on the national data of RICA1 shows that organic farming is characterised by large-scale investments in specific equipment, higher labour costs and greater sensitivity to climatic risks because of the absence of recourse to the use of pesticides (Butault et al., 2010). Other studies tend to show a significant fall in yields (Cronenberger, 2011). However, these analyses were not specifically focused on viticulture and they failed to take into account the temporal dimension of the conversion to organic farming. There is a methodological need to improve the way we acquire our knowledge of the mechanisms involved in such a change. At farm level, Hill and MacRae (1995) proposed to describe the conversion from conventional to sustainable farming according to three stages: "Efficiency, Substitution and Redesign or the 3 Rs: Reduce, Replace

[1] RICA : Réseau d'Information Comptable Agricole (Farm accountancy data network, FADN)

and Redesign". Efficiency reduces both consumption of resources and environmental impacts. In the substitution stage, resources or inputs are replaced by more environmentally-friendly ones. Finally, during the redesign stage, the system is re-structured and rethought through a new paradigm. This framework had already been applied to the transition towards integrated pest management (Patriquin, 2001; Ricci et al., 2011; Lamine, 2011). It was also used to classify innovations taking into account intensity of changes and the degree of progress towards sustainable development and ecological intensification.

In the three-year AIDY research program (Integrated Analysis of the DYnamics of the conversion to organic vineyards), we proposed to analyse the trajectories of vineyard conversions and build new tools to support the conversion to organic vineyard farming. In this article, we focus on farm scale analysis based on the ESR approach. We illustrate how the general ESR concept was modified to identify trajectories of conversion to vineyard organic farming. In fact, we developed a multi-scale integrated analysis of the changes occurring during the conversion to organic farming and highlighted the diversity of these changes.

2. Material and methods

2.1 Conceptual framework

Organic farming is defined as a form of agriculture, which does not use chemical inputs in its production process, and which enhances the biological and ecological processes to promote soil fertility and biodiversity. Thus, the conversion to organic farming implies changes in the way to manage the farming system. Literature, as cited above, showed also that the conversion to organic farming could be a much larger change by taking into account economic and financial aspects. Therefore, the grape and wine farm in conversion to organic farming can be studied under three points of view. It is considered successively as: i) a vineyard system which is composed of heterogeneous fields (agricultural point of view), ii) an enterprise which produce grapes and wine from grapes (economic point of view), iii) a farmer and his family group as a social system (social point of view). Based on these points of view, we developed an integrated system analysis of the vineyard system at farm scale. According to Lamanda et al. (2012), we defined the vineyard system in conversion to organic farming as the combination of

- a decision system (the 'Human' system), which is the association of a values-belief-identity sub-system, an observation sub-system and a planning sub-system. The observation sub-system collects information on the states of the different sub-systems and on the environment of the vineyard system. The planning sub-system is the one where the decisions are taken. It can be technical, commercial, financial, organization decisions or life decision from short to long term.
- A hierarchical cropping system (the grape production system) composed of a biophysical and a technical sub-systems which interact. The biophysical system is organized in space into groups of fields. Each field is a crop-soil-pest biophysical system which is impacted by the farmer's practices and which determines practices.
- - An economic system where the results of decisions are combined into two sub-systems associated with financial fluxes and production costs (at operations and activities level). Production costs are used to analyze the impact of the conversion on the cost of the products (charges). Financial fluxes are used to characterize the financial behavior of farms all along their trajectory.
- A wine production system (the grape-to-wine transformation system), which is the combination of a transformation sub-system (strictly speaking) and a wine breeding sub-system.

- A marketing system, which can be divided according to the different products sold in the farm on different markets to different actors of the wine industry.

Associated with this conceptualization of the vineyard system, we consider organic conversion as the administrative conversion (2-3 years). Indeed, this short period of time has to be repositioned in more substantial and longer transition processes.

1.1. Adjustments of the ESR approach to the case of vineyard farm in conversion

Vineyard conversion to organic farming is characterized by three statements:

- Conversion to organic farming in viticulture is not always a transition towards more sustainable agriculture because the gap between conventional farming and organic can be small. It is more a move on from one agriculture to another, each corresponding to different rules,
- Changes can be operated on every six sub-systems of the vineyard system presented above,
- Redesign, as described by Hill and MacRae (1995), is scarcely observed for perennial crops and for short time extent, in fact, perennial crops as vineyards are characterized by a high degree of inertia.

