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► To cite this version:

Marie Thiollet-Scholtus, Xavier X. Coquil. Farming systems design to facilitate transition toward low input agriculture. AGRO2015, 5th International Symposium for Farming Systems Design, Sep 2015, Montpellier, France. 2015. hal-02741902

HAL Id: hal-02741902

<https://hal.inrae.fr/hal-02741902>

Submitted on 3 Jun 2020

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Farming systems design to facilitate transition toward low input agriculture

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1 Introduction

Can the design of innovative farming systems facilitate transition of rural territory to more sustainable agriculture? We question the relevance of design to support and facilitate the transition towards more self-sufficient and more environmental friendly farming systems. That question is asked to two experiment in the Northern East of France: the first experiment is dedicated to step by step design of autonomous mixed crop dairy systems (self-sufficient, and converted to organic farming) in the Lorraine region; the second experiment is dedicated to the design of organic vineyards in the Alsace Region. Staudenmaier (1985) distinguishes three types of design according to their distance to the uses that are made it in the current world: the invention refers to the creative act and the creation of something that did not exist before; Innovation refers to the processes of acquisition and diffusion of novelty; project management refers to an organizational process of design. Farming System Design is mainly focused on invention of technical or organizational alternatives for the future. The invention of such alternatives relegates innovation to questions of social acceptability of innovation taking the risk of inadequation according to users' current needs and desires (see for example Temple *et al.*, 2011). The two experiments presented in this paper postulate that adhesion to the real work of farmers is necessary to think farming system design as a source of innovation in agricultural areas.

2 Materials and Methods

Step by step design of autonomous mixed crop-dairy farming systems (organic) takes place in the INRA experimental station of ASTER-Mirecourt since 2004. Two agricultural systems are designed from the natural properties of the land without using chemical or organic input (Coquil *et al.*, 2009; Coquil *et al.*, 2014b). Former experience of the staff was built according to conventional farming in mixed crop dairy systems. Design of vineyards takes place in two vineyards owned by private wineries: both farms are converted to organic farming since middle nineties' and to biodynamic since 2008 and 2009 respectively. Experimental vineyards were designed according to winegrowers' goals: the first one wished to reduce its fungicide treatments and especially reducing the amount of copper/ha/year by adding mixed essential oils of citrus fruits. The second winegrower wanted a solution to combine improvement of vineyards vigor, management of weeds and providing an unfavorable environment for fungal diseases extension, by changing the field soil cover management. Design of vineyards used designing methods presented in Metral *et al.*, (2012) and in Thiollet-Scholtus *et al.* (2013).

3 Results - Discussion

Design of autonomous and organic mixed crop dairy systems is done step by step in ASTER-Mirecourt. Scientists of the experimental station initiated this design. This design forced all experimenters to deeply transform their work in terms of practices but also in terms of values. Thus, step-by-step design was managed as a corporate project to facilitate efficient experience of the experimenters working in a new framework of activity: farmers standards and values to which they refer are not the same in 2014 compared to the pre-transition period. The resources mobilized by the experimenters to develop efficient practices are the object of discussions with farmers interested in that kind of transition towards more sustainable dairy systems (Coquil *et al.*, 2014a). These exchanges allow moving towards more efficient and autonomous systems, so that farmers are able to make their own path and develop, in turn, experience. Prior to these exchanges, we demonstrate the technical, environmental and economic efficiency of the designed dairy systems so that farmers can give them credit. From this evidence, nearly 800 visitors (mainly farmers and advisors) a year visit the experimental station of ASTER-Mirecourt.

The question of assessing the technical suitability of designed alternatives is also a prerequisite for winegrowers interested in implementing low input practices on their vineyard. The originality of this device lies on the fact that winegrowers goals have been traduced and set in an experimentation on their own vineyards with scientists and technical staff from INRA in 2013. Winegrowers are responsible of the project management. Scientists and technical staff from INRA make available technical and human resources to equip this design and to assess reliably and accurate biotech, environmental and socio-economic results of designed vineyard systems since 2014.

The main difference between the two approaches returns us to innovation: the design experiment in private vineyards assures the strong adherence of the 2 concerned winegrowers to experimental design of the systems and to the assessment of the systems. But diffusion of results of these experiments is strongly influenced by the socio-professional networks of these two winegrowers. Step-by-step design of mixed crop dairy systems in an INRA station does not *a priori* ensure the production of knowledge in adherence with the concerns of farmers. The new mixed crop-dairy systems ensure the production of knowledge in adherence with experimenters needs and concerns. However, exchanges with farmers are built according to resources used by experimenters to develop efficient way of working in designed systems. Thus, knowledge is contextualized in experimenters' daily work. In this step-by-step design, farmers interested in designed systems, come to visit the INRA experimental farm: the INRA appurtenance might be an advantage, as it is seen by farmers, as a guarantee in terms of assessment, and it makes access easier for farmers from different backgrounds as INRA station is less marked by farmers standards, values and political position than a private farm.

4 Conclusions

Design of farming systems might have a large contribution to transition of rural territories to sustainable agriculture: knowledge must be produced in adherence with farmers' concerns and goals. The design methodologies and design locations can be different, but it seems necessary, however, to consider socio-professional networks of farmers and managers of experimental stations to facilitate the innovation process.

Acknowledgements. The authors would like to thank INRA Aster-Mirecourt and Colmar team for their contributions.

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