



HAL
open science

The importance of distribution channels and food supply chain challenges on the viability of market gardening farms: insights from market gardeners in Belgium at a territorial level.

Nicolas Biot, Corentin Hecquet, Kevin Maréchal, Guillaume Lobet, Nicolas Dendoncker

► To cite this version:

Nicolas Biot, Corentin Hecquet, Kevin Maréchal, Guillaume Lobet, Nicolas Dendoncker. The importance of distribution channels and food supply chain challenges on the viability of market gardening farms: insights from market gardeners in Belgium at a territorial level.. 2024. hal-04594127

HAL Id: hal-04594127

<https://hal.science/hal-04594127>

Preprint submitted on 30 May 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

The importance of distribution channels and food supply chain challenges on the viability of market gardening farms: insights from market gardeners in Belgium at a territorial level.

Biot Nicolas^{*a}, Hecquet Corentin^b, Maréchal Kevin^c, Lobet Guillaume^a, Dendoncker Nicolas^d

^aEarth and Life Institute, Université catholique de Louvain, 1348, Louvain-la-Neuve, Croix du Sud 2 L7.05.11, Belgium

^bUniversité de Liège, Belgium

^cLaboratory of Economics and Rural Development, Gembloux Agro-Bio Tech, University of Liege, Gembloux, Belgium

^dUniversity of Namur, Geography Department, Institute of Life, Earth, and Environment (ILEE), Namur, 5000, Belgium

*Corresponding author : nicolas.biot@uclouvain.be, ELIA, Croix du Sud 2/L7.05.11, Kellner D279
1348 Louvain-la-Neuve

Abstract

Agroecology is increasingly recognized as a strategy to shift away from industrial agricultural practices and pursue comprehensive transformations in food systems. Previous studies have demonstrated the alignment of market gardening short food supply chains with agroecological principles. However, the viability of small and medium-scale market gardening farms is questioned.

Our study explores the socio-economic viability of 18 market gardeners in Coeur de Condroz (55 880 inhabitants, 625 km²; Belgium). We analyze characteristics, distribution channels, and key challenges of market gardeners within the food chain via semi-structured interviews and discuss how they influence the market gardeners' viability.

The low profitability of market gardening farms along with the challenging working conditions raise concerns about the socio-economic viability of market gardening farms. However, this needs to be qualified by looking at how market gardeners actually perceive it and using other indicators than the revenue and profit before taxes.

The viability of farms is also influenced by the collaboration among market gardeners, marketing strategies, and challenges within the food chain. The local cooperative plays a vital role in fostering collaboration among market gardeners. Local institutions, catering, and longer distribution channels are currently unviable options for market gardeners due to practical or competitive constraints. Key issues within the food chain encompass limited land availability, skilled workforce scarcity, inadequate training, consumer behavior, and lack of political recognition.

Based on these results, we advocate studying short food supply chains for agroecological transitions with a systemic perspective, understanding all actors' needs. Ethically conducted participatory action research, along with other transdisciplinary and participatory methodologies, is crucial for studying and developing agroecological supply chains like market gardening in Coeur de Condroz.

Key words: vegetables, short food supply chains, challenges, viability, agroecology, local

1 Introduction

Our global food systems are unsustainable and are in need of transformative changes (Béné et al., 2019; De Schutter, 2017; Ritchie et al., 2022). Agroecology is increasingly recognized as a strategy to shift away from industrial agricultural practices and pursue comprehensive transformations in food systems (HLPE, 2019; IPBES-Food et al., 2021; Wezel et al., 2020).

Agroecology is a science, a set of practice and a social movement (Wezel et al., 2009). The meanings, definitions, interpretations and approaches to agroecology have evolved over time (Wezel et al., 2020). According to Gliessman (2018), agroecology is *“the integration of research, education, action and change that brings sustainability to all parts of the food system: ecological, economic, and social”*. It embraces thirteen agroecological principles, which are further endorsed by initiatives like ecological organic and regenerative agriculture, in order to facilitate the imperative shifts toward greater sustainability in food systems (HLPE, 2019; IPBES-Food et al., 2021; Wezel et al., 2020).

Small and medium-scale diversified market gardening farms are an example of agroecological farms that challenge the global food system (Drottberger et al., 2021; Dumont, 2017; IPBES-Food, 2016; Navarrete et al., 2015; Palomo-Campesino et al., 2022; Pépin, 2022). In this paper, we refer to market gardening farms as farms where fresh fruits and vegetables are cultivated exclusively within their rotations (Chevalier, 2022; Dumont, 2017). Small and medium-scale market gardening farms include farms with a cultivated area ranging from less than one to ten hectares, with low level of mechanization, and that grow a wide variety of fruits and vegetables (Dumont & Baret, 2017). These farms, especially when they are in organic agriculture, are more inclined to promote agroecological practices, enhance environmental performance and functional biodiversity, and increase added value for farmers (Dumont, 2017; Kremen et al., 2012; Navarrete et al., 2015; Palomo-Campesino et al., 2022; Pépin, 2022).

This type of market gardening farms are mainly involved in short food supply chains (Chiffolleau, 2019). Many researchers have pointed out the potential positive impacts of short food supply chains (or to a broader extent local food systems and/or alternative food networks), such as promoting healthy food, supporting farmers and the local economy, enhancing consumer willingness to pay, lowering the environmental impact, and strengthening social ties in the community (Chiffolleau et al., 2017; Enthoven & Van den Broeck, 2021). For instance, short distribution channels in fruits and vegetables production systems can positively influence waste reduction efforts. Indeed, it has been shown that in short vegetable marketing channels, the visual appearance of vegetables is less critical. Growers can directly explain any challenges they faced to consumers, such as pest attacks or bad weather (Navarrete, 2009). Furthermore, short food supply chains benefit from an absence of calibration requirements and have fewer unsold items (Maréchal et al., 2019). This prevents food losses and wastes, contributing to enhancing food security and environmental sustainability (FAO, 2020; Shafiee-Jood & Cai, 2016).

Therefore, short food supply chains are recently considered as niches in the multi-level perspective framework (Geels, 2011) of sustainability transition research (El Bilali, 2019). They have been recognized as having a key role in challenging the current food system. Additionally, in the realm of agroecological literature, it is recognized that shortening the food supply chain and reestablishing direct connections between producers and consumers constitute pivotal stages in the transition towards a sustainable food system (Wezel et al., 2020). This is also reflected in European political decisions, with the European Commission that supports the shortening of food supply chains to

enhance resilience of regional and local food systems through its “Farm to Fork” strategy (European Commission, 2020).

However, such as in other short food supply chains, small and medium-scale market gardening farms exhibit weaknesses, including inefficient logistics and a questionable viability for the farmers (Dumont, 2017; Maréchal et al., 2019). The concept of viability has been defined by Morel & Léger (2016) as “*the possibility for farmers to live on a long-term basis in accordance with their material and immaterial needs and values*”. Previous studies have shown that the poor viability of small and medium-scale market gardeners is specially due to a low profitability, resulting from a high demand in workforce (Dumont, 2017; Dumont et al., 2020; Morel, 2016; Plateau et al., 2019). Besides, other issues associated to the market gardening food chain have been previously reported, such as access to land, the role of mechanization, the role of volunteering, the weak networking among market gardeners, the inadequate trainings and the lack of financial support (Dumont, 2017; Navarrete et al., 2015; Plateau et al., 2019; RwDR, 2022).

Existing literature related to market gardening short food supply chains primarily compares long and short distribution channels, with only a limited number of studies exploring the diversity within the short distribution channels employed by market gardeners (Dumont, 2017; Enthoven et al., 2023; Navarrete et al., 2015). Yet, marketing decisions significantly influence the viability of market gardening farms (Morel, 2016). In addition, there remains a lack of studies addressing the issues faced by market gardeners at a territorial level (Drottberger et al., 2021; Lamine et al., 2019; Morel & Léger, 2016; Navarrete et al., 2015). In Sweden, Drottberger et al. (2021) stressed the need to raise awareness among extension workers, researchers, and policy makers about the characteristics and requirements of market gardeners. According to them, such information is crucial in fostering the establishment of new market gardeners and contributing to the transformative agenda. In France, Morel & Léger (2016) emphasize the importance of considering farmers' perspectives and their adjustments to local opportunities and constraints. Additional place-based research, examining the distinct differences and challenges related to farmers' distribution channels, can provide valuable insights for evaluating the viability of such agroecological farms (Anderson et al., 2019; Maréchal et al., 2019; Mundler & Rumpus, 2012).

This paper presents findings from interviews with 18 market gardeners at a rural territorial scale (i.e. Coeur de Condroz, seven municipalities). Our study aims to provide context-specific insights into how market gardeners' viability is influenced by the farms' main characteristics, the types of distribution channels used and the main issues that the market gardening food chain is facing.

To achieve this, we have addressed the following research questions (RQ):

- RQ1: What are the main characteristics and distribution channels of market gardeners?
- RQ2: According to market gardeners, what key issues are faced by the market gardening food chain?
- RQ3: How do farm characteristics, distribution channels and the issues associated to the market gardening food chain influence the viability of market gardeners?

In doing so, we seek to contribute to the ongoing research on building a more sustainable and resilient food system for the future by providing nuanced data and analysis on a specific agroecological system at a territorial level. This paper provides valuable insight to understand viability as it is experienced by stakeholders in their daily professional practice.

The results presented in this paper are part of the diagnosis phase of a broader participatory action research process (Lenette, 2022; McIntyre, 2008) in the Coeur de Condroz region that involves

market gardeners, two local action groups, one food policy council, researchers and other stakeholders. These results will therefore also contribute to the development of the market gardening short food supply chain in the Coeur de Condroz region.

2 Context: The Walloon vegetable sector

In Wallonia, the vegetable sector is highly globalized, resulting in a high dependence on imported vegetables. Only 17% of the consumed vegetables are produced in the region while most of the vegetables produced are exported (Apaq-W, 2022; Riera et al., 2020). In terms of the diversity of cultivated species, peas, green beans, carrots and onions alone represent more than 80% of the cultivated area for vegetables. While most of the vegetables are cultivated for the processing industry, around a fifth of the cultivated area is dedicated to the production of vegetables for the fresh market. These fresh vegetables are produced by about 335 market gardeners that grow a large diversity of vegetables on small areas (Apaq-W, 2022). A majority of them respect organic farming principles, and most of them are certified (Dumont, 2017). Although the area cultivated for fresh vegetables is much smaller than that for the production of vegetables for the processing industry, it represents a similar economic value (40 million of euros for the fresh vegetable sector vs. 45 million of euros for the vegetable sector associated to the processing industry, in 2018; Collège des producteurs & FWH, 2018).

3 Methods

3.1 Study area

The study takes place in the Coeur de Condroz territory which consists of seven rural municipalities in the Condroz and Famenne agricultural regions in southern Belgium (55 880 inhabitants, 625 km²; SPF, 2023; Statbel, 2022). Agriculture in these regions primarily focuses on meat or dairy cattle breeding, as well as main crop production (i.e. cereals, potatoes and sugar beet). Vegetable production is minor and represent 632 ha out of the 33 042 ha of cultivated area (SPW, 2022).

