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AGROFORESTRY MARKET GARDENING: A STRATEGIC CHOICE TO IMPROVE SUSTAINABILITY IN AGROECOLOGICAL TRANSITION?

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Abstract: Agroforestry mixing fruit trees and organic diversified vegetable is currently experiencing strong growth in France. The SMART project aimed to (i) explore the sustainability of these systems, (ii) assess the effects of synergies and competitions generated by agroforestry, as perceived by the farmers. Surveys and observations carried out among farmers showed that these systems were implemented by farms involved in short food supply chains. Diversification of products was therefore a central justification for the intercropping of fruit trees and shrubs with vegetables. The majority of farmers considered that intercropping fruit trees and vegetables did not create a problem for workload organisation or competition. Their certainty in this respect was rather limited, given the generally short duration of their experience. A global assessment of their satisfaction integrating technical, agronomic, environmental or socio-economical dimensions (see results) led most of them to consider that the choice of agroforestry was fully justified and could be recommended to other market gardeners. These results showed the need, when evaluating such systems, to adopt dynamic and holistic viewpoint on the different performance levels, allowing to consider the evolution of the trade-offs between pros/cons of such systems on the long-term basis.

Introduction: Agroforestry is an effective option for the agro-ecological transition but remains poorly adopted. However, a particular form of professional agroforestry, associating fruit trees and market gardening, has been taking place in France in the past few years.

What are the advantages and disadvantages of such choice in terms of agronomics, work organisation, production and economic results?

The SMART project was conducted from 2014 to 2017, to address these questions. The partners identified farms experiencing marketing gardening agroforestry. Some of these farms were then involved in a survey to describe their structure and their motivations. Research focuses on advantages and disadvantages perceived by farmers.

Material and methods:

As a preliminary exploratory survey, an online questionnaire (126 answers analysed) was carried out in the whole country (France) with general questions about the structure of the farms, the background/profile of farmers and the history of tree implantations on the farm. Based on this global overview, we selected a sample of farms all over the country to cover the diversity observed and implemented 3 specific sub-surveys: (i) description of agroforestry plots and discussion of their productive and environmental advantages and disadvantages (31 farms); (ii) description of the farm, discussion of the role of agroforestry in the overall strategy and its impact on economic, labour, organisational and social dimensions (26 farms); (iii) collection of workload data (19 farms). In the sub-surveys (i) and (ii), mixing semi-structured interviews and closed questions, we aimed at distinguishing the impact of diversification at the farm level (growing fruit and vegetables on the same farm, 14 questions) and of spatial intercropping as such (28 questions). Surveys were carried out by asking farmers to express their agreement with a number of assertions. Following their choice (yes / no / do not know or neutral), they were asked to freely explain the reason. For information about strategic concerns, they were also asked whether this issue was, in their view, of little importance (1); important (2); central (3) from an economic, social and ecological point of view. The manifestation of the agreement (Yes = +1; No = -1; Don't know or neutral = 0) was weighted for the analysis by this note of importance in these different fields.

Results: The cultivated acreage of market gardening agroforestry plots of these farms were generally small: 1.3 ha on average. They represented a significant proportion (63% on average) of the total cultivated area. 73% of farmers had no family land inheritance. Given the difficulty in finding land, they turned to market gardening. They try to be as autonomous as possible since market gardening required little investment and allowed them to remain relatively independent. Agroforestry was an integral part of the farmers' project as they settled in 85% of cases. This did not mean, however, that the organisation of the agroforestry system had been fully planned from the outset. For many of the farmers, these adaptations were opportunistic.

Among the statements proposed to farmers in the survey, the most widely supported were those concerning economic and social dimensions (Fig 1). Growing fruit and vegetables allowed farmers to split the risks of bad harvest between more crops, diversify their commercial offer and respond more fully to consumer expectations. This broadening of product-range contributed to customer loyalty in short supply chains. In this respect, farmers considered that agroforestry was well received and contributed to strengthening consumer support for the farm project, which in turn strengthened it.