Considering the characteristics cited above, we proposed to adjust the ESR approach. Thus, in this work, ESR let to qualify changes that occur, at farm level on the six sub-systems defined above. Efficiency-Substitution-Redesign are ordinate according to a graduation of intensity and extent of changes. It means that efficiency implies less changes than substitution and redesign. One consequence is that it is necessary to integrate the initial point before conversion, because there is a wide diversity of conventional vineyard systems and the conversion pathway is dependant on this initial status of the farm before conversion. Considering the variety of changes observed, it seems essential for us to propose a fourth concept – Re-organization - which is situated in term of intensity of change between Substitution and Redesign. In fact according to Hill and MacRae (1995), Re-design is achieved when the causes of problems are recognized, and thereby prevented. In Re-organization, the causes of problems are not recognized and prevented but the changes concern more than one type of cultural intervention. We proposed consequently to convert the ESR approach in a ESRoRe approach. This re-defined approach has been applied on the different sub-systems of the vineyard system so that the vineyard system in conversion is viewed as a combination of changes and qualified by a vector of ESRoRe.

1.2. Sample for case studies

Our study is based on case studies with three different approaches (technical, socio-technical and economic) which cover the different sub-systems (see above) of the vineyard system at the farm level. We take into account not only the characteristics of firms, but also people, practices, land and their entire environment (at both natural and general sense). The sample was not exactly the same for the three approaches. Our sample is composed by grape and wine farms locate in South West of France (Aquitaine region) and in the South East of France (Languedoc-Roussillon), two main and famous wine areas in France. There were 13 farms in the technical sample, 18 farms in the socio-technical one and 11 in the economic one. More than a statistical representativeness, we were looking for the emergence of pregnant and crucial elements to deeper explore conversion trajectories toward organic farming.

1.2.1. Generic characteristics

Some generic characteristics have been collected for all the farms concerned by the case studies: city, legal form, vineyard areas, yield, date of administrative conversion (mainly recent in our sample in order to improve the data accessibility), the level of conversion (partial or total), previ-

ous practices for grape growing, mode of operation, method for harvesting, aging wine, packaging, commercialization, appellations and age of the manager.

1.2.2. Specific elements

Human sub-system analysis:This approach aims to embrace the social and technical trajectory (Smith et al., 2005) of the family-farm entity. As a matter of fact, in the studied area most of the grape or wine farms are of family type. Consequently, the decision for becoming an organic farm (highly strategic decision) is often a social process in which family members are involved. It is not rare that conversion to organic farming be a family project. Furthermore, the official conversion (to be allowed to use the French and European labels) is not always the result of a fast transformation process; in many cases it is the outcome of a transition period which can take quite a while (5 to 10 years). In some cases, the wine farm is the new living place of a family who directly implement organic practices from the beginning but without asking for an official recognition until market pressure brings a change of the commercial strategy. It is why it was decided to emphasize the story of life of the family-farm entity in order to identify precisely the motives for choosing organic practices and for becoming a labeled organic farm (Cranfield et al., 2010). Then we tried to link these different trajectories and motives with the type of technical changes that were implemented in the farm (using the E/S/RoRe categories). Eighteen farms were surveyed in the Languedoc-Roussillon area.

Cropping system analysis: In the technical approach of the vineyard system, a focus is given to changes in technical operations, organisation and management methods. 13 farms have been surveyed until now and the work is still in progress. The crop management sequences were identified before, during and at the end of the administrative conversion. All the practices were analysed: pruning, bud pruning, fertilisation, weeding in the row and in the inter-row, all phytosanitary treatments and topping. Evolutions in the equipment were also identified. For each practice in each farm, initial situation was defined and changes for each year of conversion (n-1 to n ; n to n+1; n+1 to n+2) according to the re-defined E/S/RoRe approach were characterized. An ascendant hierarchical classification was performed using R®.2.10.1 so as to identify types of conversion pathways.