As part of the Walloon government's call for projects "*Supporting the relocation of food in Wallonia*", funding has been allocated to a project in Coeur de Condroz. This project aims to support two local action groups ("*Pays des Tiges et Chavées*" and "*Condroz-Famenne*") and a network of actors on peasant and citizen seeds ("*Réseau Meuse-Rhin-Moselle*") to set up a local food policy council (Pays des Tiges et Chavées, 2024). The general objective of this structure is to co-construct a more sustainable territorial food policy by facilitating the emergence of new local food chains (including for market gardening), increasing the supply and demand for local food products, strengthening resilience and food autonomy across the region, and facilitating the numerous initiatives in the region. Our research is embedded in this context, as it is conducted in collaboration with the food policy council and the local action groups.

3.2 Sampling procedure

Market gardeners were identified by integrating information from three sources: databases from the two local action groups in the territory, the Belgian federal food safety agency (*Agence Fédérale pour la Sécurité de la Chaîne Alimentaire*, AFSCA) database, and data collected from market gardeners' websites. Two criteria were used for selecting market gardeners. The first criterion was designed to ensure the inclusion of practitioners who grow fresh fruits and vegetables exclusively in their rotations. This involves market gardeners on small, medium and large area (Dumont, 2017). The selection excluded field crop producers mostly engaged in growing major crops such as wheat, barley, sugar beet, corn, and potatoes, who only dedicate part of their land to the cultivation of vegetables. The second criterion stipulated that market gardeners must be situated within the Cœur

de Condroz area. However, two market gardeners, located close to the boundaries of the area, were included in the study because of their interactions with other market gardeners or consumers in the region.

The sampling process enabled us to locate a total of 18 market gardeners. They all agreed to and participated in the interviews. This implies that we may have interviewed all the market gardeners within the specified geographic area. The interviews have been recorded, transcribed and coded. In cases where recording was not feasible (in 6 instances), only the handwritten notes were transcribed and coded.

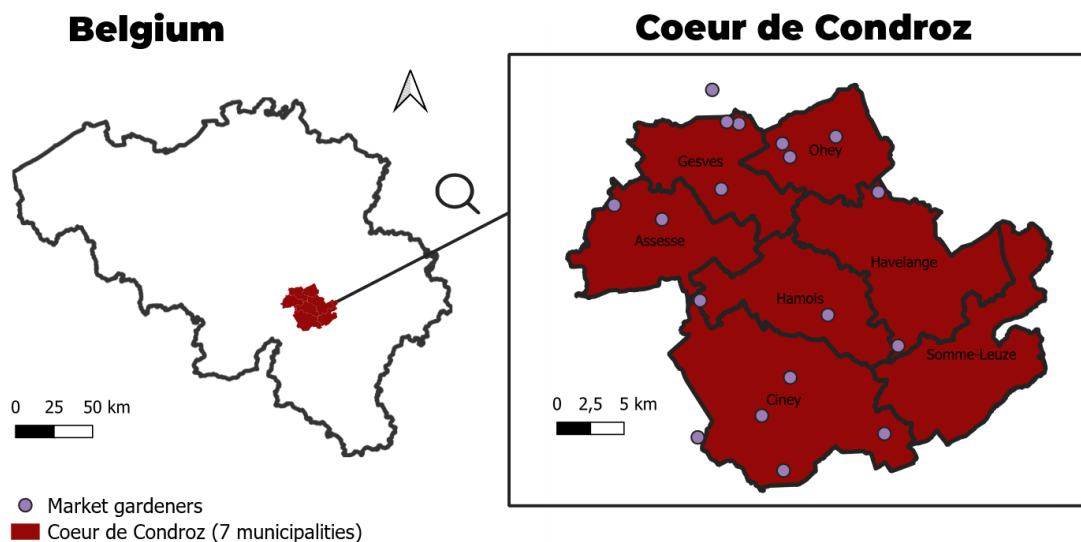


Figure 1: Map of the Coeur de Condroz area and location of the interviewed market gardeners. This map has been made with QGIS and Inkscape, using images from Flaticon.com.

3.3 Interviews

Interviews lasting one to two hours per market gardener were conducted during the year 2021-2022. The interviews were structured into two distinct parts.

The first part consisted of a semi-structured and comprehensive interview (Kaufmann, 2016; Magaldi & Berler, 2020; Appendix A). It encompassed inquiries about the market gardeners' background and history, their perspectives and future plans for their farms, details about the workforce, and their insights on the key challenges confronting the market gardening food chain.

The second part involved direct questions about market gardeners' specific characteristics such as cultivated area, types and quantities of vegetables grown, revenue, working hours, and other relevant information (Appendix B). Here, when we refer to the type of vegetable, we mean the type of vegetable that market gardeners label differently and sell at different prices. We do not particularly refer to the varieties or the species. The rationale for this approach is that it is simpler for market gardeners to provide this information. Additionally, the similarity in the types of vegetables they sell allows for meaningful comparisons between market gardeners.

The calculation of working hours was based on Morel (2016). Market gardeners were asked to specify the number of working hours in a typical, busy, or quiet week, as well as the frequency of such weeks in each month.

Eventually, questions were asked about the proportion of their revenue derived from different distribution channels. Based on existing literature (Comps et al., 2011; Dumont, 2017; RwDR, 2022)

and insights from a local market gardener, nine types of distribution channels were identified: markets (both annual and weekly), catering services (restaurants, hotels and cafes), on-farm shops, baskets (vegetable baskets prepared for consumers), local institutions (such as schools, nursing homes, and public social action centers), supermarkets, wholesalers, local cooperatives, and local shops. Following discussions with market gardeners, we chose to categorize franchise shops under local shops instead of supermarkets. This decision was made due to the small size of the shop and the fact that franchise shops sell their products exclusively within the local area.

Some market gardeners did not share their information on their revenue and profit before taxes. As a result, we gathered data from 16 market gardeners regarding revenue and profit before taxes.

Alongside interviews with market gardeners, 21 members of universities, non-governmental organizations, research institutes, associations and local institutions were consulted. These interviews were not transcribed in the study but provided an overall understanding of the market gardening sector in Wallonia.

3.4 Data analysis

All interview recordings and handwritten notes were transcribed manually and then coded and analyzed through an inductive approach using QualCoder software (Brailas et al., 2023). In the "Results" section, the notation "(n=...)" indicates the number of market gardeners who shared similar opinions in their interview. The quotes are translated by the authors into English to enhance reader comprehension. Information from the questionnaire was analyzed with the R software (R Core Team, 2023). The analysis encompasses descriptive statistics outlining the characteristics of market gardeners and their distribution channels. Additionally, two networks were established: one to depict connections among market gardeners and distribution players, and another to illustrate Spearman correlations among quantitative variables. Finally, given the non-normal distribution of the results, a mean comparison Wilcoxon test was conducted, aiming to discern differences between small and medium-scale market gardeners.

4 Results

The results are presented in four parts. The first three parts cover market gardeners' main characteristics, distribution channels, and their relationships, addressing the first research question. The fourth part discusses the main issues perceived by the market gardeners concerning the market gardening food chain, addressing the second research question.

4.1 Characteristics of market gardeners in Coeur de Condroz

4.1.1 Farm descriptions

According to Dumont's (2017) classification based on the technical orientation and the production model, our study identifies 14 market gardeners on a small scale, with 11 engaged in organic farming. The four remaining operate at a medium scale, with one of them adopting organic farming practices. All studied market gardeners cultivate a wide variety of vegetables (from 20 to 70 vegetables; Table 1). Most of them do buying-reselling (n=15) which can represent from 1 to 65% of their *revenue*. Fifteen out of the 18 market gardeners have complementary activities to market gardening, such as parks and gardens managements (n=4), orchards (n=4), farm accommodation (n=3), beekeeping (n=2), selling of plants (n=2), poultry production (n=2), main crops (n=2), etc. Most of them do not come from a farming background (n=15).

Table 1: Characteristics of market gardeners (Sd= Standard deviation; n= number of market gardeners from which data were used)

	mean	sd	median	min	max	n
Total area [ha]	15.52	30.32	2.75	0.23	100	18
Cultivated area [ha]	1.68	1.99	1.02	0.15	8.3	18
Nb. of vegetables [#]	39	14	38	20	70	18
Revenue [eu]	119 228	66 955	125 833	2 300	226 000	16
Profit before taxes [eu]	13 779	22 706	4 500	-18 259	49 600	16
Revenue per FTE [eu/FTE]	32 767	17 930	29 205	1 966	64 581	16
Profit before taxes per market gardener FTE [eu/FTE]	6 351	10 991	1 997	-6 598	34 848	16
Nb. of Market gardeners [#]	1.56	0.64	1.75	0.5	3	18
Additional FTE [#]	1.07	0.97	1	0	3.5	18
Total FTE [#]	3.42	1.38	3.37	1.17	6.92	18
Buying-reselling [%]	27.72	23.94	27.5	0	66	18
Subsidies [eu]	8 190	15 374	725	0	50 000	18
Year since installation [yr.]	8.28	6.39	6.5	1	25	18

4.1.2 Working conditions

The difficulty of the work is a major concern emphasized by market gardeners. Three main aspects were shared: the complexity of the work, the work dependence on climatic conditions and the highly physical nature of the work. Another significant aspect concerning their working conditions, although not explicitly stated by the market gardeners in their interviews, is their substantial working hours.

The complexity of the work. Seven market gardeners stressed that being a market gardener requires knowledge and experience in various domains. The ability to switch between these areas adds to the challenge of the job. In this context, six market gardeners expressed that working alone was hard.

“In fact, the downside of the Internet is that you might think that it's actually easy. While not. And in reality, it's still full of choices all the time, it's really about being able to move from one thing to another.” (Market gardener A)

“Finally. I always say, you need to be multi-skilled in the sense that: you are a boss, you are a businessman, you are a technician...” (Market gardener B)

The work dependence on climatic conditions. Eight market gardeners emphasized their dependence on climatic conditions, which are subject to substantial variability from one year to the next. For instance, a market gardener shared that climate fluctuations over two consecutive years led to a notable variation in tomato yield—from 150 kg to 950 kg per year on his farm. One market gardener specifically highlighted issues concerning water accessibility and the consequences of water-related problems (e.g. droughts and floods).

“We are never sure of having money coming in. That is what stopped me from moving forward. We are constrained by the weather and the climate. All it takes is a bad season and... We had floods, for example. Well, we are clearly screwed even though we had prepared everything, we had done everything well.” (Market gardener C)

The highly physical nature of the work. Six market gardeners stressed that market gardening requires a lot of work all the time, even when it rains or in winter. Three market gardeners reported suffering injuries due to physical exhaustion, such as a lame leg, a disc hernia, and back pain.

