What Demand and Supply Forces determine the location of off-farm points of sale in Short Food Supply Chains: Evidence from Nord and Pas de Calais, France

Rawaa LAAJIMI[*,2], Laurence Delattre[†,1], Hubert Jayet[‡,1], and Nicolas Debarsy[§,1]

[1]Univ. Lille, CNRS, IESEG School of Management, UMR 9221 - LEM - Lille Économie Management, F-59000 Lille, France.

[2]INRAE (French National Institute for Research on Agriculture, Food and Environment), Ecodéveloppement, Avignon, France

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Abstract

If the characteristics and location of farms and consumers involved in short food supply chain (SFSC) are well studied, especially for on-farm sales, the location of off-farm points of sale - as interaction point between supply and demand – has not been much analyzed, especially from a quantitative perspective. Though, a better understanding of the factors favoring and impeding the emergence of such points of sale could be valuable for producers (farmers), sellers (farmers or intermediaries), consumers (through consumers driven initiatives) but also for policymaking. To fill this gap, we have compiled an original database from local, regional, and national websites for the year 2020 and geolocalized more than 500 points of sale (pick-up point for sale by internet, pick-up point for community supported agriculture, producers' collective stores, markets and retail stores) in two French departments (Nord and Pas-de-Calais). We account for the local environment of each point of sales, both in terms of potential supply of agricultural products and potential food demand, by relying on distance-weighted variables (inspired by the concept of market potential). We then estimate a count model at the municipal level to distinguish the demand and supply factors explaining the creation of points of sale. Even though this first model is already estimated at the smallest administrative geographical scale, leading to potential policy recommendations, we also wanted to go as far as possible in the understanding of the location of off-farm points of sales and we thus estimate a model explaining the existence of a point of sales at the INSEE-grid scale (200 square meters). After discussing our finding, the paper closes on policy recommendations and future research opportunities.

1 Introduction

In recent years, short food supply chains (SFSCs) have been the subject of renewed interest on the part of consumers, agricultural producers, and public policy makers. This renewed interest can be attributed to several reasons such as concerns about loss of consumer confidence following various crises in the agri-food industry (mad cow disease, dioxin contamination in chicken and horsemeat in ready meals...) and growing environmental awareness, which induces society to question the environmental impact of our food habits (intensive farming practices, food miles...). Farmers' wage and the cost of food (and thus the margins for the agro-industry and distribution) are also part of the motives behind this renewed interest. The (re)development of local short supply chains also attracts other actors involved in organizing or promoting them, as well as public decision-makers at various levels.

[*]rawaa.laajimi@inrae.fr

[†]laurence.delattre@univ-lille.fr

[‡]hubert.jayet@univ-lille.fr

[§]nicolas.debarsy@cnrs.fr

SFSC is not uniquely defined but most of the definitions generally refer to the absence or to a limited number of intermediaries between farmers and the final consumer. Some alternative definitions can also include geographical proximity between farmers and final consumers (Kneafsey et al., 2013; Praly et al., 2014; Vonthron and Devillet, 2023). Among SFSC, we can namely distinguish on-farm and off-farm sale. On-farm sale is among the most studied SFSC marketing methods. Consequently, the location of farms involved in this sales method is also fairly well studied. By contrast, the location of other kinds of point of sales (such as markets, off-farm shops, CSA or online order pick-up points, vending machines...) has not received much attention in the literature. Yet, off-farm SFSC selling takes over an ever-increasing importance in SFSC (Martinez and Park, 2021; Aubry and Chiffoleau, 2009; Vogel and Low, 2015; Chiffoleau et al., 2021; Horvath, 2023). This lack of attention can in part be attributed to the difficulty in obtaining data about these sales points. However, the location of these points responds to logics that differ from those in the location of on-farm sales and their analysis seems necessary to better understand the factors, obstacles and development methods of SFSC in the diversity of concerned territories, particularly with a view to supporting public policies aimed at these dynamics.

This paper tends to contribute to fill in this gap by investigating the determinants that influence the location of off-farm SFSC points of sale (PoS) in the French departments of Nord and Pas-de-Calais (NPdC), a region that is quite typical of the agricultural and urbanization patterns of Northern Europe. Relying on a geolocalized dataset we built, we empirically examine the supply and demand characteristics that affect their location. We first analyse the number of off-farm SFSC PoS at the municipal level and then focus on their presence or absence at the INSEE (National Institute of Statistics and Economic Studies) grid cell level (200*200 meters). Indeed, the municipal level is relevant in the sense that it is the minimal level of aggregation that corresponds to a public decision scale. However, this level can hide a lot of infra-municipal heterogeneity that can play a role in PoS location. Therefore, we also perform the analysis at the finest disaggregated level for which we have data. In these analyses, we use variables whose calculation is inspired by the concept of market potential to take into account not only the characteristics of the location (municipality or grid) of the PoS but also the characteristics of surrounding locations as explanatory factors. While this approach is widely used in geographical economics, to our knowledge it is rarely used in works on the location of agents involved in SFSC.

Our results show that both demand and supply characteristics significantly impact the number of short food supply points. Focusing on municipalities, the negative binomial model, identifies key factors influencing the spatial distribution of off-farm points, including market potential, tourism density, environmental sensitivity of individuals, and a market potential characterized by young people and retirees. However, in terms of supply forces, the results are counter-intuitive, but we find some alignment with literature; as the number of organic farms increases, the number of off-farm points also rises. The probit model, with a finer grid scale, confirms the role of demand characteristics and underscores the importance of amenity variables in determining the probability of off-farm point locations, such as the presence of a train station, a school, or healthcare services. Our findings suggest that the choice of spatial scale is crucial, providing both broad insights at the municipal level and a detailed heterogeneity analysis at the grid level.

The remainder of this paper is structured as follows. Section 2 provides a general literature review on the factors which could determine the location of off-farm SFSC PoS. In Section 3, we provide a detailed description of the database we build. Section 4 presents the econometric models and variables used in our empirical analysis while we present and discuss the estimation results in Section 5. Finally, Section 6 concludes, highlights policy implications of the findings and suggests possible avenues for further discussion.

2 Literature

2.1 Literature dealing specifically with the location of off-farm SFSC PoS

The literature dealing specifically with the location of off-farm SFSC PoS in itself is extremely scarce, especially if we consider economic and/or quantitative approaches. Indeed, in many works, the question of the location of agents involved in SFSC is dealt with more or less explicitly but generically: - the main agents studied are agricultural producers and final consumers. Thus, the point of sale is only considered if it corresponds to the location of the farm (farm sales) or that of the consumer (home delivery, sales on the road to the home), or even that of the consumer (in the case of out-of-home catering). - SFSCs (and their associated locations) are not necessarily distinguished according to their type, and when they are, the typologies considered do not necessarily distinguish between on-farm and off-farm sales. Distinctions can be made on the basis of whether they are traditional ("classic" on-farm sales and markets, which tend to be found in rural areas) or not (other marketing methods, but also innovative forms of on-farm sales such as pick-your-own, which tend to be found in periurban and urban areas) (Kneafsey et al., 2013); on the individual or collective nature of the initiatives (e. g. Guiraud et al. (2014)); whether they involve a face-to-face meeting between the farmer and the final consumer (this meeting may take place on or off the farm), whether they sell directly to consumers, distribution or institutions (Martinez and Park, 2021; Vogel and Low, 2015; Plakias et al., 2020) or other typologies according to the local context and available data (see (Ricketts Hein et al., 2006; Bareja-Wawryszuk et al., 2020; Brinkley, 2017; Beriss, 2019). Thus, the location-related conclusions drawn from this work do not apply specifically to off-farm PoS.

Among the works that are closest to our approach, we can mention Scheffer and Dalido (2010), Guiraud et al. (2014) and Vonthron and Devillet (2023). Scheffer and Dalido (2010) developed a very detailed spatialized database on the SFSC initiatives (that belong to networks, not the individual ones) for the French region of Brittany, namely distinguishing on-farm direct selling, off-farm direct selling and intermediate selling. For each initiative, they locate the associated points of sales. They conducted a cartographic analysis of those points of sales to propose hypotheses about the determinants of emergence of SFSC initiatives. Proximity to large urban or touristic areas and accessibility (including proximity to main roads) of the farm or point of sales seems to be decisive factors in the orientation of producers towards SFSC. The characteristics of farms (especially organic farming, designation of origin and farm specialization) seems to plays a more important role than their number in the development of those initiatives. Moreover, urban and periurban locations are the ones that show the greater diversity and complementarity in terms of types of initiatives, with an increase in the number of CSA schemes and collectives points of sales. Rural areas are rather characterized by a lower concentration and diversity of initiatives, mainly multi-purpose markets, some farmer markets and on-farm selling. As the authors point out, while "cartographic interpretation can provide some interesting food for thought, this remains to be validated by a detailed understanding of territorial functioning and the structures studied". Indeed," the multiplicity of socio-demographic, political, economic and geographical factors political, economic and geographical factors influencing the orientation of players towards short-circuit approaches invalidates any simplistic interpretation of the distributions observed".

Guiraud et al. (2014) built a database on the Provence-Alpes Côte d'Azur, a southeast France region. combining an inventory by the regional authority and agricultural census data, for each municipality they enter information about the SFSC initiatives according to they type (farmer markets, CSA, on-farm sales, collective point of sales, internet or convenience stores sales). They also added information characterizing potential municipal demand (characteristics of the population but also density of local food stores and food manufacturing and catering establishments, which are potential outlets for local production) and municipal supply (characteristics of farms). Using factor analysis and classifications they create a typology of municipalities according their potential of development for SFSC. Their main result is that spatial differentiation of SFSC initiatives mainly comrs from the opposition between CSA, located mainly in urban areas, and farm-gate sales in rural areas. They also observe that individual initiatives and collective initiatives (both of them including on-farm and off-farm sale) follow different logics for their spatial distribution: the former follow the main agricultural production areas while the latter more closely follow the distribution of towns (medium-sized or large) and their suburban areas. However, we don't know exactly how initiatives are located when involving off-farm sale (farm location and/or point of sales location). Moreover, only municipal supply and demand aspects that can potentially influence the emergence of theses initiatives are considered while demand and supply can come from beyond the municipal borders.