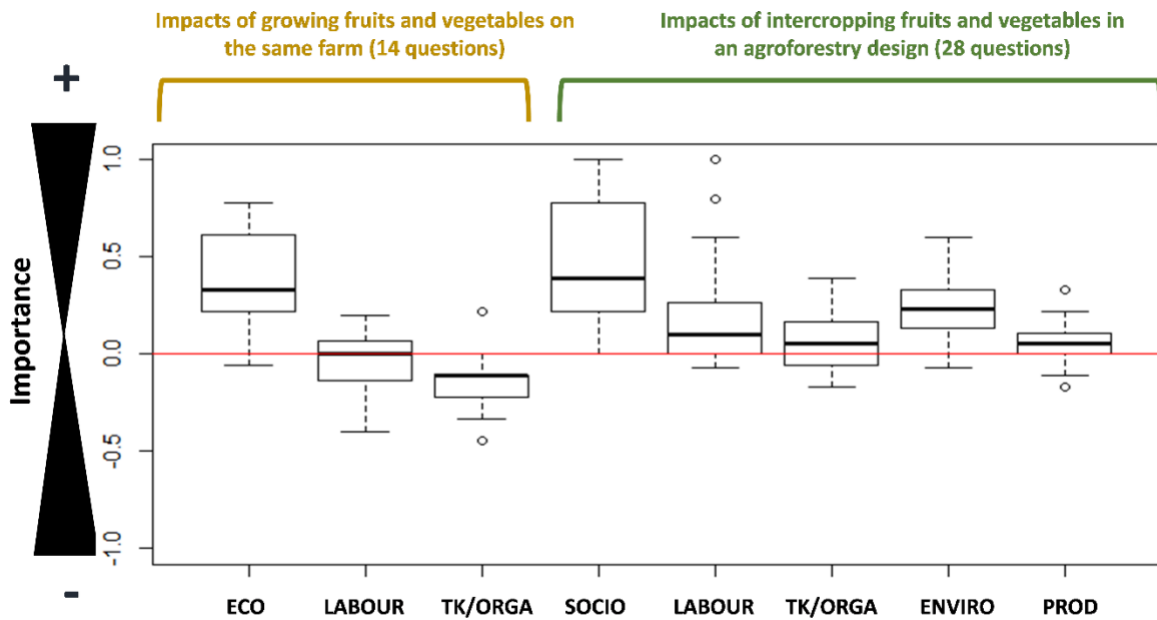


Fig1: Impacts of growing fruit trees and vegetables on the farm and on intercropping them in an agroforestry design on economic (ECO), labour, technical/organisational (TK/ORGA), sociological (SOCIO) dimensions of the farming system. A scoring higher than 0 means that the impact is positive. The higher the absolute value of scoring, the more the impact (positive or negative) was judged important (survey completed for 26 farms).

Market gardening agroforestry brings constraints on working conditions. The workload that had to be devoted to trees at the end of spring and summer was sometimes superimposed on the main peak in market gardening, especially for farmers whose trees had come into production (Fig 2). The heavy workload caused by this overlapping was considered as risky because it could lead farmers to neglect critical interventions on trees.

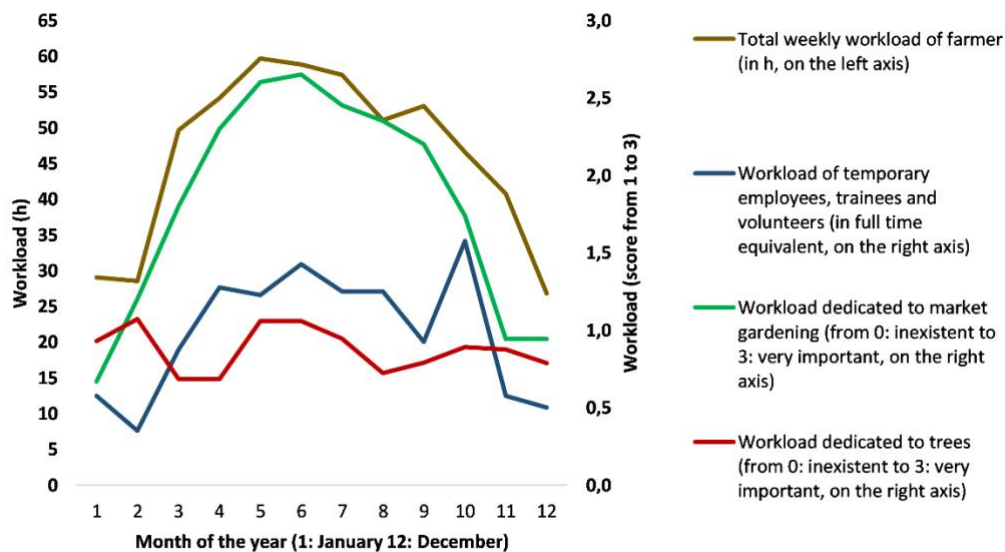


Figure 5. Workload over the year (19 surveys completed).