“So, to like our job, you really have to be passionate! As with any job, you have to find a purpose. In our case, I think that for everyone it is passion. [...] Why? Because it’s a very physical job and it depends on other things like the weather and the climate.” (Market gardener B)

The significant working times. The surveyed market gardeners reported an average working time of 59.28h per week (1.56 full-time equivalent; Figure 2). This changes substantially within the year. The busy working season last from April to October and reaches a peak of 64 hours per week on average, in May. The least busy month is January with an average of 36 hours per week.

“Obviously we work on Sundays. You have to work all the time.” (Market gardener D)

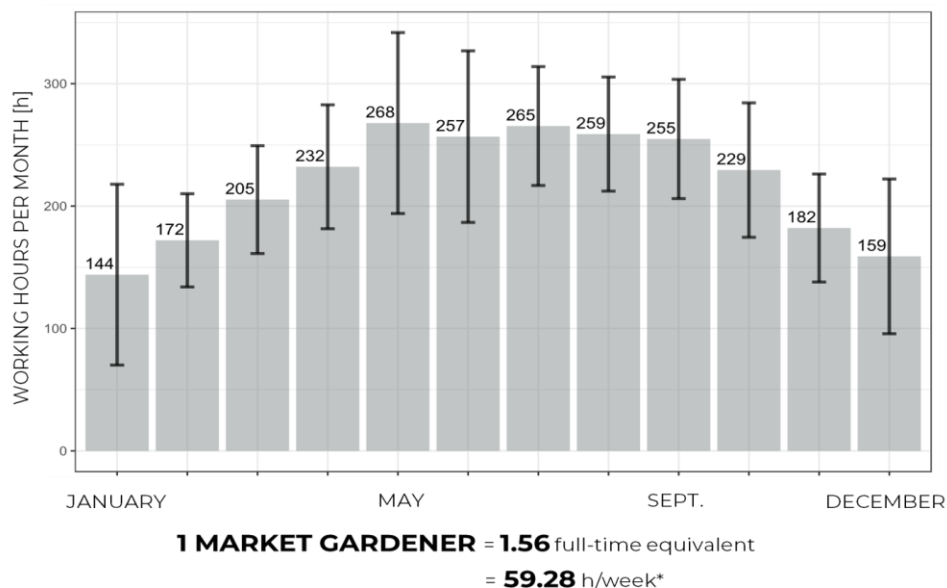


Figure 2: Average working hours per month of market gardeners. *On average, one market gardener represents 1.56 full-time equivalent (1 FTE = 1824 hours/year). If we consider that there are 48 weeks of work per year, it means that market gardeners work 59.28 h/week.

4.1.3 Economic performances

12 market gardeners mentioned clearly that market gardening is not a profitable job, specifically when you start and do not have land or money:

“Well, as a market gardener we know well that it is not with that job that we become rich.” (Market gardener C)

Indeed, four market gardeners out of 16 have a *revenue per hour* of less than 11 €/h. As a result, none of the market gardeners reaches a *profit before taxes* higher than 9 €/h. Nevertheless, the *profit before taxes* is not a good proxy of what market gardeners really earn, as it depends on the status of the farm and the investments done by the farmer. In fact, market gardeners tend to lower their *profit before taxes* to reduce the taxes they must pay. Furthermore, six market gardeners pay

themselves a salary ranging from 450 to 2100 € per month, and this is not accounted for in the *profit before taxes*.

According to them, factors that influence the profitability of the farm are the initial situation of the farmer and the management practices (e.g. choice of distribution channel, development strategy, farm size and the share of buying-reselling).

This is in line with the positive Spearman's correlation observed between the *Revenue per FTE* and the proportion of revenue generated from *buying and reselling activities* ($r = 0.59$, $p\text{-value}=0.016$; Appendix C).

However, according to our data, the *type of production system*, the *year since installation*, and the *cultivated area* do not have a major impact on the economic performances. Indeed, the only significant difference concerning the production systems on the economical performances relates to the farm size. Small-scale market gardeners have a higher *revenue per area* than medium-scale market gardeners (Appendix D). However, there is no difference in term of *revenue per FTE* between the two technical orientations.

Finally, it is worth noting that the amount of money coming from public subsidies perceived by market gardeners is rather low. Those who receive subsidies are market gardeners certified in organic farming (receiving on average 1.192 euros via the common agricultural policy) and/or market gardeners also cultivating main crops. Those who cultivate main crops obtain more subsidies since these are granted per hectare. Apart from the common agricultural policy aid, only two farms received subsidies for investment or employment in 2021-2022.

4.1.4 *Years since installation correlates to cultivated area*

Our results show a positive correlation between the *year since installation* and the *cultivated area* ($r = 0.60$, $p\text{-value} < 0.01$; Appendix C). The low availability of land and its high price play a critical role in land access for the market gardeners (see section related to land access). As a consequence, young market gardeners face difficulties to access large cultivated areas.

“There is a scarcity of goods to buy. And then the price. I was able to buy here because I already had 5-6 years of operation and profitability which meant that we were able to put in the money. And that I had a certain inertia. But from the start, without having made our hyper gradual start it would not have worked.” (Market gardener E)

4.2 Distribution channels of market gardeners

4.2.1 *Poor connectivity*

The market gardeners' network with distribution players reveals the absence of a unified community but instead consists of small groups connected to each market gardeners' network (modularity = 0.7¹; transitivity = 0; Figure 3). This network only represents sales of end products.

¹ Modularity is a function designed to assess the quality of a partition within communities in a network (Newman & Girvan, 2004). Transitivity reveals the presence of closely connected communities, clusters, subgroups, or cliques (Casleton et al., 2022).

In addition to the on-farm sales, market gardeners work on average with 5.67 distribution players (min=0; max= 15). Market gardeners on medium scales tend to work with more actors (mean=11.5) than market gardeners on small scales (mean=4). One of the local distribution cooperatives is a central distribution player, selling products of 10 market gardeners.

In the survey, 16 out of 18 market gardeners expressed their motivation to enhance any type of collaboration with other market gardeners (e.g. selling vegetables to each other, sharing equipment, etc.).

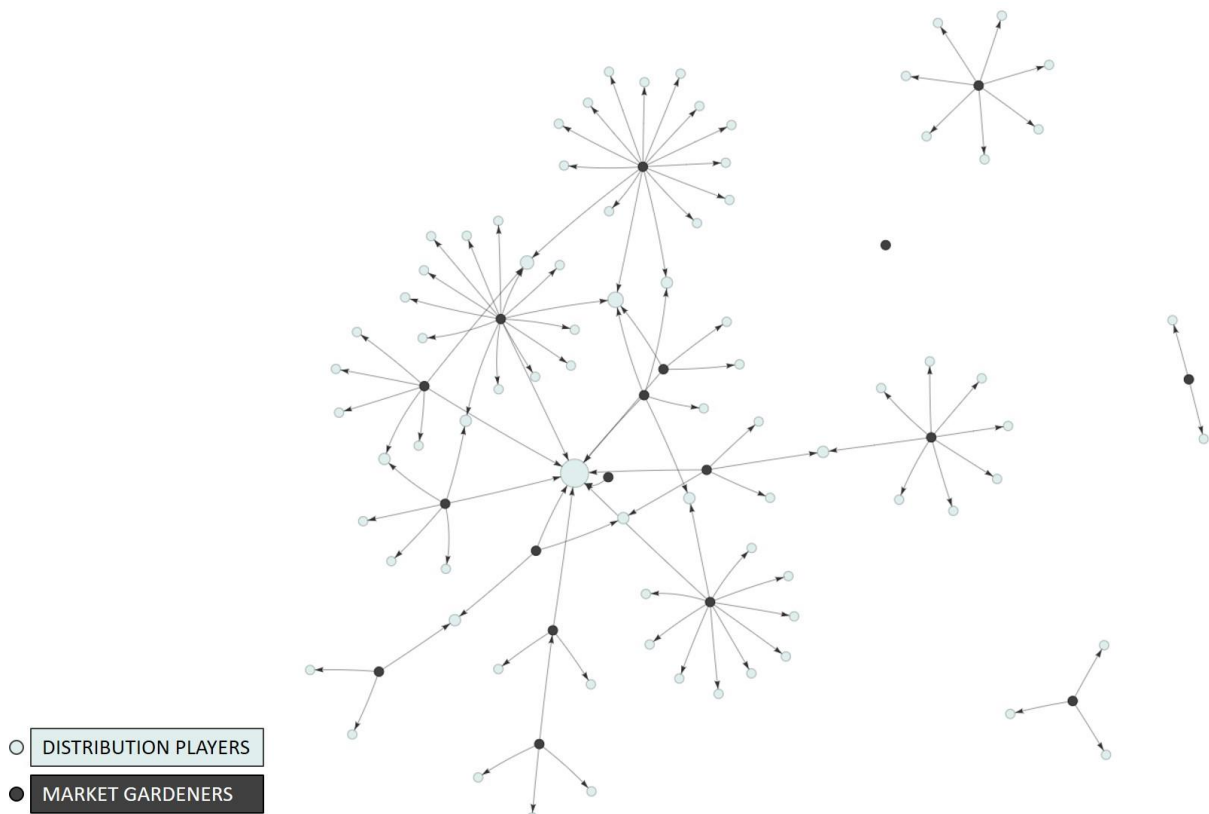


Figure 3: Market gardeners' network with distribution players. Edges represent the sales (from market gardener to distribution players). Market gardeners with no edges only sell their products on-farm. The size of the distribution players is proportional to the number of market gardeners they work with (i.e. number of in-degrees).

4.2.2 Vegetables are sold locally

Market gardeners in Coeur de Condroz sell most of their product locally. Indeed, 97 % of all the revenues come from local distribution channels (i.e. *local cooperatives, local institutions, local shops, catering, baskets, markets, on-farm shops, and other types*; Figure 4).

The remaining three percent are sold through *supermarkets* or *wholesalers*, that could also sell the products locally.

4.2.3 Strategic choices regarding distribution channels

The percentage of the revenue that each distribution channel represents varies substantially between market gardeners. Two market gardeners only sell their products through business-to-

business channels (B2B), without any contact with the consumers. For three other market gardeners, the sales through *markets* represent 75% or more of their revenue. All the remaining market gardeners have an *on-farm shop* but the share of the revenue that comes from the *on-farm shop* is highly variable. In fact, the importance of the share of *on-farm shops* in the revenue is counterbalanced by the share of the revenue represented by baskets or local cooperatives.

It is interesting to note that supermarkets and local shops represent a higher share of the revenue for medium-scale market gardeners than small-scale market gardeners (Wilcoxon test p-value < 0.01).