Vonthron and Devillet (2023) referenced 214 initiatives (corresponding to 323 points of sales) in the French-speaking part of the province of Liège (Belgium). These initiatives were active between 2018 and 2021, had as their initial objective the sale of basic local food products to individuals, and pooled their supplies in terms of product types or suppliers. The authors also characterized the food environment in which the PoS associated with these initiatives are located (number of food shops within 500 m, distance to the nearest supermarket, etc.), as well as their socio-demographic environment (characteristics of the nearby population). They distinguish three profiles of local food marketing initiatives (a network of depots run by citizens' groups and associations, retailers combining long and short supply chains, and farmers and craftsmen selling direct). Using factorial analysis, they relate these different profiles to local characteristics, notably in terms of population density and town size, income, level of education of the population and density and characteristics of nearby shops.

2.2 Literature addressing the determinants of the involvement of producers and consumers in SFSC

To the contrary, there is now an abundant literature that addresses the determinants of the involvement of producers and consumers in SFSC. Consequently, the characteristics of these individuals, including their location (agricultural farms for producers, residential or workplace areas for consumers), are beginning to be well-known, even though they are still highly debated, and the issue of location is not necessarily central in these works. Within this literature however, very few works specifically deal with involvement in off-farm SFSC marketing methods. In this section, we first mention the literature dealing with the determinants of involvement of producers and consumer in SFSC without considering the on/off-farm distinction and secondly focuses more specificallys on works that makes the distinction between them.

If we don't conside the distinction between on- and off-farm sales, the literature is rich with separate studies focusing on the characteristics of consumers on the one hand and producers on the other, both of which are involved in SFSCs. Studies reveal an emerging interest in consumers' perception, opinions, behaviours and habits around the local food production. The majority of these studies are qualitative and use a survey with a selected sample (For example, Cembalo et al. (2015); Bonnal et al. (2019)). On the one hand, in the literature, researchers find that consumers participating in a SFSC have a higher income than non-participants. This higher income allows them to pay for local food products and to bear their higher prices (Toler et al., 2009; Cranfield et al., 2012; Gracia et al., 2012). On the other hand, studies show that consumers who actively and publicly engage in alternative consumption build on a relationship of trust and fairness, with farmers. They strive for an improved quality of life by considering economic, environmental and social factors (Cembalo et al., 2013; Saito and Saito, 2013; Migliore et al., 2015). It is widely accepted among researchers that the majority of short food consumers are married, highly educated women with higher incomes (Stanco et al., 2019; Feldmann and Hamm, 2015; Pascucci et al., 2011; Varner and Otto, 2008).
Giampietri et al. (2018) explore consumers' motivations and behaviors toward short food supply chains. Using an extended model of the Theory of Planned Behavior, they constructed a questionnaire that was administered to 260 Italian consumers. Their results confirm that the growing success of short food supply chains in Italy is mainly related to the direct role of trust in the intention to purchase from these chains.

Motivations of producers involved in SFSCs are not just related to maximize their income, but also to ensure the satisfaction associated with their activity and lifestyle according to their preferences (Hunt, 2007; Barbieri and Mahoney, 2009). Supplying agricultural products in short chains would thus be a way to remain competitive and maintain or increase their profit margins (Sgroi, 2015; Jarosz, 2008) by increasing revenues and/or decreasing costs and by allowing a better allocation of resources. This can restore financial stability to struggling farms but also reduce risks by diversifying agricultural activities (Kneafsey et al., 2013), and builds loyalty among customers who share the same values.

The short food supply is a commercial strategy defined in a non-exclusive form (Dubuisson-Quellier and Le Velly, 2009). Producers can choose to sell all or part of their production through this marketing (Aubert, 2017). This diversification of marketing methods results in various outlets for the producer, where short and long supply chains coexist (Ministry of Agriculture, 2009a; Chiffoleau and Gauche, 2003). SFSC's methods reflect an individual farmer's marketing decision in an evolving environment (Capt, 1994; Aubert and Enjolras, 2015). Consequently, the marketing approach implemented depends on the specific characteristics of each farmer. (Aubert, 2017). The expansion of productive activities, specifically through short food supply chain sales, relies on knowledge, skills, know-how, and capacities unique to each farmer (Capt, 1994). Based on the French Agricultural Census of 2010, short food supply chain sales are implemented by relatively young farmers, established on small-scale farms, and who prioritize permanent employment (Aubert, 2017). Numerous studies highlight the importance of factors such as material and immaterial capacities on farms to understand the choices made by operators (Capt, 1994; Gilg and Battershill, 1999; (Aubert, 2017)).

As mentionned before, within this literature, very few works deal specifically with involvement in off-farm SFSC marketing methods. Notable exceptions are Corsi et al. (2018); Horvath (2023). Corsi et al. (2018), in Northern Italy, analyze the characteristics of producers involved in on- VS off-farm direct-to-consumer sales. They show that even if the adoption of on-farm and off-farm direct sales are not completely independent as a number of farms use both channels, the distinction between on-farm and off-farm direct sales is relevant for the analysis of the determinants, with the effects of the explanatory variables systematically stronger on the probability to sell directly on the farm rather than off the farm. More specifically, their never observe a significant impact of farm specialization in itself on the adoption of off-farm selling but other characteristics of farms have a differentiated impact on off-farm adoption according the farm specialization. Thus, Agrotourism and recreational activities has a limited effect on off-farm sales, since it is only significant and positive for some specializations. Organic farming favors off-farm direct sales, but mostly for vegetal productions. PDO-PGI qualification in general seems to discourage off-farm direct sales. Farm economic size has a positive but very weak effect and only for some specializations. The effects of personal characteristics of the operators are more widespread than for on-farm sales, but in general still rather weak. Thus, younger operators are more likely to sell directly off the farm for some specializations only. Male operators are less likely to sell off-farm for some specializations and more likely for others. Education has may have a positive or a negative affect depending upon the specialization. Attending professional courses makes significantly more likely off-farm direct sales for certain specializations. Summing up, specific personal characteristics of the operators seems to impact involvement in off-farm direct sales for two specializations only: Vineyards, with male operators, more educated especially in the agricultural field and keeping up with professional courses; and Horticulture, with female and not so educated operators. Location in the hills and even more in the mountains (i.e. further away from urban poles) is in general more favorable to off-farm direct sales than the plains. The number of close commercial poles does not seem to be important. The size of the population living at a short distance has a significant impact on this choice that is sizeable and positive.

Horvath (2023), in France, relies on data from a 2013 national survey (CODIA) and on two stated preference surveys she conducted to analyze the characteritics of consumers and producers according to their use or preference for different off-farm SFSC marketing methods. She first econometrically estimates the determinants of the most used SFSC marketing method (either none or on-farm or market or CSA/collective point of sales or others) by consumers. For on-farm sale, no socio-demographic variable seems to be a determining factor, apart from household size. However, peri-urban and rural dwellers are significantly more likely to visit farms than urban dwellers, and people living in rural areas are more likely to buy from CSA than those living in urban areas. What's more, consumers located in cantons with an easy access to farms involved in SFSC within 5km are more likely to buy from farms or CSA. In addition, people living in cantons where the Green vote was high in 2012 are more likely to go to the market, and more likely to frequent other types of SFSC (including small shops, organic stores and supermarkets, for example). On the other hand, consumers located in cantons with and easy access to supermarkets and hypermarketsy are less likely to buy from other SFSC point of sales, such as small shops or organic stores. Then, using the stated preference surveys, she studies the criteria used to decide whether or not to buy and sell fresh vegetables (as they are among the food products most consumed by the French), and in particular the preference for 5 different sales methods: farm-gate, market, supermarket, drive-through and via a consumer association ("association" in the following). She shows that consumers under 30 tend to have chosen the drive and the association, and less the supermarket. Retired people choose the market more, and the association and drive less. People with higher incomes choose the market more, and the drive and association less. Farmers with non-agricultural qualifications are more likely to choose the supermarket and the association, and less likely to choose the market. Longer-established or older farmers are less likely to choose the association. Farmers with the largest acreage choose the farm and the drive less often, and the supermarket more often. Those with the smallest surface areas are more likely to choose the association than those with larger UAAs. Women farmers were more likely to choose the farm and the drive, and less likely to choose the market and the association. Finally, organic farmers choose the market less, and the drive and the association more.

Given this state of knowledge and as off-farm SFSC PoS cand be considered as meeting points between supply and demand (even when producers and final consumers doesn't effectively meet in these points), we thus propose to rely on the characteristics of producers and consumers that are usually presented in the literature as likely to influence their use of (off-farm) SFSC channels and to test whether they influence the location of off-farm SFSC PoS.

3 Data

We have constructed an original database, compiled from reliable sources of local, regional, and national information for the year 2020[1]. This databae includes sales outlets in France, classified into five types: on-farm sales, pick-up point for sale by internet or mail order, pick-up points for community supported agriculture, producers' collective stores, markets and, last, retail stores (shops explicitly oriented towards the sale of local and/or SFSCs products). We also collected the name of the sale point and its exact geolocalisation. [2]. As we soon realised that we had many more points in the far north of France (where we are based and therefore know the best sources of information), we decided to focus on the Nord and Pas-de-Calais departments (see figure 2 in Appendix A). Nord and Pas-de-Calais constitute the former French administrative region called Nord-Pas-de-Calais (NPdC in the following) and is now part of the new and larger administrative region "Hauts-de-France".

