Strategies to manage crop planning complexity in very diversified direct selling farming systems: the example of organic market gardeners

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1 Introduction

Crop diversification and direct selling can be efficient ways to improve social, economic and environmental benefits of farming systems (Feenstra, 1997; Ponisio *et al.*, 2014). However, they can increase the complexity of the farming system management and especially the cropping plan (Aubry *et al*., 2011, Lanciano *et al*., 2010) which can be defined as the acreage devoted to each crop and the spatial and temporal allocation of crops within the farming land along the production season (Dury *et al*., 2011). Small size organic market gardens often combine a high level of diversification and direct selling (Navarette, 2009). The aim of our work was to study the strategies they developed to deal with the complexity of crop planning.

2 Materials and Methods

We carried out a multiple-case study (Yin, 2009) on 12 organic market gardens in northern France producing from 30 to 80 plant species on an acreage going from 0,5 to 2 ha. These farms sold their vegetables directly to consumers through different commercial forms: vegetables baskets paid beforehand with a yearly subscription according to the principles of Community Supported Agriculture (10 farms), vegetables baskets retailed without any subscription (6 farms), vegetables retailed piece by piece on-farm or in producers markets or shops (8 farms). 8 farms combined 2 or 3 of these channels. The common characteristic of all these selling channels is that the market gardeners have to provide from 5 to 10 vegetables species every week all along the commercial season which lasts from 7 to 12 months depending on the farm. We carried out semi-directive interviews with market gardeners about their objectives, situations and practices in order to get a first global and systemic view of the farm and then we focused on the strategies implemented by farmers to manage crop planning complexity. We realized an inductive qualitative analysis of the rich collected material (Miles & Huberman, 1984).

3 Results - Discussion

Among the 12 market gardens, crop planning decision making is a systemic challenge because it has to satisfy simultaneously 3 main objectives: (i) matching selling requirements, (ii) limiting the complexity of technical intervention, (iii) respecting rotation criteria to maintain health and fertility of plants and soils. These objectives are related to commercial, technical and ecological aspects of the farming system. To manage the complexity of this systemic challenge, market gardeners have implemented organizational strategies at the same 3 levels of their system.

Strategy A is to adapt their selling methods. It relies on the fact that in direct selling channels the producer controls the way he commercializes his vegetables. Selling vegetables baskets requires to produce every week a precise quantity of vegetables in right proportions to satisfy the customer whereas in retail selling systems the quantity of vegetables available every week and their proportion has not to be as precise. Some market gardeners choose to sell only through retail selling systems to be more flexible. Other use a retail selling system as a commercial buffer in combination to a vegetables baskets systems. In this case they can be less precise about proportions and quantities of vegetables sold in baskets because excess vegetables can be sold through the retail selling system. Some farmers use the heterogeneity of consumer's tastes to get more flexibility in planning species proportions in vegetables baskets systems. Instead of selling all baskets with the same proportion of vegetables, they can make baskets with different vegetables and different proportions and ask consumers to choose between them. They also can promote exchanges of vegetables between consumers if some of them wish a bigger or a smaller proportion of some vegetables.

Strategy B is to differentiate planning requirements in relation to the commercial function of the crops. Some crops are considered as "key vegetables" because they are strongly expected by consumers at different times of the year. The sowing or planting of these vegetables is therefore planned before the production season with safety margins. On the other hand, some vegetables may be not specifically expected by consumers but bring diversity to the commercial offer. These "complementary" vegetables can be planned with less safety margins and some of them may be planned not before but along the production season depending on opportunities. It is especially the case of short cycle species

vegetables which can be sown/planted when there is an available surface area between two long cycle vegetables. When required these short cycle vegetables can also be sown/planted in multicropping with long cycle vegetables. The proportion and nature of vegetables considered as "key" or as "complementary" vary among farmers and have an impact of the level of flexibility they can get from this strategy.

Strategy C is to aggregate crops in similar management groups. It involves the determination of aggregation criteria to create groups of species which will be grown in the same space. Instead of thinking the spatial allocation of every specie, the farmer has only to think the spatial allocation of a few groups. In the studied farms, the market gardeners use various grouping criteria: botanical family, cropping season (spring, summer, autumn or winter crops), irrigation or fertility needs (high demanding, medium demanding and low demanding). These criteria makes both spatial allocation of crops and technical management easier.

Strategy D is to differentiate the importance of phytosanitary criteria in rotations according to species and other ecological technics at the farm level. It consists in being strict in the rotation criteria for some crops considered as "sensitive" for sanitary reasons and to be more flexible or even not to use any rotation criteria for other crops considered as "less sensitive". The market gardeners can release the pressure on rotation criteria because they implement a lot of other ecological technics at the farm level to promote the global immune function of the agroecosystem: high diversity of species and varieties on a small farm, use of resistant and locally adapted varieties, growing green manures with sanitary properties, multicropping, creation and management of ecological infrastructures such as ponds, hedgerows, woodlands, grass stripes, agroforestry. The nature and proportion of plants considered as "sensitive" or "less sensitive" vary among farmers and have an impact of the level of flexibility they can get from this strategy.

These 4 organizational strategies are not implemented and combined the same way among the farms (Table 1) but have been mentioned by farmers as allowing them to reduce the complexity of crop planning.

Table 1. Combination of crop planning strategies among the 12 studied farms (X means "presence")

		Farm											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Strategy	**A**	X			X	X			X	X	X	X	X
	B	X	X			X			X	X			
	C	X	X	X	X	X	X	X	X	X	X	X	X
	D	X	X	X				X	X	X		X	X

In this study we have not associated these strategies with the economic, social and environmental performances of the farms. A multi-criteria assessment and more interviews could be carried out in order to determine in what extent certain strategies or combinations of strategies impact the performances of the farming system.

4 Conclusions

Innovative strategies have been developed on very diversified direct selling market gardens to manage the complexity of crop planning. These strategies can be combined and are implemented at different levels of the farming system: commercial, technical and ecological. They are mainly based on the opportunity farmers have to control their commercial methods in direct selling systems and on the sanitary advantage that a high level of plants diversity can bring to the farming system when associated with other ecological technics. This multiple-case study show that crop planning complexity has to be addressed as a systemic level and describe 4 strategies developed in the specific field of organic market gardening. Further investigation would be required in order to see in what extent these strategies could inspire the design of other types of farming systems such as cereal cropping or breeding farms.

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