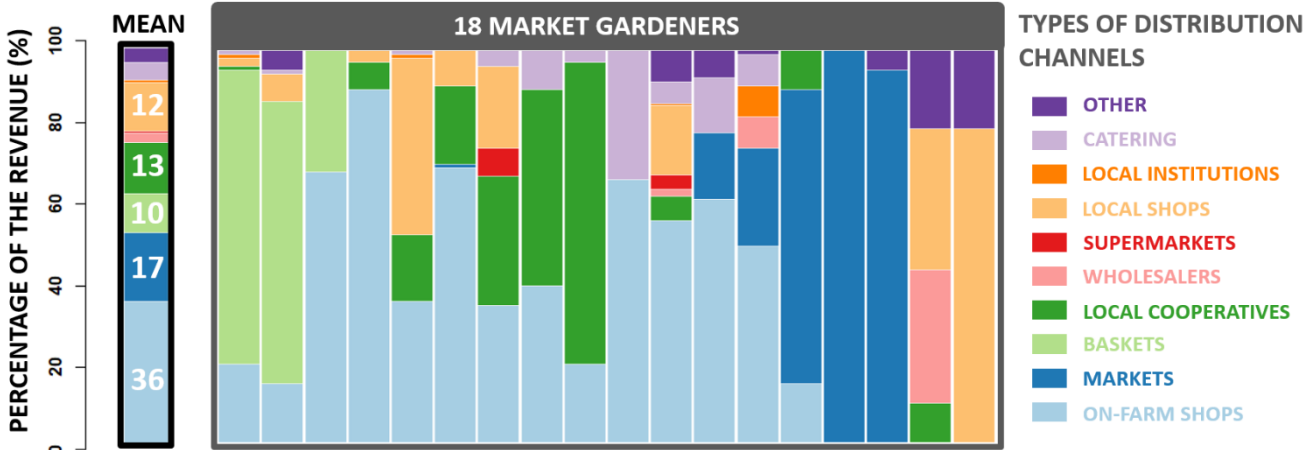


Figure 4: Percentage of the revenue that each type of distribution channel represents for each market gardener.

4.2.4 Wholesalers: Balancing scale efficiency and price pressures

Two market gardeners are selling large volumes to *wholesalers*. They claim that even if the products are sold at lower prices, it is worth it as this represents less sales efforts and larger volumes. One of them admits having felt pressure on the prices and reacted to it by choosing different distribution channels.

“But the relationship with [wholesalers], it has not always been easy. This is typically what causes problems. It’s the pressure on prices. But we also know who we’re talking to, so we don’t expect high prices. And then, having only half a full truck is costing me a lot of money ! Even if the price is 20% cheaper, the sales effort that I would have to put in to sell this volume and the risks of loss of unsold items that I could have created if I did not have this type of customers, it’s problematic too. So, all in all, you need a little bit of everything. You need to be able to do several things otherwise it’s clear that it is not going to work.” (Market gardener F)

4.2.5 Absence of local institutions & catering

Local institutions and *catering* are distribution channels that are hardly used by market gardeners, representing on average 5% of their revenue. Six market gardeners mentioned that *local institutions* and *catering* are highly demanding, unpredictable, and require a lot of time for the few vegetables sold.

“Before, at the beginning. I worked with restaurants, but you have to chase them all the time to get your money. They buy you two salads... It's a lot of quibbling for not much.” (Market gardener G)

4.2.6 Potential of local cooperatives

Market gardeners in Coeur de Condroz work with two main local cooperatives. One is a key distribution player, selling products of ten market gardeners. Opinions among market gardeners on both cooperatives are mixed. Eight agree that the cooperatives' intentions are good and that they have a great potential. They underline that local cooperatives allow them to reach more clients by extending their network and that this helps them to dispose of the surplus.

“I think it's a great initiative. As a market gardener. I find it great. [...] Here, with the cooperative, you do everything by ordering. There's no damage, there's no excess, it's great.” (Market gardener H)

However, 12 market gardeners nuance these positive impacts. Some of them emphasized a pressure on the price due to an increased competition between market gardeners (n=4) and the consumer-driven decision model of the cooperatives (n=5).

“These are basically good ideas. But the problem is that at some point, for me, they then tend to have a kind of monopoly too. They put market gardeners in competition. If someone has priority. I end up with all my fennels because in fact there was a guy who had priority.” (Market gardener A)

Others criticize the structure of the cooperatives (n=5), particularly its reliance on volunteers and subsidies and the irrelevance of the working hours of its employees in relation to the reality of market gardening. Finally, two conventional market gardeners feel that the main cooperative favours organic produce, sometimes to the detriment of promoting local produce (i.e. buying from an organic wholesaler rather than from a conventional local market gardeners).

4.3 Main characteristics and distribution channels of market gardeners

4.3.1 Buying-reselling correlates with selling at markets

The share of *buying and reselling* activities in the *revenue* is significantly correlated with the share of the *revenue* originating from *markets* ($r = 0.63$, $p\text{-value} < 0.01$). *Buying-reselling* is done by most market gardeners (n=15). This practice has been mentioned by some as essential for the farm profitability.

“We need the buying-reselling to survive. And it is necessarily to propose different products for the consumer.” (Market gardener I)

The consumers' desire for a diverse selection of fruits and vegetables at their shopping destinations largely accounts for this phenomenon. *Markets*, in particular, require market gardeners to offer a broad range of fruits and vegetables because consumers prefer not to visit additional locations for their shopping needs.

“For 4-5 years. I didn't do it, and I realized that I had to. All the market gardeners who say: 'Yeah. we won't do it', well, they all end up doing it. People don't want to eat only apples.” (Market gardener G)

Market gardeners who carry out a lot of *buying-reselling* (25 to 65% of turnover) mainly buy from a wholesaler. However, most of them pay attention to where their products come from. Often, these are fruits (e.g. bananas, oranges, etc.) bought outside Belgium. This range of market gardeners includes all those who attend *markets* (weekly or annually) and some who sell direct (*on-farm shops*).

4.3.2 *Years since installation negatively correlates with baskets*

The proportion of revenue derived from selling *baskets* exhibits a negative correlation with the *number of years since installation* ($r = -0.51$, $p\text{-value} = 0.029$). For example, two experienced market gardeners mentioned that selling *baskets* directly to consumers demands a considerable amount of energy and, in their view, is not profitable.

4.4 Issues related to the market gardening food chain in Coeur de Condroz

4.4.1 *Access to land: low land availability and high prices*

Nine market gardeners brought up concerns regarding access to land. They unanimously acknowledged the low availability of lands and particularly the difficulty of locating good and nearby land. In addition, the unaffordable cost of land was raised by seven market gardeners as another important aspect of the land access issue.

Besides, a trade-off exists between owning land, which demands substantial capital and could lead to years of debt, and renting land, which typically offers subpar conditions and lacks long-term security.

“The land pressure here in Belgium is crazy. It is crazy! I mean, we just discussed it again at lunchtime. You don't have enough with five farming careers to pay for your land, that's not possible. It's just if you have money to invest. But when you start on the farm you don't have money to invest so you don't have 45 solutions.” (Market gardener J)

The reasons for this lack of land access cited by market gardeners were the competition between cultivated and buildable area ($n=2$) and the involvement of prominent landowners (e.g. large supermarkets) investing in land ($n=3$), resulting in land speculation and a reluctance of these landowners to sell.

4.4.2 *Competent workforce is hard to find*

Finding workforce is essential for small market gardeners. Interestingly, this is perceived as a source of stress for three market gardeners that are not in organic farming. A major problem, highlighted by at least five market gardeners, is the difficulty of finding a workforce that is motivated, competent, and that stays in the long term.

“And then we have labor problems too. We have a lot of difficulty finding labor. And since we have a market gardening farm, it requires a lot of labor. And we realize that we no longer find any. So, in fact, it becomes unmanageable. [...] The labor is awful! Labor is really one of the things that makes me the most stressed, actually. [...] Well, the obstacles are that we can't find anyone reliable.” (Market gardener J)

Different kinds of workforces were cited: volunteers, seasonal workers, employees, group of employees and trainees. According to eight market gardeners, it is difficult to find an employee or a trainee that stays. They said that, in general, the best workers leave to create their own business. Also, one market gardener highlighted that having employees was stressful in the winter season

because you must find them something to do that still makes them profitable for you. In that sense, three market gardeners mentioned that hiring seasonal workers is convenient because it provides workforce during the harvesting season. One issue highlighted by a market gardener is the predominance of non-Belgian seasonal workers. The market gardener attributes this phenomenon to the observation that Belgians often receive comparable earnings from unemployment benefits as they would from working as a seasonal worker.

4.4.3 Lack of quality training

Ten market gardeners highlighted the insufficient training quality in market gardening. One of them pointed out the limited knowledge about organic market gardening in Belgium and the lack of emphasis on organic farming and market gardening in agricultural schools.

“And the other fundamental element is training. And on that side, it's the same. Because in terms of organic farming we are absolutely nowhere. Nowhere! It's impressive. And it is not only that we are nowhere but there is actually a rejection. In agricultural schools, organic is struggling to find space. Here in [municipality] for example. I don't know what this school is called, there, there is hostility towards organic.” (Market gardener K)

“We see the main field crops, the cereals, the meadows and that's all. Everything that is vegetables, we discover, we learn, we do trials and errors.” (talking of an agricultural school program; market gardener L)

4.4.4 Consumers' behavior: why do consumers not buy local?

Three market gardeners argued that consumers are aware of the interest of purchasing local, but one said that it does not imply that they will purchase local products. Indeed, three other market gardeners mentioned that consumers are not ready to pay more.

According to market gardeners, the reasons why consumers are not buying local food are practical (n=4) and because they have a wrong image of local products' price (n=2). The practical reasons mentioned by the market gardeners are that the farms are far away from where consumers are, and that the consumers must go to different selling points to fulfill their needs. In addition, they often lack time due to the current lifestyle. Concerning the price of local products, according to two market gardeners, consumers think that local is always more expensive, which is not necessarily the case.

“Now, it's true that we're also a bit isolated here. You have to come specifically. At the current pace of society, it's not possible for everyone to do that. People, we've seen it when there was the lockdown and there was nothing else to do but visit the producers, they found it extraordinary. And then afterward, they still find it extraordinary, but there's no one coming anymore, you know.” (Market gardener J)

Furthermore, five market gardeners highlighted the competition from supermarkets because they have all products in one place and can spend a lot of money on advertising.

“Yeah, that's it. Convenience. But there's still the communication aspect! When you get in your car, turn on the radio, you keep hearing [supermarkets], all the time. It is repeated constantly, and it stays in your mind all the time. They have huge visibility thanks to big budgets. And in the end, people are also paying for that in their vegetables. They're paying for the advertising, you know. They end up buying low-quality vegetables. That's my opinion.” (Market gardener A)

4.4.5 Lack of political recognition

Seven market gardeners pointed out the lack of recognition of market gardening. Indeed, due to their unique and complex nature, market gardeners often face marginalization or a lack of recognition from public services and other farmers. Furthermore, it is important to note that there is not agricultural union representing market gardeners' interest in Wallonia.

"I think that one difficulty is being taken seriously by the public authorities because we always feel not like a farmer but the little market gardener who does his weird thing on the side. So that plays out at the administrative level and at the financial level. But I think it also plays a role in the image that people have of our profession and the place we take in the sector. It's not always easy." (Market gardener I)

Despite political talk of promoting sustainable and local products, according to one market gardener no tangible changes have been observed in practice. Another highlighted the influence of powerful lobbies that favor intensive agriculture on the political side.