With 66% of its surface area dedicated to the Utilized Agricultural Area (UAA), (827,280 ha out of a total of 1,245,080 ha), NPdC is a big agricultural region (French Ministry of Agriculture, 2015). NPdC is characterized by larger farms than the national average (78% medium and large farms in NPdC vs. 64% in France), mainly specialized in field crops, polyculture and mixed livestock farming (see Agreste, 2015). Cereals, largely intended for the national and international markets, account for the majority (45% of the regional UAA). But Nord-Pas-de-Calais also has a number of special features: the region accounts for a significant proportion of French potato acreage (first region in France), industrial beet (third region), fresh vegetable (third region) and is also France's second-largest malting and brewing region (see Boutry and Ferru, 2016). In addition, farming also employed 27,250 people in 2010 (0.7% of the region's population but around 2.8% of the population working in agriculture in France, according to Lesdos-Cauhapé, 2011). However, despite this a priori unfavorable context for short circuits, characterized mainly by small-scale farms focusing on products such as honey, vegetables or fruit (see Raton et al., 2016a,b), these practices are expanding in NPdC, notably due to join interest of consumers and producers. In the NPdC, we obtained 516 points of short food sale (63% of these points in the Nord and 37% in the Pas-de-Calais). Figure 1 shows the spatial distribution of these short food supplies. The total number of physical points is 516; however, a single point can adopt two different marketing types. Table 1 shows the distribution of marking types and Table 2 displays the distribution of points according to their marketing types. Figure in

[1]The websites used for this purpose are: http://www.reseau-amap.org/ ; https://www.amap-hdf.org/ ; https://www.magasin-de-producteurs.fr/ ; https://www.capoupascap.info/ ; https://locavor.fr/ ; https://www.drive-fermier.fr/ ; https://ouacheterlocal.fr/ ; https://www.pourdebon.com/ ; https://www.hallesmodernes.fr/ ; https://lecourtcircuit.fr/index.php ; https://www.biocoop.fr/ ; https://www.magasin-prisedirect.fr/ ; https://www.labelvie.fr/ ; https://www.otera.fr/ ; https://www.acheteralasource.com/ ; https://www.fraisetlocal.fr/

[2]However, sales outlets corresponding to certain SFSC marketing methods, notably described in the agricultural census, such as sales on tours, at trade fairs and shows, in commercial or institutional catering and in supermarkets and hypermarkets (that are not specialized in SFSC sales) could not be collected using this methodology.

Appendix B shows the spatial distribution of the different types of marketing. Our database may not be exhaustive, but thanks to local websites, we have tried to get as close as possible to reality. Indeed, as far as we know, the best available database at the time of our collection was "fresh and local". While our database for metropolitan France was generally less well informed than frais et local, this was not the case for NPdC.

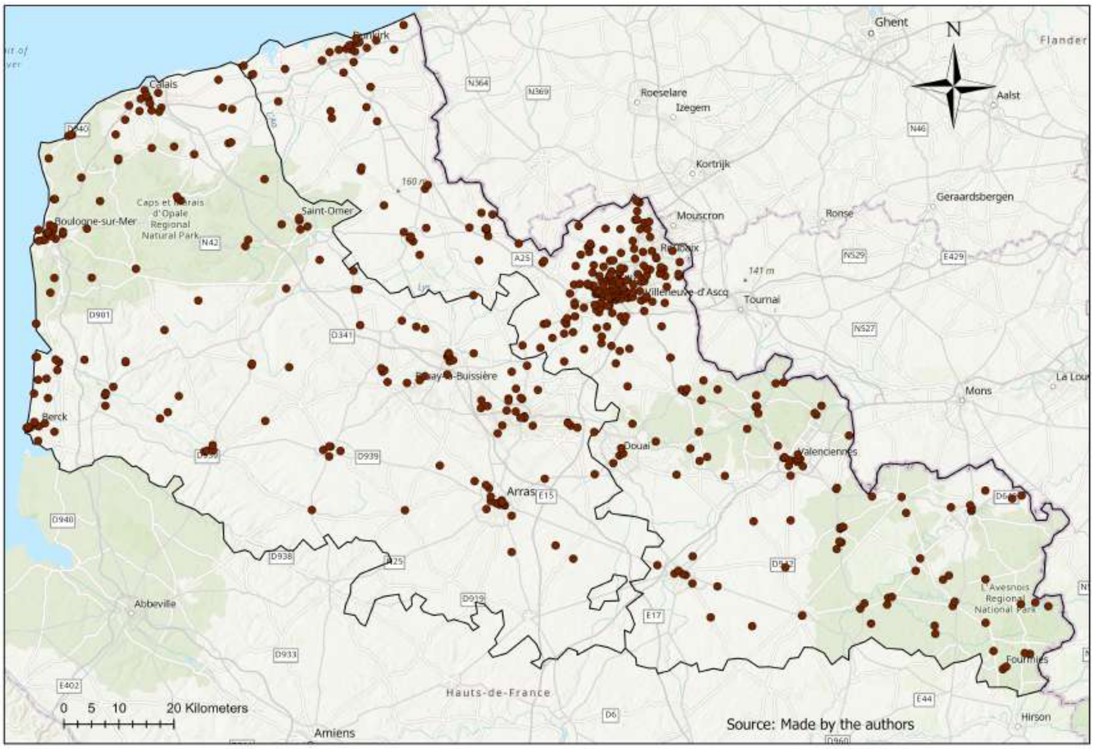

Figure 1: Spatial distribution of points of short food supplies in the Pas-de-Calais and Nord departments

Table 1: Distribution of short food supply chain marketing types in the departments of Pas-de-Calais and Nord

Types	Number	Percentage
Pick-up point for sale by internet or mail order	229	43
Pick-up point for community supported agriculture	53	10
Producers' collective stores	15	3
Markets	124	24
Retail stores	105	20
	526	100

Table 2: Distribution of short food sale points according to their types

Marketing type	Number	Percentage
One Type		
Pick-up point for sale by internet or mail order	193	37.4
Pick-up point for community supported agriculture	49	9.5
Producers' collective stores	14	2.71
Markets	124	24.03
Retail stores	96	18.6
Two Types		
Pick-up point for sale by internet or mail order - Pick-up point for community supported agriculture	1	0.19
Pick-up point for sale by internet or mail order - Retail stores	8	1.55
Pick-up point for sale by internet or mail order - Producers' collective stores	1	0.19
Pick-up point for sale by internet or mail order - On-farm sales	26	5.04
Pick-up point for community supported agriculture - On-farm sales	3	0.58
Retail stores - On-farm sales	1	0.19
Total	516	100

4 Econometric models and variables used

We propose two types of econometric estimations. In the first type, observations consist of municipalities. This aims to estimate the number of off-farm SFSC points of sale per municipality using a negative binomial model. In the second type, observations are INSEE grid-cells, which is a spatial decoupage into 200-meter grid cells applied by the French National Statistics Institute to the whole of France. Given that almost all these grid cells either have 0 or 1 off-farm SFSC point of sales, we estimate the presence or absence of such points of sale in the grid using a binary probit model.

We employ these two models for multiple reasons. Firstly, the counting model operates at the municipal level, which is the spatial unit more commonly used for public policy and in other research studies. This allows our results to be potentially utilized in establishing public policies and also compared with other studies. Additionally, at the municipal level, we have more explanatory variables, especially political variables such as votes in the presidential election. However data at the municipal level are aggregated and then may smooth out information, losing details regarding spatial heterogeneity. Therefore, to complement our study and gain a better understanding of spatial differences, we use grid cells, which represent a very fine spatial level. This allows us to obtain more insights into the location determinants of off-farm points, even if we miss some variables. In fact, these two models are more complementary than contradictory.

Considering the distribution of sales points, as outlined in Table 3, we employ a negative binomial model (NB2) to explain the count of distribution points per municipality, denoted as N_i. We choose the negative binomial model over the conventional Poisson specification because the former addresses the overdispersion observed in the data. Additionally, we explored a generalized Poisson model, and the dispersion parameter indicated significant overdispersion, thereby justifying the adoption of a negative binomial model. The findings of this model are detailed in Appendix C. The dichotomous location using gridded data aims to identify factors leading to the appearance of a point within a grid. Consequently, our dependent variable, denoted as Y_c, is a binary variable equal to one if a grid cell c has an off-farm point of sale in SFSCs. We employ a basic binary probit model, estimated using the entire sample of 83,805 grids, of which 492 have at least one point. Note that the number of grid cells containing more than one point is notably low, with 21 grid celles out of the total 492 filled cells (4.27%) and a mere 0.03% of the entire 83,829 grids (whether empty or filled).

Table 3: Distribution of observations with respect to the number of sale point

Number of points of sale	Count/ Number of communes	% of total
0	1244	83.32
1	158	10.58
2	43	2.88
3	15	1
4	13	0.87
5	6	0.4
6	3	0.2
7	3	0.2
8	1	0.07
9	4	0.27
10	1	0.07
11	1	0.07
51	1	0.07
	1493	100

Short food supply chain locations are represented as meeting points between supply and demand, between consumers and producers. Hence, we assume that the location chosen to provide local food products can be determined by factors including potential demand as well as potential supply. Based on this idea, we distinguish independent variables to be used in the regressions which also had a large discussion in the literature. Tables 4 and 5 provide the description of variables.

In this paper, we focus on the municipal and regional levels and characterize supply and demand in terms of socio-demographic characteristics that may influence the choice of supply and purchase from short food channels in a specific location. For this reason, it is necessary to consider and define the influence zone of these marketing locations, i.e. the spatial radius to which the consumers/farmers can buy/sell their products in SFSCs. We have, therefore, set a 50-kilometer radius for consumers and a 100-kilometer radius for producers. Subsequently, we calculated weighted indicators within these radii based on population (or number of farms) and distance to the centroid of the considered municipality (for the negative binomial model) or to the centroid of the considered grid cell (for the binary probit model). For each type of model, the explanatory variables describe the characteristics of the population and farms in and around the municipality or grid under consideration. However, their calculations differ; these weighted variables operate according to the principle of market potential (Harris, 1954; Bruna et al., 2016). Appendices B and C provide detailed explanations for the construction of these weighted variables.