Marketing and economic sub-system analysis: Concerning the economic approach, the analysis is based on farm level rather than focused on differentiated cultural practices, taking into account three main steps in a wine product-oriented farm: producing grapes, making wine, selling it. And of course, changes that happen when converting to organic may affect those three steps, simultaneously or not, and with different intensity of change. Therefore, the E/S/RoRe approach is helpful for describing those changes. three main indicators have been defined for this: the grape growing operations costs with the operation based costing method (OBC) (Ugaglia, 2009), the cost of each different product calculated with the activity based costing (ABC) method (Pailler, 2004) and the multi-yearly financial flows, which are particularly adapted for showing changes at farm level (Pailler, 2000).

3. Results

3.1 Human sub-system conversion

Applying the Cranfield (Cranfield et al, 2010) approach to the data collected through the socio-technical trajectory survey, we were able to describe a set of farmers' motives for the choice or the conversion to organic farming. For each farmer we were able to identify and prioritize them. According to this, it was possible to build a typology of the farm-family entities. Three different

types were identified. The first one called “nature concerned farmers” brings together farmers who first address concerns about the environment (soil, landscape, water…). As a rule, people who arrived from outside the area for setting up a new life in the agricultural sector belong to this group. The second group called “heath concerned farmers” is composed of farmers who decided to shift to organic farming after an accident with the use of pesticides. Finally, the third group called ”economical optimizators” brings together people who consider organic farming as a mean to ensure the surviving or the growth of the farm enterprise. Farmers of the first group have realized their transition towards officially labeled organic farming several years ago; they did not need the administrative recognition until recently; so when they decided to shift towards an official recognition, they just had to manage a little substitution (S) for the remaining “conventional” practices used in the farm. Recently they are the ones regarding Re changes with attention. Farmers of the second group have fulfilled a dramatically rapid conversion because of the urgent banishment of conventional pesticides; starting with a S type change, they have evolved towards E and Ro strategies in order to improve the functioning of the new implemented system. For the third group, an anticipation of the conversion may exist or not, with different levels of intensity. For this group, S is the more frequent strategy at the beginning of the process; it can remains like this with people looking for new product-type technologies or evolve towards E and Ro. In some cases farmers of the third group may adopt quite rapidly a combination of E, Ro and even Re changes, this is facilitated by their high level of capital and their close links with advisors. This first global approach claims for a focus on the type the different type of technical operations (weeding, fertilizing …).

3.2 Cropping system conversion pathways

Changes were more consistent for some technical operations. Thus, agrochemically based practices (e.g. fertilisation, weeding on the row, pests and diseases treatments, bud pruning) were directly modified so as to use only pesticides allowed in organic farming. Weeding in the inter-row is scarcely changed. When modified, these practices become more efficient. Some practices are indirectly modified related to organizational changes and resources constraints. Four types of trajectories of cropping systems have been identified (table 1): administrative conversion (Type 2), rational conversion (Type 3), innovative technical conversion (Type 1) and exacting conversion (Type 4). These types differed one from each other concerning the initial situations, particularly Type 2 versus Type 3. They differ also on the technical conversion pathway. Thus, Types 1 and 4 are very close in terms of initial situations, but the differences stand in the intensity of changes (more Re-organisation for Type 1) and in the type of changes (organic fertilizers in Type 1 versus bud pruning in Type 4). Furthermore, the analysis showed that some changes occur during the first year of conversion (Re-organisation and Redesign for Type 1). Concerning Type 3, when Re-organisation occurs, it is during the second year, as a consequence of first year changes. In fact, farmers first substituted agrochemicals by alternative techniques (e.g.mechanical weeding), but learned more progressively the way to manage (new decision rules, indicators), organize (new period for practices, more time needed or labour) alternative practices. Therefore, the Re-organisation is a consequence of Substitution.