Fig2: Average workload over the year (survey completed for 19 farms).

Intercropping of trees and legumes was sometimes said to increase management complexity. Most farmers insisted on the fact that such spatial issues could be avoided at designing the system if enough distance was planned between trees and vegetables.

However, working in a plot with trees and vegetables helped farmers to always have an eye on both crops which allowed farmers to be more reactive in some critical interventions. It was also more pleasant to work in the shade and trees allowed to break the wind. The feeling that agroforestry contributed to a higher biodiversity also helps. Although farmers highlighted that an increase in workload and complexity was not to be neglected, the benefits brought by agroforestry resulted in most farmers considering agroforestry as rather favourable in terms of work.

Most farmers considered that trees did not affect the essential ecophysiological factors of vegetable productivity. The major benefit was a higher perceived level of biodiversity and the possibility to optimise space and reducing land use footprint (Table 1).

Table 1: Answers to assertions about the productive and ecological advantages and disadvantages of market gardening agroforestry (Survey completed for 31 farms; letters indicate significant differences at 0.1 level for post-hoc pairwise chi-square tests carried out with the R-package rcompanion))

Dimension	Assertion	I don't know	No	Yes
Productive	Trees has a negative effect on germination and the beginning of growth of vegetables	39% ^a	57% ^a	4% ^b
	Trees cause harmful hydric competition with vegetables	25% ^a	75% ^b	0% ^c
	Shade of trees hinders market gardening crops	25% ^a	50% ^a	25% ^a
	The quality of harvested vegetables is better in agroforestry plots	64% ^a	14% ^b	21% ^b
	Productivity of vegetables is lower in agroforestry plots	41% ^a	33% ^a	26% ^a
	The impact of trees on vegetables is stronger on the vegetables in their proximity	36% ^a	32% ^a	32% ^a
	The overall productivity of the intercropped plots makes them more interesting than separated pure crops	33% ^a	19% ^a	48% ^a
Environmental	Biodiversity (birds, insects) is higher in agroforestry plots	18% ^a	11% ^a	71% ^b
	The impact of diseases and pests on trees is lower in agroforestry plots (lower inputs)	54% ^a	14% ^b	32% ^{ab}
	The impact of diseases and pests on vegetables is lower in agroforestry plots (lower inputs)	57% ^a	18% ^b	25% ^b
	Agroforestry allows to save space (land use)	15% ^a	15% ^a	70% ^b
	Agroforestry impacts irrigation practices (water use)	37% ^a	32% ^a	32% ^a
	Agroforestry impacts fertilisation practices (lower inputs)	20% ^a	35% ^a	45% ^a

Although the major uncertainties of farmers about agroforestry were related to its environmental and productive impacts, the survey also highlighted doubts and knowledge gaps on other dimensions (Fig 3). Farmers with more experience generally had a clearer opinion on certain subjects proving that some difficulties of agroforestry are maybe underestimated. They considered that trees could disrupt vegetable growth and production, were more aware of the challenges of handling peaks workload for trees and vegetables in the same time and advised to be very careful with distance between trees and vegetables in order not to make interventions on trees or vegetables more complicated.

This advocates for experience exchanges between more advanced and new agroforestry practitioners which is all the more crucial for innovative practices lacking stabilised knowledge.