Demand characteristics. Urban consumption patterns differ from traditional rural food habits, reflecting changes in marketing systems (Bonnal et al., 2019). Numerous studies have shown that selling in SFSCs is a common strategy for farms located in or near densely populated areas. However, the impact of residential area on consumer purchasing behavior is not clear. Some studies found no discernible differences between consumers living in urban or rural areas (Chambers et al., 2007), while other studies suggested that individuals living in rural areas are more likely to buy locally (Mirosa and Lawson, 2012; Varner and Otto, 2008). To capture the market potential, following Harris (1954); Bruna et al. (2016), we define the indicator of Market Potential (Appendix A). Moreover, our region is particularly interesting due to the Belgian border. The neighboring Belgian municipalities can be a source of demand and/or supply in Short Food Supply Chains (SFSCs). Thus, to complete the market potential, we calculate the market potential at the Belgian level and also separately for Flemish and Walloon levels in order to capture the differences between them. Since local production is also considered as a tourist activity, thus tourists can be a potential group of SFSC products (Bareja-Wawryszuk et al., 2020). This can be achieved through two options, restaurants and accommodation buy local products to promote regional specialization, and some farmers also offer activities for tourists. We thus introduce the density of tourist accommodations in our analysis.

Regarding individual characteristics, recent evidence suggests that income plays a central role in SFSCs. Consumers participating in SFSCs have higher incomes than non-participants. This higher income allows them to pay for local food products and bear their higher prices (Cranfield et al., 2012; Gracia et al., 2012). They also favour products considered to be better for their health and the environment (Bonnal et al., 2019). Education level is one of the most important variables that can affect the likelihood of purchasing products from SFSCs. ANSES[3] reveals that the higher the education level of the head of the family, the more households buy fresh fruits and vegetables at the market and in short chains, as well as bread, pastries and fresh fish in local shops to the detriment of supermarkets (Bonnal et al., 2019). The age of consumers who buy their food at farmers' markets is expected to be higher compared to those who make purchases at grocery stores. This could be explained by the stronger attachment to tradition among elderly consumers, which motivates them to opt for locally produced foods (Henseleit et al., 2007). Another interesting characteristic of consumers who participate in SFSCs is their commitment and responsibility to society and the environment. They are more aware of the potential problems that arise at all stages of food production for local farmers. As a result, they pay close attention to societal issues in their purchasing choices (Stanco et al., 2019). Then, we include the ecological votes in the 2022 presidential election as a proxy for the commitment and responsibility of individuals to society and the environment.

Supply characteristics. To capture whether regional supply influences the emergence of a new off-farm point, we need to characterize it and its farmer features. To do so, we calculate the potential supply based on the number of farmers in the studied region, with a mathematical formula similar to the market potential (Appendices B and C).
Farmer-related variables. To identify farmers who are more likely to supply their products through SFSCs, characteristics of the farm head have to be considered. Younger farmers may be more open to social interactions (Corsi et al., 2018) and more able to respond to new opportunities and market changes, (Parker, 2006) including adapting their entrepreneurial strategy, adopting new technologies and updating their skills to remain competitive in an increasingly competitive environment (Aguglia et al., 2009; Cembalo et al., 2013). Thus, a negative relationship is often observed between age and selling in SFSCs (Aguglia et al., 2009; Martinez, 2010; Aubert, 2015) even if this effect can be weak compared to that of other characteristics (Corsi et al., 2018; Capt and Wavresky, 2014; Detre et al., 2011) or even not significant (Charatsari et al., 2018). However, age is also considered in agricultural economics to capture the effects of experience (Tauer, 1995). To capture the role of this variable, we introduce the number of years of experience of the farmer in agriculture activities
Skills and knowledge of the workforce are widely studied in agricultural economics. This human capital is generally approximated by the level of general and/or agricultural education and participation in professional training. Commercial skills, complementary to productive skills, may have a positive impact on food short supply (Dufour and Lanciano, 2012; Capt and Wavresky, 2014). For that, we include various variables to describe the profile of farms, such as the education level of the farm head and whether or not they are established within a family setting installation. Moreover, to capture the difference in gender, we introduce the weight of female labor in farm activities, rather than indicating whether the farm head is female or not.
Farm-related variables. The impact of farm size has been a subject of significant study in this literature, however, there is no consensus on its effects. On the one hand, holders with small farm size may be more interested in SFSCs, as it is more difficult for them to take full advantage of Long Food Supply Chains (LFSCs) (Dufour and Lanciano, 2012). SFSCs may offer these small farms a way to increase their income, as they would be more sensitive to increases in added value and decreases in certain costs. Several studies have found a negative relationship between size and involvement in SFSCs (Aguglia et al., 2009; Martinez, 2010; Low and Vogel, 2011). On the other hand, large farms have a greater capacity for productive and commercial diversification since they have better access to

[3]Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail

financial and non-financial resources. Another important variable is the full-time equivalent devoted to farm work. Selling through short chains can be very time-consuming and several studies have pointed out that farmers are more likely to be involved in the circuit when they have enough time to dedicate to it. This suggests that farmers who work full-time on their farms may be more likely to participate in short chains (McNally, 2001; Low and Vogel, 2011).

Certification and labeling can be a way to reassure consumers about product quality. SFSCs are considered as an alternative to these contracts since they offer the opportunity to communicate directly and thus to etablish a relationship of trust between consumers and producers. In addition, consumers often confuse local products with organic ones, mistakenly believing that local products from urban farm are organic (Printezis and Grebitus, 2018). Ellison et al. (2016) show that consumers often assume that tomatoes purchased from direct-to-consumer outlets are organic. Farm type (whether specialized in a particular crop or production, or unspecialized) and regional agricultural specialization may have important effects on the supply in short chains (Capt and Wavresky, 2014). The processing, perishability and seasonality of products make selling in the short circuit more or less profitable for producers. It is thus often observed that products that do not require processing are more likely to be sold in short chains. This is the case, for example, of fruit, vegetables and wine (products that are processed but easily stored), unlike cereals or meat that require more processing and storage (McNally, 2001; Aguglia et al., 2009; Martinez, 2010; Aubert, 2015). To capture this effect, we introduce a variable to indicate the dominant specialization in each farm (OTEX) and another for farms engaged in non-agricultural activities. Local sales by farmers are more important in regions close to densely populated areas, where the mild climate and fertile soil favour the production of fruits and vegetables. (Low and Vogel, 2011).

Table 4: Variables used in regressions

VARIABLES	DEFINITION	Source
Market_FRENCH	French market potential	French National Institute of Statistics and Economic Studies (INSEE)
Market_Income_FR	Income-based Market Opportunities Potential	
Market_Belgium	Belgium market potential per municipality	
Market_Flemish	Flemish market potential per municipality	The Belgian statistical office (Statbel)
Market_Walloon	Walloon market potential per municipality	
Proxy for environmental sensitivity	Density indicator of ecological votes in the 2022 presidential election	Official website of the French government
Tourism	Tourist density	
POP_15_29	Density indicator of population aged 15-29	
POP_30_44	Density indicator of population aged 30-44	
POP_45_59	Density indicator of population aged 44-59	
POP_more60	Density indicator of population aged over 60	
Train_Station	Dummy variable: the presence or absence of a train station within a one-kilometer radius	
Primary_secondary school	Dummy variable: the presence or absence of a primary secondary school within a one-kilometer radius	French National Institute of Statistics and Economic Studies (INSEE)
Health facility	Dummy variable: the presence or absence a health facility within a one-kilometer radius	
	Municipality belonging to a major center (10,000 jobs or more)	
	Municipality belonging to the periphery of a major center	
	Multipolarized municipality in large urban areas	
Municipal Zoning into Urban Areas (ZAU)	Municipality belonging to a medium center (5,000 to less than 10,000 jobs)	
	Municipality belonging to the periphery of a medium center	
	Municipality belonging to a small center (from 1,500 to less than 5,000 jobs)	
	Municipality belonging to the periphery of a small center	
	Other multipolarized municipality	
	Isolated municipality outside the influence of centers	

Table 5: Variables used in regressions (Suite)

VARIABLES	DEFINITION	Source
Supply_FR	Supply Potential (agricultural farmers)	French General Agricultural Census
SGP	Standard Gross Production	
OTEX_Bovine	Density indicator of specialized cattle farms	
OTEX_ Sheep_Goats_Herbivores	Density indicator of farms specialized in sheep and/or goats, and/or other herbivores	
OTEX_ Swine_Poultry	Density indicator of farms specialized in swine and/or poultry	
OTEX_Poly-culture_Livestock	Density indicator of farms specialized in poly-culture and/or livestock	
OTEX_Gardening_Horticulture_Viticulture	Density indicator of farms specialized in fruit/permanent crops or in market gardening, horticulture, or viticulture per municipality	
Organic agriculture	Density indicator of farmers certified in organic agriculture	
Label or Others	Density indicator of farmers producing Label Rouge and/or AOP or AOC and/or IGP and/or STG products	
Quality or environmental initiatives	Density indicator of farms engaged in other quality initiatives or environmental initiatives	
Micro-farms	Density indicator of micro-farms: Standard Gross Production below 25,000 euros	
Small Farms	Density indicator of small Farms: Standard Gross Production ranging from 25,000 to below 100,000 euros	
Medium Farms	Density indicator of medium Farms: Standard Gross Production ranging from 100,000 to below 250,000 euros	
Full_Time_Equivalent	Density indicator of Full-Time Equivalent (FTE)	
Diversification	Density indicator of farms engaged in non-agricultural activities	
On farm sales	Density indicator of farms engaging in direct-to-consumer sales on their premises	
Experience	Density indicator of experience of the farm's head	
Female labor	Density indicator of female labor on the farm	
High_education_Farmer	Density indicator of farm heads with high education	
Not_family_setting_installation	Density indicator of farm heads established not within a family setting installation	
FTE_Family Labor	Density indicator of Full-Time Equivalent of Family Labor per municipality	

To gain a better understanding of our variables, we use a naive difference-in-difference estimation for all our indicators calculated for the count model (Table 8 in Appendix D)) and the probit model (Table 9 in Appendix D). This involves comparing the means in the sample for municipalities or grids that contain at least one off-farm point and those that do not. These tests suggest that municipalities (grids) with at least one off-farm point and those without differ on almost all indicators of potential market. Thus, the off-farm points are located in areas characterized by a large market as well as supply potential. They are mainly indistinguishable along variables related to supply characteristics.