Table 1: The four types of organic conversion pathway identified in this study

	Type 2	Type 1	Type 4	Type 3
Short description	**Administrative conversion**	**Innovative technical conversion**	**Exacting conversion**	**Rational conversion**
Initial point before conversion	Conventional practices close to organic practices	Weeding in the inter-row and bud pruning managed as organic practices – other practices based on agrochemicals	Weeding in the inter-row and nitrogen supply managed as organic practices – other practices based on agrochemicals	Agrochemicals based practices, excepted mechanical weeding in the inter-row
Trajectory 1st year	Not many changes during conversion First year: agrochemicals used to put right big problems are stopped and totally substituted	More efficient practices when already close to organic farming - When agrochemical based practices: Ro or Re for practices so as weeding of the row and pesticides application	More efficient practices when already close to organic farming - When agrochemical based practices: S, Ro or Re for practices so as weeding of the row and pesticides application	Mostly substitution of agrochemicals Stop of leafhopper and vine moth treatments
Trajectory 2nd year	Equipment Substitution	Practices in evolution : search of Efficiency or Substitution of the equipment	Not many changes if adjustments possible, search of efficiency or substitution	If Substitution not sufficient, it could lead to a Re-organisation
Trajectory 3rd year	Continuous process of progress	Practices in evolution : search of Efficiency or Substitution of the equipment	Not many changes	Not many changes
Farm surveyed	1, 3, 9, 12	2, 5	7, 10, 13	4, 6, 8, 11

1.3. *Economic sub-system conversion :*

Using the ESRoRe approach as re-defined before by agronomic and socio-technical approaches for an organic conversion in a wine product-oriented farm, we can rely types of changes and our indicators. Our main results are presented in table 2.

Table 2: ESRoRe concept with indicators allows to illustrate different types of changes when converting organic

	Indicator	Characteristics
E	Activity based costs (measured per unit (ha or hl)	- Efficiency in intermediate consumption uses could mean reducing costs per unit (ha or hl), and at least maintaining it if the yield decreases in grapes production. - Initial situation in technical issues affects the level of change, and therefore can imply changes in costs (low efficiency evolution means lows costs reduction).
	Multi-yearly financial flows	- No specific changes in financial behavior - Such changes in wine making and commercial activities have not been described until now.
S	Activity based costs (measured per unit (ha or hl)	- When replacing operations during conversion process, an increase of activity based costs per unit in grapes production is often observed, either due to production factors (using external services, chemical products replaced by work) more expensive, or due to yields' reduction (due to lower control or to willingness for increasing quality).
	Multi-yearly financial flows	- For wine making, no major changes have been observed (sample effect ?). - Depending the type of Substitution, investment behavior in new equipments may be observed, which frequently means decreasing solvency situation with new loans.
Ro **Re**	Activity based costs (measured per unit (ha or hl) Operation based costs (measured per unit) Multi-yearly financial flows	- Taking into account the graduate changes between Ro and Re, implementing such way of changes leads quite automatically to a cost per unit increase. - When identifying this type of changes, producing grapes requires first new operations, this means finally more operations, and therefore cost increase. - 2 main ways are found: changes when replacing technical operations by manual ones, or the contrary. - In this type of change, yield reduction is also present. - But the main result is the change observed in commercial activities see figure 1. Producing organic wine quite always means new market channels (mainly direct selling) which always lead to commercial cost increase. - When changes require new equipment (for grapes or wine making or for commercial issues), an investment behavior is observed, and as before, a solvency degradation.