"If politics made good decisions for the people who elected them, in the sense that they don't try to promote big lobbies, then things would already be better." (Market gardener M)

5 Discussion

In this section, we build upon the results related to the research questions one and two to answer the third research question: How do farm characteristics, distribution channels and the issues associated to the market gardening food chain in Coeur de Condroz influence the viability of market gardeners.

5.1 Viability of market gardeners: an approach to socioeconomic evaluation

We showed that market gardeners perceived their profitability as low. Market gardening often involves finding a balance between working in alignment with personal convictions and meeting the requirements of technical efficiency and economic sustainability (Lanciano et al., 2010). In our study, market gardeners appear to be environmentally conscious, which could account for their modest economical performances (Morel, 2016). Yet, they are all aware of the difficulty and the importance of being sufficiently profitable to be able to continue their activity.

Our findings emphasize that one method for market gardeners to enhance their profits is through buying and reselling. This strategy has previously been identified as profitable in a study on market gardening in Wallonia (Dumont, 2017). The low taxation rate on food products in Wallonia and the ease of buying and reselling, especially for market gardeners with on-farm shops (which is common in Coeur de Condroz), contribute to this profitability. However, these buying and reselling transactions create a genuine ethical problem. It is paradoxical because market gardeners rely on and support the main regime actors by purchasing their vegetables. This contradicts the principle of being financially independent from other non-agroecological actors (Dumont et al., 2020). Future research could explore the relevance of this practice in local contexts and assess how buying and reselling could facilitate collaboration between market gardeners and other local producers or artisans. One possible approach could involve facilitating the purchase and resale of locally grown vegetables that are less profitable for small and medium-scale farms, such as carrots, potatoes, and onions. Market gardeners could source these products from larger farmers for resale. For instance, if

they are supported by the authorities, local cooperatives, larger-scale market gardeners, or collective groups of market gardeners could facilitate the development of local buying and reselling practices.

We highlighted that market gardeners in Coeur de Condroz have low revenues and profit before taxes. This is in line with what market gardeners perceived and other similar studies (Dumont, 2017; Morel, 2016). One of the reasons these production systems might be less profitable compared to conventional systems is their heavy reliance on manual labor (Dumont, 2017; Navarrete et al., 2015). However, Morel (2016) showed that microfarms could be economically viable due to an increase production per area, and a higher added value.

We found revenues and profit before taxes to be inadequate indicators for accurately assessing and comparing the economic viability of farmers. Some farmers with low revenue and profit before taxes reported a satisfactory well-being without feeling deprived, while others with high revenue and profit before taxes expressed concerns about their farm's viability. We believe that factors such as the minimum income needed to support the well-being of farmers, the maximum acceptable weekly workload, and the environmental and social aspirations that are meaningful to the farmer could be relevant additional information to better understand their viability (Morel, 2016; Plateau et al., 2019). Moreover, in this paper, we treated the viability of farms and market gardeners as interchangeable, as they often do not differentiate between the viability of their farm and their personal viability (Lanciano et al., 2010). Further exploration of this dual perspective may assist researchers in gaining a deeper understanding, and if necessary, distinguishing between the viability of market gardeners and/or their farms.

In addition, revenues and profit before taxes do not account for market gardeners' self-consumption of vegetables and complementarity activities, which may significantly impact their livelihood. Research demonstrates that self-consumption is vital for ensuring food security and sovereignty in various countries (Abdoellah et al., 2020; Hansen et al., 2022; Sant'Anna de Medeiros et al., 2020).

Our study also showed that the majority of market gardeners are involved in supplementary activities. Previous studies has indicated that engaging in supplementary activities, or having a partner with a stable job, influences farmers' investment capabilities and flexibility (David et al., 2010; Drottberger et al., 2021).

In this regard, we agree with Maréchal et al. (2019) and Morel (2016) that economic viability is not only related to farm profitability but also includes other aspects such as financial autonomy, price stability or contractual security. Moreover, the strategic decisions regarding the choice of distribution channels have been proven crucial in evaluating the economic viability of the farm (Morel, 2016).

Considering this, the working conditions, all the information related to the distribution channels, the degree of collaboration among market gardeners, and the key issues identified in this research regarding the market gardening food chain have a direct or indirect impact on the the viability of farms (Figure 5). Their impacts will be discussed in the four following subsections.

5.1.1 How do working conditions impact the viability of market gardeners?

Our results are in line with previous studies that highlighted the challenging working conditions in market gardening. These challenges stem from the complexity of the farming systems, the physically demanding nature of the job, and the reliance on weather conditions, leading to extended working hours (Dumont, 2017; Escalante & Santos, 2010; Hermesse et al., 2020; Lanciano et al., 2010; Morel, 2016; Navarrete et al., 2015). As mentioned by Navarrete et al. (2015), we observed a trend towards

simplification among some market gardeners, such as the willingness to simplify crop management and reduce the number of vegetables grown. Simplifying the work as much as possible and continuing with practices that work were advised given by experimented market gardeners in the interviews.

The calculated working hours are consistent with previous studies conducted in Belgium and France, which demonstrated a range from 36 to 120 hours per week (Dumont, 2017; Hermesse et al., 2020; Lanciano et al., 2010; Morel, 2016). These extended working hours are a common concern in small-scale market gardening and could potentially affect the farms' viability (Dumont, 2017). However, focusing solely on numerical data may be insufficient to capture the experiences of market gardeners. In certain cases, market gardeners do not perceive working hours in a traditional sense, leading to a blurred boundary between work, domestic, and leisure time (Lanciano et al., 2010). Literature on organic market gardening pointed out that in small and diversified systems work intensity is partly counterbalanced by an increase in work satisfaction, due to the interest and challenges that a more diverse system brings (Navarrete et al., 2015). As others, we found that direct selling contributed to a professional pride of producing healthy food for their local community (Enthoven & Van den Broeck, 2021; Navarrete et al., 2015).

5.1.2 How do distribution channels impact the viability of market gardeners?

Only few studies recorded the share of vegetables sold through the diverse distribution channels (Comps et al., 2011; Enthoven et al., 2023; Navarrete, 2009). We observed that, apart from market gardeners involved in direct sales at markets, all of them resort to at least two or three different distribution channels. This aligns with the findings of Enthoven et al. (2023), who noted that market gardeners in Wallonia typically rely on one primary marketing channel with additional ones for smaller volumes. We further observed that the selling price and the choice of distribution channel may vary based on the quantity produced. For instance, a strategic decision might involve starting with on-farm sales, followed by sales through local cooperatives or local shops, and then targeting supermarkets. This diversification in marketing strategies for fresh vegetable production plays a role in mitigating the risks associated with selling perishable products (LeRoux et al., 2010).

However, market gardeners employ other strategic decisions to deal with the perishability of vegetable products. Those engaged in market sales predominantly prefer this channel for almost all their products. This specific choice has not been extensively documented in prior research, largely because studies do not delve into individual farmer circumstances, do not analyse the volume or turnover percentage distributed through different channels, or primarily focus on comparing direct sales with other distribution methods (Comps et al., 2011; Enthoven et al., 2023; LeRoux et al., 2010; Navarrete, 2009). Another strategy used by market gardeners is to sell large volumes through a specific channel at reduced prices, leveraging economies of scale (LeRoux et al., 2010). In our study, we identified two market gardeners employing this strategy. However, it is worth noting that one of them acknowledged feeling price pressure, leading him to an increase in the number of distribution channels.

We showed that market gardeners with less experience are more likely to use baskets as a distribution channel. This could be due to their assumed stronger social and ecological convictions. Indeed, using baskets demands extensive time for harvesting and preparation, involving intricate planting patterns that can be challenging to manage (Navarrete et al., 2015). Moreover, some market gardeners avoid this distribution channel due to the year-long commitments required from consumers. The viability of this channel is then questionable. Some young market gardeners might

choose it due to their strong beliefs, such as desiring a close connection with consumers, or because it can be a way of ensuring a steady income.

The absence of local institutions and catering in market gardeners' distribution networks illustrates their current lack of viability, attributed to the demanding nature of these channels. In addition, our study revealed challenges faced by market gardeners in engaging with longer chains such as supermarket and auctions. Market gardeners encounter a competitive disadvantage when competing with larger producers who sell similar products at lower prices, making it challenging for them to secure fair prices through those channels (Mazoyer & Roudart, 2002). This is particularly noteworthy, considering that 88% of fresh fruit and vegetable purchases in the Walloon region are made in supermarkets (Collège des producteurs & FWH, 2018).

5.1.3 How do distribution network and collaboration impact the viability of market gardeners?

Except for a local cooperative occupying a central role, most distribution networks are tailored to individual market gardeners. This situation underscores the competitive nature among market gardeners, who operate within a relatively confined territory while producing similar vegetables. Navarrete et al. (2015) also highlighted competition among organic market gardeners, especially in direct selling activities. However, it is important to note that this competitive environment does not exclude the possibility of collaboration between them. For example, two market gardeners engaged in a mutual exchange, swapping a plow for a tiller. Additionally, one market gardener is supplying plants to at least two other market gardeners.

The cooperative has played a pivotal role in fostering collaboration among market gardeners. Participation in the cooperative has led market gardeners to engage in mutual planning, enabling each of them to sell their products effectively. This collaborative effort has led to the formation of an adaptive network, where market gardeners can complement each other's products within the cooperative. Additionally, the cooperative has sparked discussions about the balance between local and organic production among market gardeners and cooperative members, given the involvement of both conventional and organic market gardeners. However, our study also highlighted potential drawbacks associated with this cooperative, including increased competition and pricing pressures.

The role of collaboration is essential for sustaining local food systems (Chiffolleau, 2019; Lamine & Chiffolleau, 2016; Maréchal et al., 2019; Renting et al., 2003). It is even sometimes seen as one of the conditions for their success (Chiffolleau, 2019). By enhancing professional information sharing, collective initiatives can help solve technical and economic issues originating at the farm level (Chiffolleau, 2019; David et al., 2010; Renting et al., 2003). These collaborative efforts can also enhance economic viability through joint initiatives, such as shared use of specific materials, collective purchasing of inputs, sales of farm products or shared workforce (David et al., 2010; Navarrete et al., 2015). Moreover, collaboration and actions among farmers can help mitigate production irregularities through the exchange of products, as demonstrated in the mutual planning example mentioned earlier (Renting et al., 2003).

5.1.4 How does the market gardening food chain impact the viability of market gardeners?

The issues associated with land access play a critical role in the economic viability of market gardeners (Comps et al., 2011; Drottberger et al., 2021; RwDR, 2022). If the farmer does not own the land, it is more difficult for him or her to get access to financial support (Drottberger et al., 2021) and to invest in the long run (Dumont, 2017). In addition, this lack of a long-term vision is often seen as

preventing farmers from investing in agroecological practices, which are known both to be time-consuming and to yield the expected outcomes (such as providing ecosystem services) only over the long run (Duru et al., 2015). However, and quite interestingly, it appears that many market gardeners similar to those in Coeur de Condroz do implement agroecological practices despite not having long-term access to land.