5 Estimation results

Location across municipalities (Count model)

The estimated results from the negative binomial model are presented in Table 6. The models presented in this table are the most robust and the most informative among all our attempts. Alternative model specifications are provided in Table 10 in Appendix D. Model 1 illustrates the overall model, whereas in Model 2, we substitute the farm size variable (SGP) with categorical representations of farm sizes. For each model, we present both coefficients and average marginal effects to provide a comprehensive view of the results.

In line with our expectations, we find a positive and highly significant effect of the market potential. To complete our market potential, the coefficient of the Flemish market is significant and positive in contrast to the Walloon market which is not significant. Contrary to our expectations, the coefficient of the log of the income proxy is significantly negative. The corresponding elasticity is greater than unity, which implies that the market potential within a 50-kilometer radius characterized by high income hosts fewer off-farm points of SCSFs.

For further demand characteristics, the proxy for environmental sensitivity is significantly highly positive, consistent with the literature on consumer characteristics. Another result in line with the literature is that off-farm points are significantly encouraged to locate in regions with high tourist density. Off-farm points are encouraged to be located within a 50-kilometer radius of areas with a younger population aged 15-29 and a population aged 60 or older, as the corresponding coefficients are significant. This finding suggests an alternative interpretation: these points are located in areas with a higher prevalence of smaller households.

With regard to the characteristics of farmers and farms, the results are mixed. Firstly, in NPdC, the potential supply is significantly associated with the logarithm of the count of off-farm points. This can be explained by the fact that short food supply chains are not only linked to local farms, but digital tools also help connect farms from anywhere to consumers in NPdC, contributing to the increase in the number of off-farm points. Unexpectedly, the coefficient on full-time-equivalent is significantly negative, which is contrary to the literature. In addition, the indicator of full-time equivalent of family labor is negatively correlated with the logarithm of the number of off-farm points..

Our results show that the presence of organic farms and farms participating in quality or environmental initiatives favors the location of these points in NPdC. Moreover, the presence of farms specialized in horticulture, gardening or viticulture increases the number of off-farm points. An interesting result is that the more farms practising on-farm sales are present in and around the municipality, the more the number of off-farm points in the municipality is likely to be high. This can be explained by the complementarity and synergy between these two types of SFSC marketing.

In Model 2, all coefficients have the same sign and level of significance. However, this specification is more informative for farm size. In Model 1, the coefficient of the logarithm of farm size (SGP) is insignificant while, in Model 2, we show that the presence of small and medium farms is more attractive for off-farm sales points in SFSCs compared to large farms. In addition, the coefficient of the logarithm of micro-farms is not significant.

Robustness analysis. For robustness checks, we re-estimated our models excluding the municipality of Lille (Table 11 in Appendix D), as it is the largest municipality and could be considered an outlier. We obtained similar results, with no significant change in the coefficients' values. The significant difference lies in the fact that the proxy for the age group 45-59 has a significantly negative coefficient, indicating that off-farm sale points are less spatially present in the market potential characterized by individuals aged 45-59.

We also check the robustness of binomial negative results by employing a generalized Poisson model [4] (Table 12). In our results, the positive value of the dispersion parameter (delta) indicates over-dispersion, confirming the robustness of using a negative binomial model. In terms of results, we show the same sign and significance for all variables except for the proxy for small farms, which is not significant. In addition, the coefficient values are smaller than those in the negative binomial model.

Dichotomous location

The estimation results from the probit model are displayed in Table 7. Column 1 displays the coefficients, while column 2 includes the average marginal effects. In this model, we include zoning in urban areas (ZAU), departments, and their interaction as dummies to capture any common factors affecting points located in the same urban areas and departments, aiming to mitigate bias from omitted variables. We introduced additional variables that make sense at this level, mainly amenity variables. The change in the spatial scale also led to slightly different calculations of the variables that are common to both models. The variables (ZAUs and amenity variables) that are added to the binary model were not used in the counting model because of their collinearity to the market potential. Therefore, we obtain different results, especially for the supply potential and its characteristics.

The coefficient associated with supply potential is significantly positive. Thus, the more farms there are within a 100-kilometer radius, the more likely an off-farm point of sale is to be located within a 200-meter grid. For the supply characteristics, our results show that a higher share of organic farms, farms specialized in bovine production, and farms engaging in non-agricultural tourism activities are associated with a greater likelihood of having an off-farm point of sale located within a 200-meter grid. In addition, we find the same results as in the count model: the share of on-farm sales is positively associated with the probability of establishing an off-farm point within a 200-meter grid. This confirms the spillover effect between these two different marketing approaches in SFSCs. The fact that the head of the farm is not in a family-setting installation has a highly positive and significant effect. This result can be explained by the fact that the farm's head has a new idea, supplying their products in SFSCs, and does not follow the ideas of their family predecessors.

For demand variables, we find almost the same results as for the count model. The market potential is positively correlated with the probability of an off-farm point being located in a 200-meter grid. The potential market can be the variable that most determines the spatial presence of these points, since one of the objectives of the SFSCs is to get closer to the consumers and to restore the link between producers and consumers. However, the coefficient of the proxy for living standards is significantly positive, while the equivalent of this proxy in the count model is significantly negative.

It is important to highlight that an automatic comparison between the two models is not feasible. Not only is the mathematical theory underlying these two models different, but also the nature of the data and the method of calculating explanatory variables differ between them. This also underlines the importance of the choice of the spatial scale to be studied. In the count model, data are aggregated at the municipality level, potentially masking spatial heterogeneity within each municipality.

[4] For the theoretical and mathematical concepts of this model, see Harris et al. (2012).

Table 6: Estimates for the negative binomial model

	Dependent variable : Off-farm points count			
	Model 1		Model 2	
VARIABLES	Coefficients	Av. marg. eff.	Coefficients	Av. marg. eff.
French_Market_Potential	0.316***	0.117***	0.288**	0.106**
	(0.112)	(0.043)	(0.115)	(0.044)
French_Market_Income	-2.650***	-0.977***	-2.557***	-0.937***
	(0.658)	(0.262)	(0.666)	(0.262)
Flemish_Market	0.094***	0.035**	0.094***	0.034**
	(0.036)	(0.014)	(0.036)	(0.014)
Walloon_Market	0.004	0.001	0.014	0.005
	(0.033)	(0.012)	(0.033)	(0.012)
Proxy for environmental sensitivity	1.445***	0.533***	1.407***	0.516***
	(0.293)	(0.122)	(0.297)	(0.121)
Tourism density	0.115***	0.042***	0.122***	0.045***
	(0.037)	(0.014)	(0.038)	(0.014)
POP_15_29	4.123***	1.521***	4.364***	1.599***
	(0.830)	(0.344)	(0.827)	(0.343)
POP_30_44	-0.202	-0.075	-0.154	-0.057
	(1.484)	(0.546)	(1.479)	(0.541)
POP_45_59	-2.563**	-0.945**	-2.451**	-0.898**
	(1.018)	(0.375)	(0.998)	(0.365)
POP_more60	6.017***	2.219***	6.080***	2.228***
	(1.186)	(0.5)	(1.184)	(0.496)
Supply_FR	-0.411**	-0.152**	-0.412**	-0.151**
	(0.194)	(0.073)	(0.198)	(0.074)
SGP	-0.337	-0.124		
	(0.256)	(0.095)		
OTEX_Bovine	0.131	0.048	0.125	0.046
	(0.104)	(0.039)	(0.102)	(0.038)
OTEX_ Sheep_Goats_Herbivores	-0.010	-0.004	0.020	0.007
	(0.096)	(0.035)	(0.098)	(0.036)
OTEX_ Swine_Poultry	0.099	0.037	0.093	0.034
	(0.060)	(0.023)	(0.058)	(0.021)
OTEX_Polyculture_Livestock	0.024	0.009	0.003	0.001
	(0.113)	(0.042)	(0.111)	(0.041)
OTEX_Gardening_Horticulture_Viticulture	0.168**	0.062**	0.172**	0.063**
	(0.076)	(0.028)	(0.075)	(0.027)
Organic agriculture	0.283***	0.104***	0.267***	0.098***
	(0.082)	(0.031)	(0.083)	(0.031)
Label or Others	0.116	0.043	0.111	0.041
	(0.084)	(0.031)	(0.082)	(0.03)
Quality or environmental initiatives	0.222***	0.082**	0.217***	0.08**
	(0.085)	(0.032)	(0.084)	(0.031)
Experience	0.393	0.145	0.418	0.153
	(0.411)	(0.152)	(0.405)	(0.148)
Full_Time_Equivalent	-0.653***	-0.241**	-0.710***	-0.26***
	(0.250)	(0.096)	(0.231)	(0.09)
Female labor	0.221	0.082	0.288*	0.106*
	(0.159)	(0.059)	(0.157)	(0.058)
High_education_Farmer	1.578	0.582	1.508	0.553
	(1.742)	(0.644)	(1.712)	(0.629)
Diversification	0.132	0.049	0.104	0.038
	(0.144)	(0.054)	(0.145)	(0.053)
Not_family_setting_installation	0.075	0.028	0.108	0.04
	(0.129)	(0.048)	(0.131)	(0.048)
FTE_Family Labor	-0.260***	-0.096***	-0.257***	-0.094***
	(0.072)	(0.029)	(0.073)	(0.028)
On farm sales	0.248**	0.091**	0.249**	0.091**
	(0.109)	(0.04)	(0.107)	(0.039)
Micro-farms			0.063	0.023
			(0.157)	(0.057)
Small-Farms			0.269*	0.099*
			(0.149)	(0.055)
Medium-Farms			0.487**	0.178**
			(0.198)	(0.075)
Constant	-8.338		-16.827	
	(13.035)		(13.469)	
Observations	1,493		1,493	
alpha	0.547 (0.161)		0.495 (0.150)	
lnalpha	-0.603**(0.295)		-0.703**(0.304)	
Log Likelihood	-756.516		-753.719	
Pseudo R2	0.254		0.257	
AIC	1573.032		1571.438	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: All these variables are in logarithmic form.