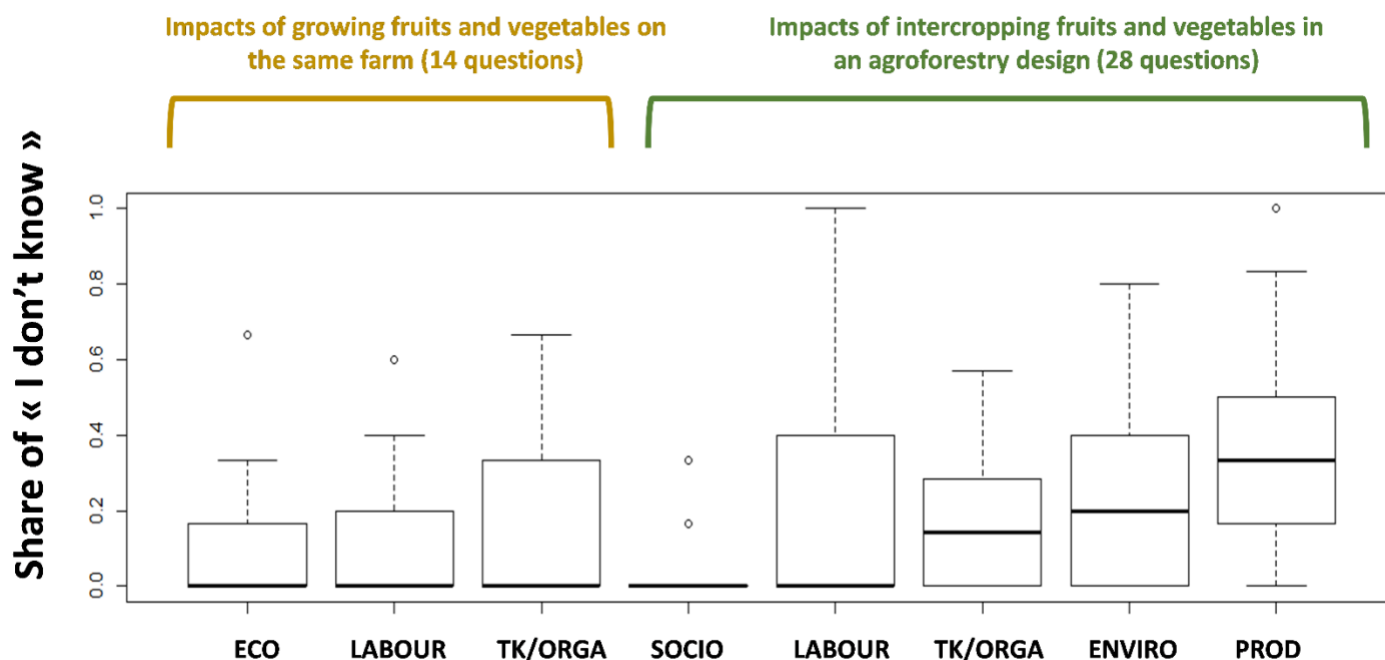


Fig3: Share of “I don’t know answers” across farmers about the impacts of growing fruit trees and vegetables on the farm and of intercropping them in an agroforestry design on economic (ECO), technical/organisational (TK/ORGA), sociological (SOCIO), environmental (ENVIRO) and productive (PROD) dimensions of the farming system (26 surveys completed).

Discussion:

For the first time in France, the SMART research programme explored market gardening agroforestry systems. These, which were still extremely rare at the beginning of this century, are currently undergoing a strong development, in line with the current trend of establishment of small organic farms, generally created by people without any previous family farming ties. The survey work carried out among farmers led to a better understanding of the determinants of their choice of this type of practice. It showed that integrating agroforestry was part of a life project and involved socio-economic, organisational, labour, agronomic and environmental dimensions, which advocates for a holistic approach to agroforestry integration in farming systems design. However, the relative youthfulness of these experiences did not yet allow a reliable assessment to be made of the performance, advantages and disadvantages of market gardening agroforestry. In order to achieve this, the work undertaken should be pursued through longer-term monitoring, in close cooperation with the farmers concerned.

A key issue that needs to be addressed is the dynamics of these systems and the adaptive management that needs to be adopted to take into account the structural and functional changes they are undergoing over time. This question is all the more difficult as these agroforestry systems are extremely diverse in their spatial organisation and in the diversity of cultivated species they manage, annuals, perennials, bushes and trees. Each situation thus appears radically unique. It would probably be meaningless to infer directly reproducible recommendations from their study. Rather, the nature of scientific knowledge to be generated should focus on identifying design and conduct principles that can be used to guide efforts to improve existing systems and enable new project developers to take full advantage of the experience gained by these pioneers.

The interest of the study of these agroforestry market gardening systems lies also in its heuristic value for reflection on the production of scientific knowledge necessary for an agroecological transition and the articulation between this knowledge

and the knowledge of practitioners. Market gardening agroforestry seems to us to be a particularly fruitful model for thinking about the agro-ecological design of agricultural systems, valuing ecosystem services while ensuring their reproduction, thus guaranteeing the sustainability and resilience of these systems.

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Disclosure of Interest: None Declared

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