The limited financial support received by market gardeners in Coeur de Condroz is evident, as only two of them received subsidies for investment or employment. Besides, the insufficient subsidies from the Common Agricultural Policy received by market gardeners are attributed to the area-based distribution method (Drottberger et al., 2021). This may change as the new Walloon Strategic Plan for the Common Agricultural Policy 2023-2027 has planned to give 4 000 euros per hectare for “*diversified market gardeners*” (SPW, 2021). However, considering the average size of market gardeners in Coeur de Condroz, that would only represent 6 720 euros per farm, which is still less than the average of 20 071 euros per farm in Belgium (BELPA, 2023). Proposals like increasing the basic income tax threshold, reducing employer taxes, or transitioning to an employment-based system for direct payments may address the lack of financial support for small-scale producers (Drottberger et al., 2021).

The challenge of land access not only affects non-owner farmers but also those who own land. Our study revealed that even land-owning farmers may encounter economic difficulties while repaying their loans. In our study, we noticed a positive correlation between market gardeners’ experience and the size of their cultivated area. This shows another link between land and farmers’ economic viability as we hypothesize that experienced market gardeners tend to increase their profits over the years, allowing them to invest in acquiring or renting more land.

The workforce also plays a critical role in the viability of farms. As already observed in France and Belgium (Dumont, 2017; Navarrete et al., 2015), we observed the challenges faced by market gardeners in finding competent and motivated workers, and the difficulty in retaining them in the long run. This situation sometimes results in an inefficient and unprofitable workforce for market gardeners, where more time is spent on training and supervising the workforce than the time saved by their contribution. Moreover, even when the workforce is skilled, typically trained by the market gardener on-site, they tend to leave. Contrary to other studies, ours did not consider the share of total labor associated with different types of labor (Dumont, 2017; Hermesse et al., 2020). Hermesse et al. (2020) highlighted that the use of volunteer workforce can play a role for the farm’s economic viability. In our study, even though a majority of market gardeners engaged with volunteers, this workforce model was not viewed as sustainable or desirable for the farm.

The status of market gardeners is another important aspect to consider, closely linked to the absence of political recognition. In Belgium, market gardening is not a regulated profession, and no specific training is required to enter the field. This lack of regulation can be crucial, as many market gardeners pointed out that newcomers often enter the profession with misguided expectations and typically abandon their activities after a short period. Furthermore, we pointed out the lack of quality training for market gardening in Belgium. This could also impact the economic performance of farmers, as some of them admitted feeling inadequately prepared to manage the diverse tasks involved in the job. Similar findings have been reported in Sweden (Drottberger et al., 2021).

Lastly, consumers' willingness to pay and rising demand significantly enhance farmers' sales. All market gardeners observed a positive economic impact in 2020 during the COVID-19 pandemic, thanks to increased demand for local products. This trend has also been observed more generally among market gardeners in Wallonia (Enthoven et al., 2023). However, this situation is nuanced, as for some, the heightened demand also created pressure to meet consumers' expectations. Previous studies indicate that consumers are willing to pay for local products, often even more than for organic alternatives, and local food is not necessarily perceived as expensive (Enthoven & Van den Broeck, 2021; Feldmann & Hamm, 2015). However, this can vary with the distribution channel used. For example, in Phoenix and Detroit (USA), consumers are more inclined to choose local products at a grocery store (i.e. intermediated channel) over farmers markets or on-farm shops (Printezis & Grebitus, 2018). In Wallonia, a study revealed that consumers in local food systems travel very short distances (Comps et al., 2011). Therefore, these systems are addressed almost exclusively to consumer nearby a selling point. In our study, market gardeners also emphasized that the distance to the on-farm shop affects consumers' willingness to pay. As a consequence, the supply in local products must cover the whole territory to meet enough interest (Comps et al., 2011).

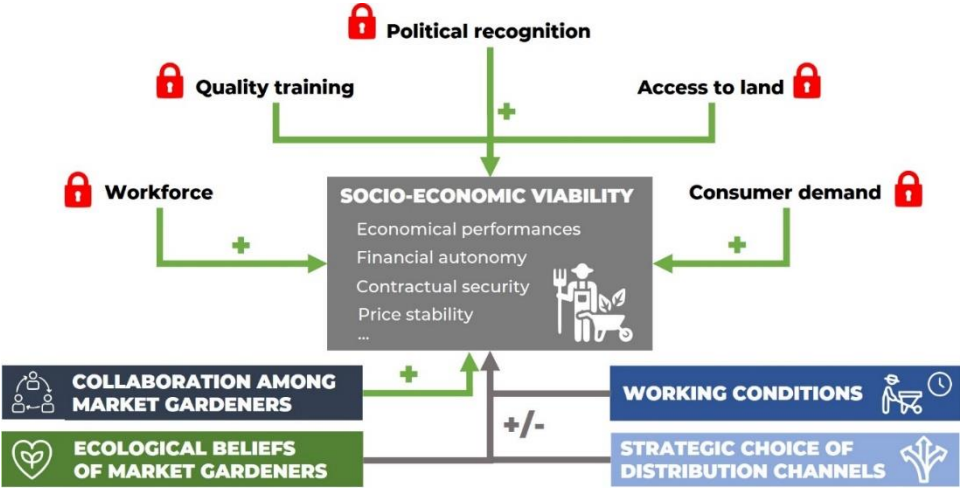


Figure 5: Schematic view of what influences market gardeners' socio-economic viability in Coeur de Condroz. Red padlocks highlight factors challenging market gardeners' socio-economic viability rather than contributing to its increase. Images: Flaticon.com.

6 Perspectives and conclusions

Market gardeners in Coeur de Condroz exhibit a strong environmental consciousness. They operate as small to medium-scale farmers, cultivating a diverse range of vegetables, and exclusively participate in short food supply chains. Their characteristics and challenges align with those of other small to medium-scale market gardeners in Wallonia, in Sweden and parts of France. Our study identified five key issues within the market gardening food chain: limited availability and high prices of land, difficulty in finding skilled workforce, lack of quality training, consumer behavior, and lack of political recognition. Assessing the socio-economic viability of these farms should consider factors such as working conditions, the choice of distribution channels, collaboration among market gardeners, and challenges specific to the market gardening food chain.

The viability of market gardeners is challenged by various factors in their working conditions, including the complexity of the farming system, physically demanding tasks, dependency on weather conditions, and long working hours. Conducting further qualitative research on market gardeners'

perceptions of their extended working hours and conditions is imperative. This investigation is essential for assessing whether these factors genuinely impact farm and/or market gardener viability or not.

The economic viability of market gardeners is critical. There is a correlation between higher revenues and buying-reselling activities, raising questions about the potential of this activity in promoting short food supply chains in Belgium. Despite the low economic performances, we argue that assessing socio-economic viability should be nuanced by incorporating qualitative insights into how market gardeners perceive their viability, their values, and requirements. This would enable us to better understand the tensions faced by market gardeners arising from the combination of logics (i.e. self-management, agroecological, territorial and commercial logics ; Plateau et al., 2021).

Furthermore, market gardeners employ diverse distribution channels and marketing strategies. However, no superior strategy was identified because market gardeners already employ diverse strategies adapted to their individual circumstances. Many market gardeners utilize multiple distribution channels, often with one main channel. Some of these channels, including local institutions, catering, and longer distribution channels, are presently inaccessible for market gardeners due to practical or competitive challenges. In light of these findings, future research could concentrate on developing strategies to render these distribution channels financially viable for farmers, especially within the context of fostering a more sustainable local food system.

The local cooperative was found to play an important role in enhancing collaboration among market gardeners. While it holds significant potential, attention must be paid to potential drawbacks, particularly concerning competition and pricing pressures. Collaboration plays a vital role in strengthening the sector and enhancing the logistics of this short food supply chain. Additional institutional support and the development of new types of associations involving various actors within the chains and their surrounding networks would promote the establishment of collaborative networks (Renting et al., 2003). In this respect, governments can play a role by promoting territorial food policy projects. It exists a lot of initiatives such as Food Policy Councils in cities across North America, Europe, the United Kingdom, and Australia (Prové et al., 2019; Schiff et al., 2022), the Territorial Food Projects in France (Guillot & Blatrix, 2021), and the Food Acquisition Program in Brazil (Oliveira & Galván, 2023).

Finally, we advise future research to look at other aspects than the farm economic performances to assess the socio-economic viability of market gardening. Evaluating and promoting the viability of a farm necessitates an understanding of its unique requirements and values (Morel, 2016). By addressing the issues of the food chain faced by market gardeners, we attempted to do so. We advocate for research focusing on short food supply chains and their potential contribution to an agroecological transition to adopt a systemic approach, aimed at understanding the distinct requirements and principles of all actors within the chain. Thus, we align with other scholars in recognizing the necessity for participatory action research or similar participatory methods, conducted ethically, to study and advance the development of agroecological short food supply chains, such as the market gardening short food supply chain in Coeur de Cendroz (Lenette, 2022; Wezel et al., 2020).

Acknowledgements

We sincerely thank Goedele Van den Broeck for her help with the methodology and the reading. We also thank all the market gardeners who took the time to be interviewed and share their information.

Declaration of interest

None.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT in order to improve readability and language. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

References

- Abdoellah, O. S., Schneider, M., Nugraha, L. M., Suparman, Y., Voletta, C. T., Withaningsih, S., Parikesit, Heptiyanggit, A., & Hakim, L. (2020). Homegarden commercialization : Extent, household characteristics, and effect on food security and food sovereignty in Rural Indonesia. *Sustainability Science*, *15*(3), 797-815. <https://doi.org/10.1007/s11625-020-00788-9>
- Anderson, C. R., Bruil, J., Chappell, M. J., Kiss, C., & Pimbert, M. P. (2019). From Transition to Domains of Transformation : Getting to Sustainable and Just Food Systems through Agroecology. *Sustainability*, *11*(19), Art. 19. <https://doi.org/10.3390/su11195272>
- Apaq-W. (2022). *Informations générales sur les légumes wallons | l'Apaq-W.* <https://www.apaqw.be/fr/informations-generales-sur-les-legumes-wallons>
- BELPA. (2023). *BELPA.* <https://www.belpa.be/en/search-data>
- Béné, C., Oosterveer, P., Lamotte, L., Brouwer, I. D., de Haan, S., Prager, S. D., Talsma, E. F., & Khoury, C. K. (2019). When food systems meet sustainability – Current narratives and implications for actions. *World Development*, *113*, 116-130. Scopus. <https://doi.org/10.1016/j.worlddev.2018.08.011>
- Brailas, A., Tragou, E., & Papachristopoulos, K. (2023). Introduction to Qualitative Data Analysis and Coding with QualCoder. *American Journal of Qualitative Research*, *7*(3), 19-31. <https://doi.org/10.29333/ajqr/13230>