Conversely, the grid scale is very spatially fine, allowing for a more detailed capture of spatial heterogeneity. Nevertheless, it remains crucial to analyze the spatial distribution at the municipal level for a comprehensive understanding of public policies and the formulation of suitable policies.

The contribution of the probit model is further emphasized by the introduction of amenity variables. Our results show that each additional amenity variable has a significant positive effect. Thus, the likelihood of an off-farm outlet being located within one kilometer of a train station, a primary or secondary school, and a health care facility is significantly increased. This finding is noteworthy, indicating that the off-farm points represent an adopted marketing strategy strategically targeted at locations characterized by the convergence of various activities that significantly influence daily life. It also signifies an approach designed to enhance the accessibility of these points.

6 Conclusion

This paper attempts to identify the determinants of demand and supply that influence the location of off-farm sale points in SFSCs in the Nord and Pas-de-Calais departments. Doing so is necessary to implement and evaluate policies aimed at increasing local food sales and reconnecting consumers with farmers. Analysis of our estimates' results corroborates some previous findings and provides new information on the location of off-farm points by examining the characteristics of consumers and producers situated around these points.

To do so, we have employed two distinct empirical strategies to enhance the robustness of our analytical approach. Consequently, some similar as well as contrasting results have emerged between the two. For demand characteristics, our results remain consistent across these two strategies. They have shown the importance of the potential market as a factor emerging the creation of these points in the Nord and Pas-de-Calais. This pool of potential consumers is also characterized by a population of both young and retired individuals, giving the impression of opposite generations, but indicating a higher concentration of smaller households. Consistent with the literature, our results also confirm the role of consumers' social commitment to local production and high quality agricultural products. For supply characteristics, we obtain mixed results when employing different methods and considering different spatial scales. However, in all cases, our results confirm that a potential supply characterized by organic farms encourages the location of these points in the Nord and Pas-de-Calais departments. In addition, on-farm sales act as a driving force to attract other off-farm points.

The above results lead to several considerations. Distinguishing between on-farm and off-farm direct sales is important in analyzing the determinants, as highlighted by Corsi et al. (2018). Based on our findings, the spatial structure of off-farm points of sale in SFSCs is more strongly associated with the potential market and its characteristics than with the potential supply and its characteristics. This underscores the crucial role of digitalization in short food supply chains.These methods allow consumers to purchase quality agricultural products from anywhere, and the establishment of these points of sale further increases accessibility. As a result, these outlets can be critical for producers located in remote and distant areas from the potential market.

Table 7: Estimation results for the probit model

	Dependent variable: Dummy variable: Having a point or not	
Variables	Coefficients	Av. marg. eff.
Market_FR	0.258***	0.0039***
	(0.057)	(0.0009)
Living standards	0.933***	0.0142***
	(0.320)	(0.0049)
Belgium market	-0.003	-0.0001
	(0.016)	(0.0002)
Share_POP_15_29	1.557***	0.0237***
	(0.454)	(0.0069)
Share_POP_more64	1.152***	0.0175***
	(0.231)	(0.0036)
Tourism	0.163***	0.0025***
	(0.034)	(0.0005)
Supply_FR	0.228**	0.0035**
	(0.097)	(0.0015)
SGP	-0.076	-0.0012
	(0.151)	(0.0023)
Share_OTEX_Gardening_Horticulture_Viticulture	-0.061	-0.0009
	(0.044)	(0.0007)
Share_OTEX_Bovine	0.167***	0.0025***
	(0.049)	(0.0008)
Share_OTEX_Sheep_Goats_Herbivores	-0.077*	-0.0012*
	(0.046)	(0.0007)
Share_OTEX_Swine_Poultry	0.002	0
	(0.040)	(0.0006)
Share_OTEX_Polyculture_Livestock	0.017	0.0003
	(0.062)	(0.0009)
Share_Organic_agriculture	0.086**	0.0013**
	(0.043)	(0.0007)
Share_Label_or_Others	-0.016	-0.0002
	(0.043)	(0.0007)
Share_Quality_or_environmental_initiatives	0.075	0.0011
	(0.073)	(0.0011)
Share_Experience	0.019	0.0003
	(0.345)	(0.0052)
Full_Time_Equivalent	-0.174	-0.0027
	(0.154)	(0.0023)
Share_Female_labor	0.201	0.0031
	(0.125)	(0.0019)
Share_High_education_Farmer	-0.048	-0.0007
	(0.078)	(0.0012)
Diversification	0.096**	0.0015**
	(0.037)	(0.0006)
Share_Not_family_setting_installation	0.227***	0.0035***
	(0.084)	(0.0013)
Share_FTE_Family_Labor	-0.341***	-0.0052***
	(0.091)	(0.0014)
Share_On_farm_sales	0.257***	0.0039***
	(0.076)	(0.0012)
Train_Station_1km	0.145***	0.0025***
	(0.045)	(0.0008)
Primary_secondary school_1km	0.121**	0.0017**
	(0.054)	(0.0007)
Health facility_1km	0.125***	0.002***
	(0.043)	(0.0007)
Constant	-7.319*	
	(4.410)	
ZAU	Yes	
DEPARTEMENTS	Yes	
Fixed effects DEP * ZAU	Yes	
Observations	83,805	
Log Likelihood	-2,679.271	
Pseudo.R.squared (McFadden)	0.112	
Akaike Inf. Crit.	5,432.542	

Note: All these variables are in logarithmic form, except for dummy variables.
Robust standard errors in parentheses and *p<0.1;**p<0.05;p<0.01***