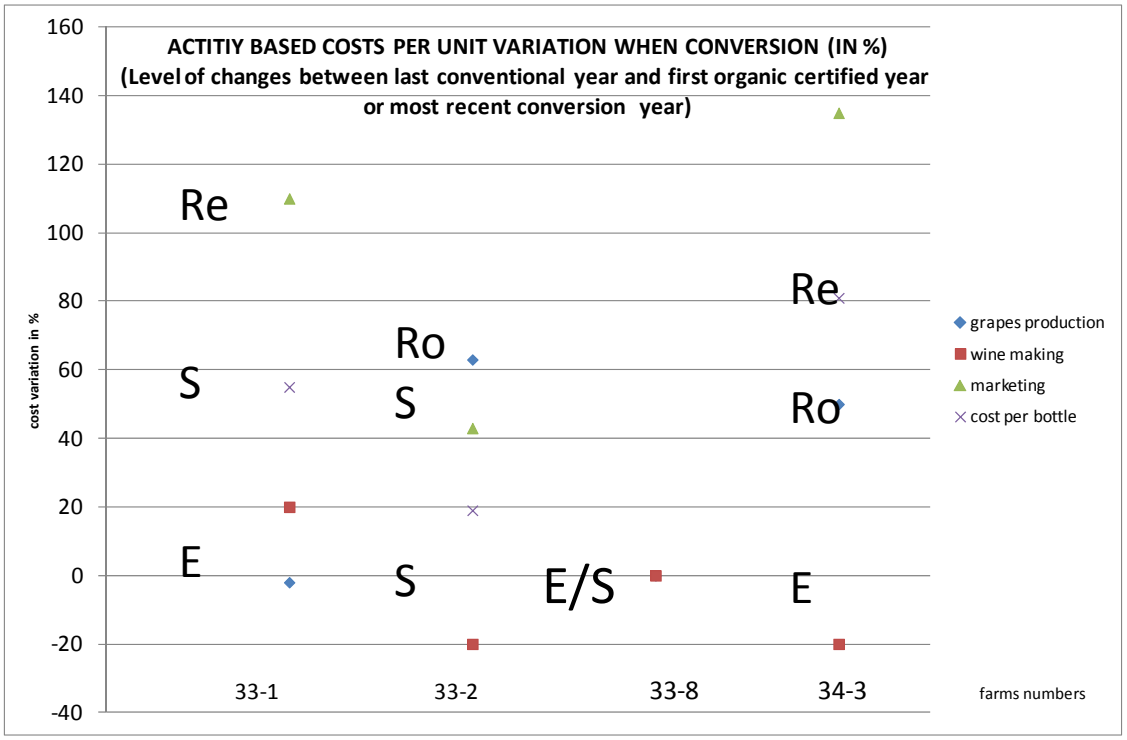

Figure 1: ESR description in sample observed

Of course, this first set of results is absolutely not sufficient for qualifying trajectories types from economic point of view. It however shows that an ESRoRe approach is interesting for classifying type of changes in each part of farm system. Evolving when using S or Ro, Re qualification often seems leading to increase costs per unit during the conversion period, while using E allows reducing or maintaining them. But there is apparently no graduated evolution between those two ways of changes (S or Ro, Re) when taking into account costs per unit. Changes when converting affect activity based costs, but changes intensity in production factor use can not be linked at full cost evolution, as each detailed activity based cost may evolve differently, and as inside each activity based costs production factors may compensate each others. What has also to be underlined is the fact that, in many cases, we seem rely organic conversion with cost increase in grapes production. This is not always true, especially if yields can be maintained at the same level, and does not seem a great issue in quality wine production. But it should absolutely be completed by another increasing source of cost which is more expectable: the commercial activities. Changing for organic farming is quite always associatedith new markets, meaning new products and new clients. And this change in commercial activities, as it requires time spending, yelds increasing costs. It also has to be noticed that increasing costs does not imply that farm profitability will decrease, depending on the commercial side evolution (and the market prices obtained). For financial behavior, the more changes affect costs, the more we can meet investment behavior for grapes production as well as for wine making or for commercial activities. The short duration observed (maximum five years) does not always allow to obtain a clear picture. And it has already been mentioned, the initial farm situation towards changes expected when converting organic may affect the level of changes observed in term of costs as well as in term of behavior. From this economic approach, it finally seems possible to characterize changes that happen at farm level, when regarding production costs per unit in different farm activities, operation costs in grapes

production and financial behavior with its control. Of course, those first results have to be confirmed by new surveys that are heavy to carry out due to set of information requested.

4. Discussion and conclusion

Each of the three approaches presented before gives a way to qualify changes in organic conversion using ESR method. The main advantage of such a method is to classify farm changes with a same rationale and gives an overview of the different ways of changes that are observable. Of course we have probably not taken into account all aspects that may affect changes. For example, farm size, farmer's age, farm history, location are other factors that play a role in differentiation between situations, and that are at the moment included in different determinant but not identified separately. So each approach has to more detail its part. But we also have to do more. Our goal is to qualify farm trajectories that are observable when converting to organic. And we just have for the moment pieces of those trajectories.

This is the reason why, for being able to determine types of trajectories, it is now requested to combine the different approaches presented above. Comparing criteria underlined in each approach, and mainly their changing qualification level given by the E/S/RoRe approach, should allow finding links in changes measurement, and therefore creating a set of determinants explaining which type of changes could happen at farm level. Of course, this typology will have to take into account other aspects already mentioned: speed and intensity of changes found, that could be linked with the initial farm situation. It probably be on this similarity of speed and changes intensity that different approaches will be able to be aggregated. Then, applying this "organic trajectories typology" should lead to advise farms, once identified its situation towards those indicators before conversion.

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