- Casleton, E., Nordman, D. J., & Kaiser, M. S. (2022). Modeling Transitivity in Local Structure Graph Models. *Sankhya A*, 84(1), 389-417. <https://doi.org/10.1007/s13171-021-00264-1>
- Chevalier, C. (2022). *Exploring intercropping in market gardening* [UCL - Université Catholique de Louvain]. <https://dial.uclouvain.be/pr/boreal/object/boreal:263448>
- Chiffolleau, Y. (2019). *Les circuits courts alimentaires : Entre marché et innovation sociale*. Erès éditions.
- Chiffolleau, Y., Akermann, G., & Canard, A. (2017). Les circuits courts alimentaires, un levier pour une consommation plus durable ? Le cas d'un marché de plein vent. *Terrains & travaux*, 31(2), 157-177. <https://doi.org/10.3917/tt.031.0157>
- Collège des producteurs, & FWH. (2018). Horticulture Comestible—Plan de développement stratégique 2018 – 2028. *Filagri*. <http://filagri.be/horticulture-comestible/le-secteur-horticulture-comestible/plan-strategique-horticulture-comestible/>
- Comps, S., Jean-Jacques, C., Marc, V., Eléonore, H., & Philippe, L. (2011). Local food systems in Walloon Region (Belgium) : Definition and trends in supply and demand. In *ERSA conference papers* (ersa11p757; ERSA Conference Papers). European Regional Science Association. <https://ideas.repec.org/p/wiw/wiwrsa/ersa11p757.html>
- David, C., Mundler, P., Demarle, O., & Ingrand, S. (2010). Long-term strategies and flexibility of organic farmers in southeastern France. *International Journal of Agricultural Sustainability*, 8(4), 305-318. <https://doi.org/10.3763/ijas.2010.0497>
- De Schutter, O. (2017). The political economy of food systems reform. *European Review of Agricultural Economics*, 44(4), 705-731. <https://doi.org/10.1093/erae/jbx009>
- Drottberger, A., Melin, M., & Lundgren, L. (2021). Alternative Food Networks in Food System Transition—Values, Motivation, and Capacity Building among Young Swedish Market Gardeners. *Sustainability*, 13(8), 4502. <https://doi.org/10.3390/su13084502>
- Dumont, A. (2017). *Analyse systémique des conditions de travail et d'emploi dans la production de légumes pour le marché du frais en Région wallonne (Belgique), dans une perspective de*

transition agroécologique [UCL - Université Catholique de Louvain].

<https://dial.uclouvain.be/pr/boreal/object/boreal:192704>

Dumont, A., & Baret, P. (2017). Why Working Conditions Are a Key Issue of Sustainability in Agriculture? A Comparison between Agroecological, Organic and Conventional Vegetable Systems. *Journal of Rural Studies*, 57.

<https://dial.uclouvain.be/pr/boreal/object/boreal:187962>

Dumont, A. M., Gasselin, P., & Baret, P. V. (2020). Transitions in agriculture : Three frameworks highlighting coexistence between a new agroecological configuration and an old, organic and conventional configuration of vegetable production in Wallonia (Belgium). *Geoforum*, 108, 98-109. Scopus. <https://doi.org/10.1016/j.geoforum.2019.11.018>

Duru, M., Therond, O., Martin, G., Martin-Clouaire, R., Magne, M.-A., Justes, E., Journet, E.-P., Aubertot, J.-N., Savary, S., Bergez, J.-E., & Sarthou, J. P. (2015). How to implement biodiversity-based agriculture to enhance ecosystem services : A review. *Agronomy for Sustainable Development*, 35(4), 1259-1281. <https://doi.org/10.1007/s13593-015-0306-1>

El Bilali, H. (2019). The Multi-Level Perspective in Research on Sustainability Transitions in Agriculture and Food Systems : A Systematic Review. *Agriculture*, 9(4), Art. 4.

<https://doi.org/10.3390/agriculture9040074>

Enthoven, L., Skambracks, M., & Van den Broeck, G. (2023). Improving the design of local short food supply chains : Farmers' views in Wallonia, Belgium. *Journal of Rural Studies*, 97, 573-582.

<https://doi.org/10.1016/j.jrurstud.2023.01.016>

Enthoven, L., & Van den Broeck, G. (2021). Local food systems : Reviewing two decades of research.

Agricultural Systems, 193, 103226. <https://doi.org/10.1016/j.agsy.2021.103226>

Escalante, C. L., & Santos, F. I. M. (Éds.). (2010). *Differentiation in Farm Labor Complement Profiles of Organic and Conventional Farms in the Southeast : Coping with a Changing Farm Labor*

Market. <https://doi.org/10.22004/ag.econ.61359>

- European Commission. (2020). *Farm to Fork Strategy*. https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en
- FAO. (2020). *Fruit and vegetables – your dietary essentials : The International Year of Fruits and Vegetables, 2021, background paper*. FAO. <https://doi.org/10.4060/cb2395en>
- Feldmann, C., & Hamm, U. (2015). Consumers' perceptions and preferences for local food : A review. *Food Quality and Preference, 40*, 152-164. <https://doi.org/10.1016/j.foodqual.2014.09.014>
- Geels, F. W. (2011). The multi-level perspective on sustainability transitions : Responses to seven criticisms. *Environmental Innovation and Societal Transitions, 1*(1), 24-40. <https://doi.org/10.1016/j.eist.2011.02.002>
- Gliessman, S. (2018). Defining Agroecology. *Agroecology and Sustainable Food Systems, 42*(6), 599-600. <https://doi.org/10.1080/21683565.2018.1432329>
- Guillot, L., & Blatrix, C. (2021). Food, State and Territories : Dissemination and recognition of Territorial Food Projects in France (2014—2021). *Geographie Economie Societe, 23*(4), 437-459. Scopus. <https://doi.org/10.3166/ges.2021.0017>
- Hansen, L.-S., Sorgho, R., Mank, I., Nayna Schwerdtle, P., Agure, E., Bärnighausen, T., & Danquah, I. (2022). Home gardening in sub-Saharan Africa : A scoping review on practices and nutrition outcomes in rural Burkina Faso and Kenya. *Food and Energy Security, 11*(3). Scopus. <https://doi.org/10.1002/fes3.388>
- Hermesse, J., Van der Linden, M., & Plateau, L. (2020). Le bénévolat, un soutien au maraîchage professionnel agroécologique en phase d'installation. *[VertigO] La revue électronique en sciences de l'environnement, 20*, en ligne.
- HLPE. (2019). *Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security*.

- IPBES-Food. (2016). *From uniformity to diversity : A paradigm shift from industrial agriculture to diversified agroecological systems. International Panel of Experts on Sustainable Food systems.* <http://www.ipes-food.org/>
- IPBES-Food, IFOAM, Agroecology Europe, FiBL Europe, & Regeneration International. (2021). *A unifying framework for food systems transformation. A call for governments, private companies & civil society to adopt 13 key principles.*
- Kaufmann, J.-C. (2016). *L'entretien compréhensif: Vol. 4e éd.* Armand Colin; Cairn.info.
<https://www.cairn.info/l-entretien-comprehensif--9782200613976.htm>
- Kremen, C., Iles, A., & Bacon, C. (2012). Diversified Farming Systems : An Agroecological, Systems-Based Alternative to Modern Industrial Agriculture. *ECOLOGY AND SOCIETY*, 17, 44.
<https://doi.org/10.5751/ES-05103-170444>
- Lamine, C., & Chiffolleau, Y. (2016). Reconnecter agriculture et alimentation dans les territoires : Dynamiques et défis. *Pour*, 232(4), 225-232. <https://doi.org/10.3917/pour.232.0225>
- Lamine, C., Garçon, L., & Brunori, G. (2019). Territorial agrifood systems : A Franco-Italian contribution to the debates over alternative food networks in rural areas. *Journal of Rural Studies*, 68, 159-170. <https://doi.org/10.1016/j.jrurstud.2018.11.007>
- Lanciano, E., Bon, N., Héroult-Fournier, C., & Aubrée, P. (2010, décembre 9). *Diversité des logiques de travail dans les exploitations maraîchères en circuits courts.* 4ièmes journées de recherche en Sciences sociales - INRA SFER CIRAD. <https://shs.hal.science/halshs-00676845>
- Lenette, C. (2022). *Participatory Action Research : Ethics and Decolonization.* Oxford University Press.
<https://doi.org/10.1093/oso/9780197512456.001.0001>
- LeRoux, M. N., Schmit, T. M., Roth, M., & Streeter, D. H. (2010). Evaluating marketing channel options for small-scale fruit and vegetable producers. *Renewable Agriculture and Food Systems*, 25(1), 16-23. <https://doi.org/10.1017/S1742170509990275>

- Magaldi, D., & Berler, M. (2020). Semi-structured Interviews. In V. Zeigler-Hill & T. K. Shackelford (Éds.), *Encyclopedia of Personality and Individual Differences* (p. 4825-4830). Springer International Publishing. https://doi.org/10.1007/978-3-319-24612-3_857
- Maréchal, K., Plateau, L., & Holzemer, L. (2019). La durabilité des circuits courts, une question d'échelle ? L'importance de court-circuiter les schémas classiques d'analyse. *Économie rurale. Agricultures, alimentations, territoires*, 367, Art. 367. <https://doi.org/10.4000/economierurale.6487>
- Mazoyer, M., & Roudart, L. (2002). *Histoire des agricultures du monde : Du néolithique à la crise contemporaine* (Nouv. éd.). Éd. du Seuil.
- McIntyre, A. (2008). *Participatory Action Research*. SAGE.
- Morel, K. (2016). *Viabilité des microfermes maraîchères biologiques. Une étude inductive combinant méthodes qualitatives et modélisation*. (p. 353 p.) [Phdthesis, Université Paris Saclay (COMUE)]. <https://hal.archives-ouvertes.fr/tel-02801554>
- Morel, K., & Léger, F. (2016). A conceptual framework for alternative farmers' strategic choices : The case of French organic market gardening microfarms. *Agroecology and Sustainable Food Systems*, 40(5), 466-492. <https://doi.org/10.1080/21683565.2016.1140695>
- Mundler, P., & Rumpus, L. (2012). The energy efficiency of local food systems : A comparison between different modes of distribution. *Food Policy*, 37(6), 609-615. Scopus. <https://doi.org/10.1016/j.foodpol.2012.07.006>
- Navarrete, M. (2009). How do Farming Systems Cope with Marketing Channel Requirements in Organic Horticulture? The Case of Market-Gardening in Southeastern France. *Journal of Sustainable Agriculture*, 33(5), 552-565. <https://doi.org/10.1080/10440040902997785>
- Navarrete, M., Dupré, L., & Lamine, C. (2015). Crop management, labour organization, and marketing : Three key issues for improving sustainability in organic vegetable farming. *International Journal of Agricultural Sustainability*, 13(3), 257-274. <https://doi.org/10.1080/14735903.2014.959341>