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A Descriptive statistics

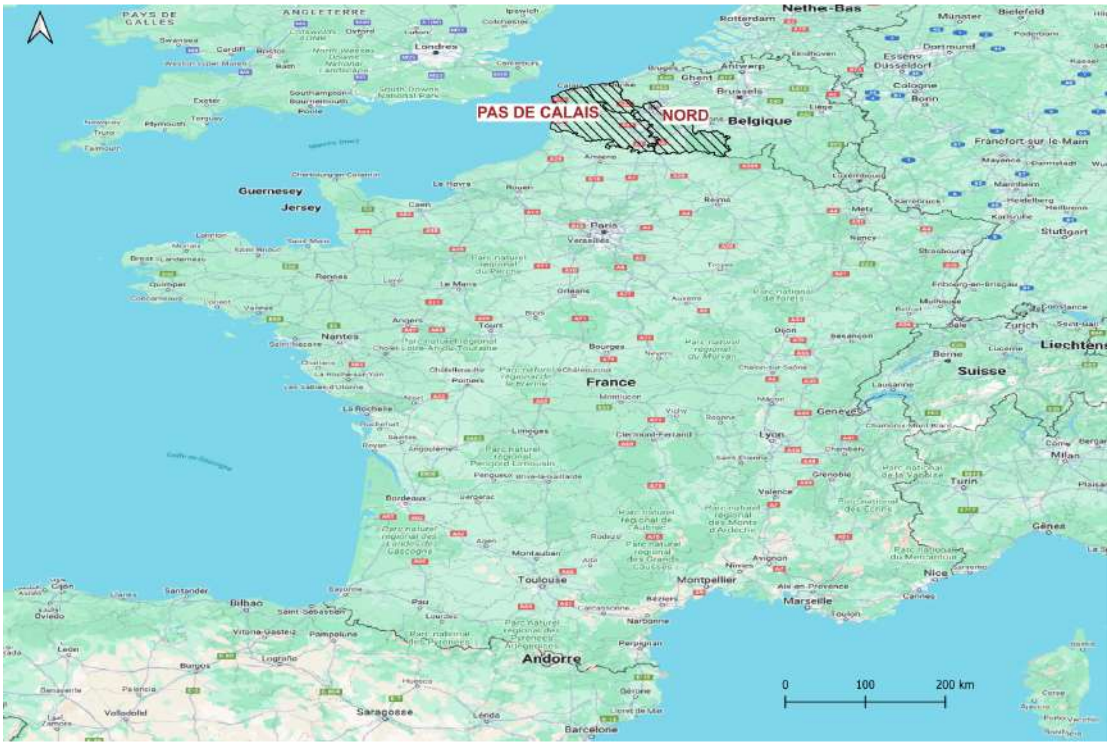

Figure 2: Departments of Nord and Pas-de-Calais

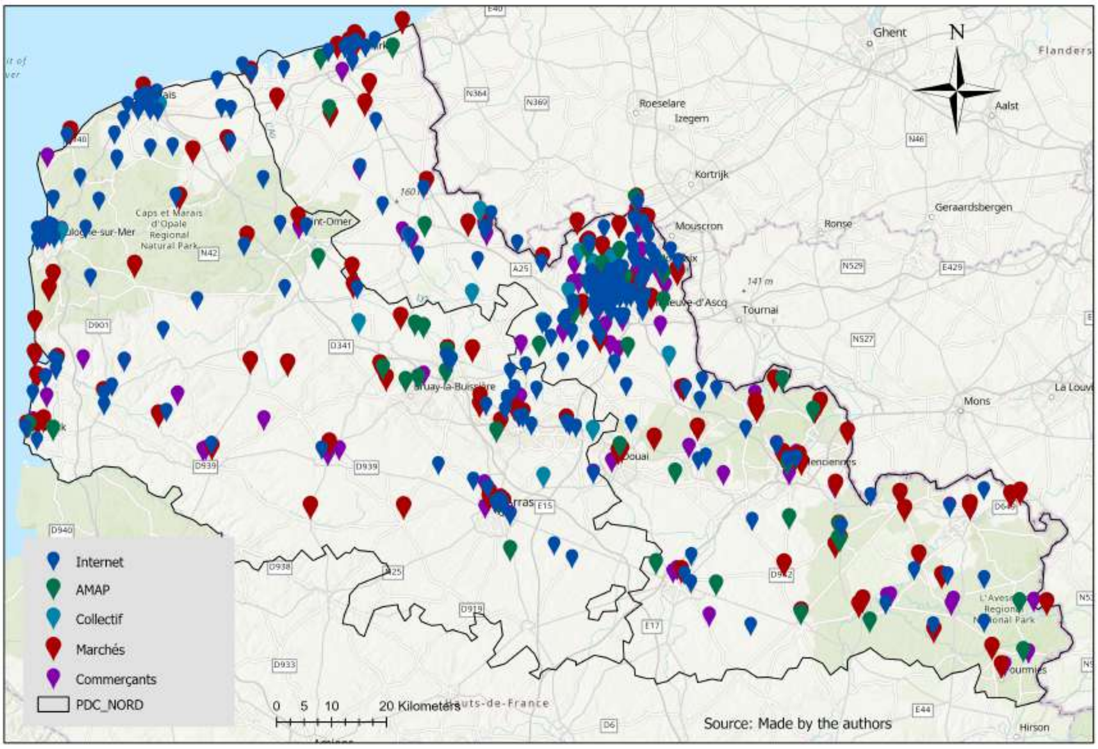

Figure 3: Spatial distribution of short food supplies by type in the Nord and Pas-de-Calais departments

B Construction of variables used in the negative binomial model

In this section, we explain how we construct indicators for the variables used in the negative binomial model.

Basically, we follow the standard methodology used in economic geography for calculating variables measuring a market potential. When our variable is an aggregate, for example population, we aggregate the values of these variables divided by the squared distance to the observation. If the variable is a ratio, for example the share of educated people, we calculate an average, with weights that are proportional to the contribution of each observation to the market potential variable corresponding to the relevant population.

Market Potential (MP) of the municipality i within a 50 km radius:

$$MP_i = \sum_{j}^{N} \frac{\text{Pop}_j \times \mathbb{1}\left(d_{ij} \leq 50\right)}{d_{ij}^2} \tag{1}$$

where i represents the municipality of interest, j is the neighboring municipality, Pop is the population, d is the Euclidean distance between the centroid of the municipality of interest and that of the neighboring municipality. When $i = j$, the distance is calculated using the following formula:

$$d_{ii} = \frac{1}{3} r_i = \frac{1}{3}\sqrt{\frac{\text{area }_i}{\pi}} \tag{2}$$

The division by the square of the distance suggests a quadratic relationship. As the distance d increases, the denominator increases, resulting in a smaller fraction. This potentially indicates a decrease in population density as the distance increases.

Income-based Market Opportunities Potential (IMOP) of the municipality i within a 50 km radius:

$$IMOP_i = \sum_{j}^{N} \frac{\frac{\text{POP}_j}{d_{ij}^2} \times \text{Median income}_j \times \mathbb{1}\left(d_{ij} \leq 50\right)}{MP_i} \tag{3}$$

The following equation illustrates how to calculate the contribution of each age group in the market potential of the global region, using the example of the population aged 15-29.

Contribution of the population aged 15-29 of the municipality in the global region i within a 50 km radius:

$$\text{POP-25-19}_i = \sum_{j}^{N} \frac{\frac{\text{POP}_j}{d_{ij}^2} \times \text{\% population aged 15-29} \times \mathbb{1}\left(d_{ij} \leq 50\right)}{MP_i} \tag{4}$$

Similarly, the distance d_{ij} is calculated between the centroids of municipalities i and j. For the same municipality, we use the same formula (5).

Supply Potential (SP) of the municipality i within a 100 km radius:

$$SP_i = \sum_{j}^{N} \frac{\text{Number of farmers }_j \times \mathbb{1}\left(d_{ij} \leq 100\right)}{d_{ij}^2} \tag{5}$$

Production-Based Supply Potential (PSP) for the municipality i within a 100 km radius:

$$PSP_i = \sum_{j}^{N} \frac{\frac{\text{Nber\_farmers}_j}{d_{ij}^2} \times \text{Median production}_j \times \mathbb{1}\left(d_{ij} \leq 100\right)}{SP_i} \tag{6}$$

The equation below shows the calculation of the contribution of each group of farmers based on their features to the supply potential in the global region. This is demonstrated exploiting the example of organic farmers:

Contribution of organic farmers within a 100 km radius to the municipality's overall supply potential in the global region i:

$$\text{Organic\_Farmers}_i = \sum_{j}^{N} \frac{\frac{\text{Number\_farmers}_j}{d_{ij}^2} \times \text{\%organic\_farmers} \times \mathbb{1}\left(d_{ij} \leq 100\right)}{SP_i} \tag{7}$$

C Construction of variables used in the probit model

This section displays our calculations for explanatory variables used in the probit model.

Number of individuals (Ind) within a 50 km radius:

$$Ind_i = \sum_{\substack{j \\ i=j}}^{N} \frac{\text{Individuals}_j \times \mathbb{1}\left(d_{ij} \leq 50\right)}{d_{ij}^2} \tag{8}$$

Where i represents the grid of interest, j is the neighboring grid, Pop is the number of individuals per grid, d is the Euclidean distance, with internal distance d_{ii} set to 1. External distances d_{ij} between grids are calculated based on their centroids, and distances less than 1 are set to 1.

Population features within a 50-kilometre radius: For example, share of individuals aged 15-29:

$$\text{Share\_Ind\_15\_29}_i = \sum_{\substack{j \\ j=i}}^{N} \frac{\frac{\text{Number\_individuals\_15\_29} \times \mathbb{1}(d_{ij} \leq 50)}{d_{ij}^2}}{Ind_i} \tag{9}$$

$$\text{Income}_i = \sum_{\substack{j \\ i=j}}^{N} \frac{\frac{\text{Average\_Income}_j \times \text{Number\_individuals}_j \times \mathbb{1}(d_{ij} \leq 50)}{d_{ij}^2}}{Ind_i} \tag{10}$$

Number of farmers within a 100 km radius:

$$\text{Farmers}_i = \sum_{\substack{j \\ i=j}}^{N} \frac{\mathbb{1}\left(d_{ij} < 100\right)}{d_{ij}^2} \tag{11}$$

Farmers features within a 100 km radius: For exemple, share of organic farms:

$$\text{Share\_Organic\_Farms}_i = \sum_{\substack{j \\ j=i}}^{N} \frac{\frac{\mathbb{1}(d_{ij} \leq 100) \times \mathbb{1}(\text{If Farm = organic})}{d_{ij}^2}}{\text{Farmers}_i} \tag{12}$$

$$PSP_i = \sum_{\substack{j \\ j=i}}^{N} \frac{\frac{PBS_j \times \mathbb{1}(d_{ij} \leq 100)}{d_{ij}^2}}{Farmers_i} \tag{13}$$

D Other results

Table 8: Differences in means of indicators calculated for the count model

VARIABLES	Municipalities without points Mean	Std. err.	Municipalities with points Mean	Std. err.	Diff	
Market_FR	11669.56	472.29	472.29	2897.65	-23882.88	***
Market_Income_FR	21530.49	52.04	20730.06	186.5	800.43	***
Market_Flemish	81.4	6.6	354.03	49.13	-272.63	***
Market_Walloon	221.53	13.7	409.46	42.08	-187.92	***
Proxy for environmental sensitivity	2.93	0.02	3.2	0.07	-0.28	***
Tourism density	1.5	0.2	4.86	1.2	-3.35	***
High_education_POP	25.59	0.12	25.4	0.41	0.19	no.sig
POP_15_29	15.3	0.03	16.32	0.16	-1.02	***
POP_30_44	19.05	0.03	18.43	0.09	0.62	***
POP_45_59	21.35	0.04	20.57	0.1	0.78	***
POP_more60	24.82	0.06	25.79	0.23	-0.96	***
Supply_FR	47.75	0.47	40.44	1.28	7.31	***
SGP	180705.5	1755.22	159501.5	3495.53	21204.06	***
OTEX_Bovine	17.29	0.42	15.09	0.82	2.2	**
OTEX_ Sheep_Goats_Herbivores	3.85	0.12	4.27	0.27	-0.41	no.sig
OTEX_ Swine_Poultry	2.3	0.11	2.32	0.24	-0.02	no.sig
OTEX_Polyculture_Livestock	15.71	0.28	14.56	0.51	1.15	*
OTEX_Gardening_Horticulture_Viticulture	4.27	0.14	8.45	0.6	-4.17	***
Organic agriculture	5.16	0.17	7.21	0.42	-2.05	***
Label or Others	3.93	0.13	4.02	0.29	-0.09	no.sig
Quality or environmental initiatives	11.58	0.27	11	0.48	0.58	no.sig
Experience	20.8	0.12	21.24	0.22	-0.45	no.sig
Full_Time_Equivalent	1.32	0.01	1.37	0.04	-0.05	**
Female labor	28.64	0.32	27.96	0.66	0.68	no.sig
High_education_Farmer	95.01	0.1	95.08	0.21	-0.07	no.sig
Diversification	23.86	0.31	24.73	0.62	-0.87	no.sig
Not_family_setting_installation	18.84	0.27	20.91	0.61	-2.07	***
FTE_Family Labor	0.12	0.03	0.03	0.06	0.09	no.sig
On farm sales	11.6	0.25	16.13	0.66	-4.53	***
Micro-farms	15.47	0.25	18	0.6	-2.53	***
Small-Farms	18.95	0.28	21.49	0.65	-2.54	***
Medium-Farms	29.12	0.33	28.38	0.59	0.74	no.sig
Large-Farms	33.31	0.37	29.09	0.75	4.22	***