- Newman, M. E. J., & Girvan, M. (2004). Finding and evaluating community structure in networks. *Physical Review E*, 69(2), 026113. <https://doi.org/10.1103/PhysRevE.69.026113>
- Oliveira, A. R., & Galván, G. H. (2023). The transformations of the Food Acquisition Program (PAA) in Goiás, Brazil (2010-2020) : Limits and possibilities for food sovereignty construction. *Atelie Geografico*, 17(2), 32-57. Scopus. <https://doi.org/10.5216/ag.v17i2.75620>
- Palomo-Campesino, S., García-Llorente, M., Hevia, V., Boeraeve, F., Dendoncker, N., & González, J. A. (2022). Do agroecological practices enhance the supply of ecosystem services? A comparison between agroecological and conventional horticultural farms. *Ecosystem Services*, 57, 101474. <https://doi.org/10.1016/j.ecoser.2022.101474>
- Pays des Tiges et Chavées. (2024). Conseil de Politique Alimentaire Cœur de Condroz. *Pays des Tiges et Chavées*. <https://www.tiges-chavees.be/alimentation-agriculture/conseil-de-politique-alimentaire/>
- Pépin, A. (2022). *Performance environnementale de fermes maraîchères en agriculture biologique*.
- Plateau, L., Maughan, N., Pipart, N., Visser, M., Hermesse, J., & Maréchal, K. (2019). La viabilité du maraîchage urbain à l'épreuve de l'installation professionnelle. *Cahiers Agricultures*, 28, 6. <https://doi.org/10.1051/cagri/2019005>
- Plateau, L., Roudart, L., Hudon, M., & Maréchal, K. (2021). Opening the organisational black box to grasp the difficulties of agroecological transition. An empirical analysis of tensions in agroecological production cooperatives. *Ecological Economics*, 185, 107048. <https://doi.org/10.1016/j.ecolecon.2021.107048>
- Printezis, I., & Grebitus, C. (2018). Marketing Channels for Local Food. *Ecological Economics*, 152, 161-171. <https://doi.org/10.1016/j.ecolecon.2018.05.021>
- Prové, C., de Krom, M. P. M. M., & Dessein, J. (2019). Politics of scale in urban agriculture governance : A transatlantic comparison of food policy councils. *Journal of Rural Studies*, 68, 171-181. Scopus. <https://doi.org/10.1016/j.jrurstud.2019.01.018>

- R Core Team. (2023). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Renting, H., Marsden, T. K., & Banks, J. (2003). Understanding Alternative Food Networks : Exploring the Role of Short Food Supply Chains in Rural Development. *Environment and Planning A: Economy and Space*, 35(3), 393-411. <https://doi.org/10.1068/a3510>
- Riera, A., Antier, C., & Baret, P. (2020). The vegetable sector in the Walloon Region : Current situation and scenarios towards 2050. *Sytra*. <https://sytra.be/publication/vegetable-sector-wallonia/>
- Ritchie, H., Rosado, P., & Roser, M. (2022). Environmental Impacts of Food Production. *Our World in Data*. <https://ourworldindata.org/environmental-impacts-of-food>
- RwDR. (2022). *Quelles stratégies pour le maraîchage durable sur petites et moyennes surfaces en Wallonie d'ici 2030 ? Enseignements & recommandations*.
- Sant'Anna de Medeiros, N., do Carmo, D. L., Priore, S. E., & Santos, R. H. S. (2020). Diverse food in urban gardens in the promotion of food and nutrition security in Brazil : A review. *Journal of the Science of Food and Agriculture*, 100(4), 1383-1391. Scopus. <https://doi.org/10.1002/jsfa.10127>
- Schiff, R., Levkoe, C. Z., & Wilkinson, A. (2022). Food Policy Councils : A 20—Year Scoping Review (1999—2019). *Frontiers in Sustainable Food Systems*, 6. Scopus. <https://doi.org/10.3389/fsufs.2022.868995>
- Shafiee-Jood, M., & Cai, X. (2016). Reducing Food Loss and Waste to Enhance Food Security and Environmental Sustainability. *Environmental Science & Technology*, 50(16), 8432-8443. <https://doi.org/10.1021/acs.est.6b01993>
- SPF. (2023). *Statistiques de population—Population—Direction générale Identité et Affaires citoyennes*. <https://www.ibz.rrn.fgov.be/fr/population/statistiques-de-population/>
- SPW. (2021). *Plan stratégique PAC - 2023-2027—Portail de l'agriculture wallonne*. Agriculture en Wallonie.

<http://agriculture.wallonie.be/cms/render/live/fr/sites/agriculture/home/politique-economie/plan-strategique-pac-2023-2027.html>

SPW. (2022, avril 1). *Régions agricoles de Wallonie*. Portail agriculture.wallonie.be. https://etat-agriculture.wallonie.be/contents/indicatorsheets/EAW-A_1_d_2.html#

Statbel. (2022). *Occupation du sol selon le Registre cadastral | Statbel*.

<https://statbel.fgov.be/fr/themes/construction-logement/occupation-du-sol-selon-le-registre-cadastral#figures>

Wezel, A., Bellon, S., Doré, T., Francis, C., Vallod, D., & David, C. (2009). Agroecology as a science, a movement and a practice. A review. *Agronomy for Sustainable Development*, 29(4), 503-515. <https://doi.org/10.1051/agro/2009004>

Wezel, A., Herren, B. G., Kerr, R. B., Barrios, E., Gonçalves, A. L. R., & Sinclair, F. (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. *Agronomy for Sustainable Development*, 40(6). Scopus. <https://doi.org/10.1007/s13593-020-00646-z>

Appendices

A. Questionnaire - Part 1: general information, workforce and key challenges

General information

Q1. What is your story? What brought you to the profession of market gardener?

[Motivations ; obstacles for installation ; previous experiences ; installation date ; qualifications ; acquisition of heritage ; agricultural origin ; beliefs]

Q2. What is the history of your farm? How does it work now?

[Viability ; advantages and constraints ; pride ; pluriactivity ; production mode ; marketing method(s); major developments]

Q3. What trajectory(s) for your farm?

[Perspectives of evolution ; challenges ; vision]

Workforce

Q4. How many people are there working on your farm?

[Role of the spouse on the farm; example for this year; sources of workforce]

Q5. What are the employment conditions?

[Type of contract ; statutes ; qualification (e.g. agricultural entrepreneur, skilled worker, unskilled worker, intern, family help)]

Q6. Estimated number of hours worked over the year for each worker

Key challenges

Q7. In your opinion, what are the main challenges for the market gardening sector in “Coeur de Condroz”?

B. Questionnaire - Part 2: main characteristics and distribution channels

This is a synthetized version of the questionnaire which shows what data was collected to the market gardeners. For the complete version, please ask to the corresponding author.

1. Farm characteristics

- Total area of the farm [ha]

- Area cultivated for vegetables [ha]
- Number of vegetables grown
- Type of certification (if there is)

2. Working hours

- Working hours for a typical, busy and quiet week
- Number of typical, busy and quiet weeks per month

3. Economic data

- Revenue for the year 2021 [euros]
- Profit before taxes for the year 2021 [euros]
- Percentage of the revenue coming from buying-reselling [%]
- Amount received by subsidies [euros]

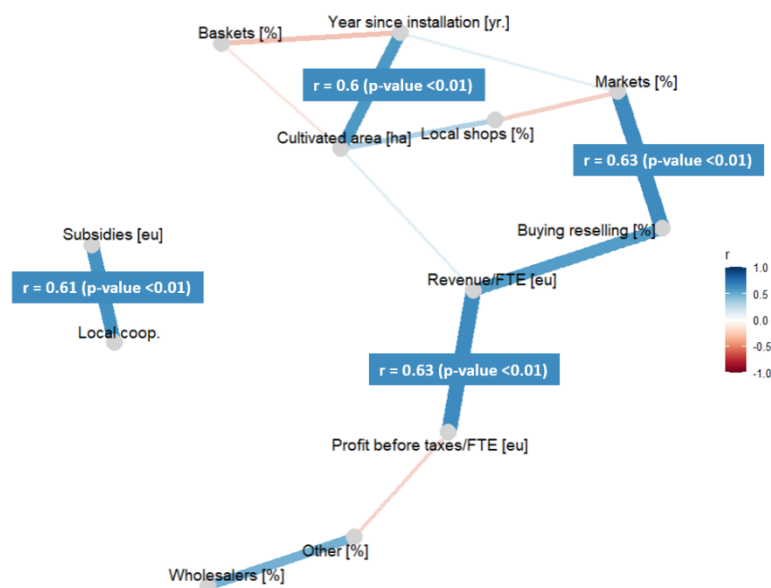
4. Distribution channels

- Which distribution channels are used among these: on-farm shops, markets, baskets, local cooperatives, wholesalers, supermarkets, local shops, local institutions, catering, others
- Percentage of the revenue coming from each distribution channel used [%]
- Name(s) of the distribution actor(s), for each distribution channel used

5. Complementary activities and collaboration (if there is)

- Complementary activities (other than related to vegetable production)
- Type of specialization linked to vegetable production (e.g. specialized in squash)
- Willing to collaborate with other market gardeners. For instance, if there are specialized in the production of one type of vegetable.

C. Correlation network based on significant spearman's correlations among quantitative variables (p-values < 0.05; H0: r=0 vs. HA: r≠0)



D. Differences in market gardeners' characteristics based on Dumont (2017) classification

Mean, differences in means (Difference), adjusted p-value (method: Holm–Bonferroni) and significance of Wilcoxon test (* adj. p-value < 0.05; ** adj. p-value < 0.01) for market gardeners on a small scale (MPS) and on a medium scale (MMS).

Variable	Mean MMS	Mean MPS	Difference	Adjusted P_value	Significance
Cultivated area [ha]	4.53	0.86	3.67	0.003	**
Nb. of vegetables [#]	39.25	38.79	0.46	0.83	ns
Revenue [eu]	151781.75	138501.54	13280.21	0.336	ns
Profit before taxes [eu]	16102.75	13004.17	3098.58	1	ns
Revenue/FTE [eu/FTE]	32963.41	32701.45	261.96	0.862	ns
Profit before taxes/FTE [eu/FTE]	7195.69	6069.9	1125.79	0.903	ns
Revenue/ha [eu/ha]	38590.29	152866.07	-114275.78	0.042	*
Profit before taxes/ha [eu/ha]	2787.48	12437.14	-9649.66	0.714	ns
% buying-reselling	13.25	30.71	-17.46	0.241	ns
FTE of market gardener [#]	1.6	1.55	0.05	0.233	ns
Number of market gardeners [#]	1.75	1.5	0.25	0.731	ns
Additional FTE [#]	2.29	0.71	1.58	0.019	*
Area per vegetable [ha/# of vegetables]	0.12	0.03	0.09	0.005	**
Total FTE [#]	4.9	3	1.9	0.035	*
Total FTE/ha [FTE/ha]	1.32	6.19	-4.87	0.012	*
Year since installation [year]	9.75	7.92	1.83	0.82	ns
Subsidies [eu]	20 466	4 682	15 784	0.095	ns