Table 9: Differences in means of indicators calculated for the probit model

Variables	Difference = Mean(0) - Mean(1)	
Market_FR	-15337.07	***
Living standards	-248.06	***
Belgium market	-289.5116	***
Share_POP_15_29	-0.0037	***
Share_POP_more64	0	
Tourism	-3.667	***
Train_Station_1km	-0.1561	***
Primary_secondary school_1km	-0.3345	***
Health facility_1km	-0.1934	***
Supply_FR	2.9303	***
SGP	12159.4	***
Share_OTEX_Gardening_Horticulture_Viticulture	-0.032	***
Share_OTEX_Bovine	0.0208	***
Share_OTEX_Sheep_Goats_Herbivores	0.0004	
Share_OTEX_ Swine_Poultry	0.0047	***
Share_OTEX_Polyculture_Livestock	0.0055	**
Share_Organic agriculture	-0.0132	***
Share_Label or Others	0.0027	**
Share_Quality or environmental initiatives	0.0037	*
Share_Experience	0.0557	
Share_Full_Time_Equivalent	-0.076	***
Share_Female labor	0.0029	
Share_High_education_Farmer	-0.0043	**
Share_Diversification	-0.0065	***
Share_Not_family_setting_installation	-0.001	
Share_FTE_Family Labor	0.0012	
Share_On farm sales	-0.0282	***

Table 10: Alternative specifications for the count model

	Model 1	Model 2	Model 3	Model 4	Model 5
Market_FR	0.325***	0.326***	0.409***	0.332***	0.425***
	(0.113)	(0.118)	(0.110)	(0.119)	(0.110)
Market_Income_FR	-2.083*	-2.119**		-2.196***	
	(1.067)	(0.846)		(0.831)	
Market_Flamand	0.090**	0.089**	0.079**	0.090**	0.080**
	(0.036)	(0.036)	(0.034)	(0.036)	(0.035)
Market_Wallon	0.011	0.009	0.004	0.010	0.005
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
High_education_POP	-0.288				
	(0.622)				
Proxy for environmental sensitivity	1.485***	1.494***	1.296***	1.457***	1.231***
	(0.350)	(0.341)	(0.344)	(0.334)	(0.337)
Tourism density	0.115***	0.115***	0.120***	0.113***	0.117***
	(0.035)	(0.034)	(0.035)	(0.035)	(0.035)
POP_15_29	3.920***	3.802***	3.795***	3.928***	3.971***
	(0.840)	(0.862)	(0.928)	(0.835)	(0.913)
POP_30_44	-0.864	-1.045	-2.091	-0.791	-1.809
	(1.380)	(1.467)	(1.594)	(1.348)	(1.492)
P19_POP_45_59	-2.898***	-2.942***	-3.701***	-2.823***	-3.581***
	(1.093)	(1.081)	(1.153)	(1.029)	(1.107)
P19_POPmore60	5.458***	5.427***	4.427***	5.506***	4.490***
	(1.137)	(1.113)	(1.203)	(1.109)	(1.187)
Professions: Employees_Workers		0.014	0.017		
		(0.037)	(0.037)		
Professions: Craftsmen_merchants		-0.055	-0.087		
		(0.117)	(0.119)		
Professions: Executive_positions		-0.018	-0.087	-0.027	-0.102**
		(0.068)	(0.060)	(0.056)	(0.047)
Supply_FR	-0.407**	-0.405**	-0.404**	-0.409**	-0.410**
	(0.200)	(0.202)	(0.201)	(0.200)	(0.199)
SGP	-0.411*	-0.427*	-0.419*	-0.413*	-0.396
	(0.245)	(0.246)	(0.246)	(0.245)	(0.246)
OTEX_Bovine	0.146	0.150	0.187*	0.146	0.183*
	(0.105)	(0.105)	(0.104)	(0.104)	(0.104)
OTEX_Sheep_Goats_Herbivores	-0.056	-0.058	-0.034	-0.057	-0.031
	(0.099)	(0.099)	(0.096)	(0.099)	(0.097)
OTEX_Swine_Poultry	0.082	0.077	0.072	0.079	0.075
	(0.061)	(0.060)	(0.061)	(0.060)	(0.061)
OTEX_Polyculture_Livestock	0.025	0.026	0.042	0.024	0.039
	(0.112)	(0.112)	(0.112)	(0.112)	(0.112)
OTEX_Gardening_Horticulture_Viticulture	0.175**	0.174**	0.188**	0.173**	0.188**
	(0.078)	(0.078)	(0.077)	(0.077)	(0.076)
Organic agriculture	0.259***	0.259***	0.258***	0.259***	0.258***
	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)
Label or Others	0.140*	0.141*	0.144*	0.139*	0.142*
	(0.084)	(0.084)	(0.083)	(0.084)	(0.083)
Quality or environmental initiatives	0.248***	0.250***	0.256***	0.249***	0.255***
	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
Experience	0.450	0.443	0.442	0.448	0.446
	(0.406)	(0.409)	(0.408)	(0.407)	(0.408)
Full_Time_Equivalent	-0.595**	-0.591**	-0.584**	-0.604**	-0.602**
	(0.243)	(0.245)	(0.251)	(0.244)	(0.250)
Female labor	0.228	0.233	0.241	0.232	0.239
	(0.164)	(0.166)	(0.166)	(0.166)	(0.166)
High_education_Farmer	0.719	0.766	0.617	0.788	0.646
	(1.681)	(1.694)	(1.667)	(1.685)	(1.656)
Diversification	0.124	0.128	0.131	0.122	0.123
	(0.145)	(0.145)	(0.143)	(0.145)	(0.142)
Not_family_setting_installation	0.131	0.137	0.154	0.132	0.148
	(0.133)	(0.134)	(0.134)	(0.133)	(0.134)
FTE_Family Labor	-0.267***	-0.270***	-0.285***	-0.268***	-0.284***
	(0.077)	(0.078)	(0.077)	(0.077)	(0.076)
On farm sales	0.235**	0.233**	0.227**	0.236**	0.231**
	(0.108)	(0.108)	(0.110)	(0.108)	(0.110)
Constant	-3.388	-2.992	-15.336	-4.013	-17.446
	(13.204)	(14.231)	(14.069)	(13.731)	(13.821)
Observations	1,493	1,493	1,493	1,493	1,493
Log Likelihood	-786.057	-785.865	-788.202	-786.064	-788.620
theta	1.508***(0.343)	1.495***(0.337)	1.437***(0.318)	1.500***(0.340)	1.439***(0.320)
Akaike Inf. Crit.	1,632.114	1,635.730	1,638.404	1,632.128	1,635.240

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Note: All these variables are in logarithmic form.

Table 11: Estimates for the negative binomial model without Lille

	Dependent variable : Count Vente Hors Ferme / without Lille			
	Model 1		Model 2	
VARIABLES	Coefficients	Av. marg. eff.	Coefficients	Av. marg. eff.
Market_FR	0.321***	0.109***	0.295**	0.1**
	(0.112)	(0.04)	(0.116)	(0.041)
Market_Income_FR	-2.703***	-0.92***	-2.630***	-0.892***
	(0.668)	(0.247)	(0.676)	(0.247)
Market_Flemish	0.094***	0.032**	0.094***	0.032**
	(0.036)	(0.013)	(0.036)	(0.013)
Market_Walloon	0.004	0.001	0.014	0.005
	(0.033)	(0.011)	(0.033)	(0.011)
Proxy for environmental sensitivity	1.430***	0.487***	1.385***	0.47***
	(0.297)	(0.113)	(0.300)	(0.113)
Tourism	0.112***	0.038***	0.118***	0.04***
	(0.037)	(0.013)	(0.038)	(0.013)
POP_15_29	4.093***	1.394***	4.330***	1.468***
	(0.834)	(0.319)	(0.827)	(0.318)
POP_30_44	-0.031	-0.01	0.084	0.028
	(1.539)	(0.524)	(1.529)	(0.519)
POP_45_59	-2.389**	-0.813**	-2.193**	-0.744**
	(1.113)	(0.377)	(1.093)	(0.368)
POP_more60	6.157***	2.096***	6.274***	2.127***
	(1.235)	(0.483)	(1.231)	(0.48)
Supply_FR	-0.417**	-0.142**	-0.420**	-0.142**
	(0.194)	(0.067)	(0.198)	(0.069)
SGP	-0.345	-0.117		
	(0.256)	(0.088)		
OTEX_Bovine	0.130	0.044	0.124	0.042
	(0.104)	(0.036)	(0.102)	(0.035)
OTEX_ Sheep_Goats_Herbivores	-0.010	-0.003	0.020	0.007
	(0.096)	(0.033)	(0.098)	(0.033)
OTEX_ Swine_Poultry	0.100*	0.034	0.094	0.032
	(0.060)	(0.021)	(0.058)	(0.02)
OTEX_Polyculture_Livestock	0.025	0.008	0.003	0.001
	(0.113)	(0.038)	(0.111)	(0.038)
OTEX_Gardening_Horticulture_Viticulture	0.168**	0.057**	0.172**	0.058**
	(0.076)	(0.026)	(0.075)	(0.025)
Organic agriculture	0.281***	0.096***	0.264***	0.089***
	(0.083)	(0.029)	(0.084)	(0.029)
Label or Others	0.119	0.04	0.114	0.039
	(0.084)	(0.029)	(0.082)	(0.028)
Quality or environmental initiatives	0.222***	0.075**	0.217***	0.073**
	(0.085)	(0.03)	(0.084)	(0.029)
Experience	0.396	0.135	0.422	0.143
	(0.411)	(0.139)	(0.404)	(0.137)
Full_Time_Equivalent	-0.633**	-0.215**	-0.682***	-0.231***
	(0.257)	(0.091)	(0.239)	(0.085)
Female labor	0.223	0.076	0.292*	0.099*
	(0.159)	(0.054)	(0.157)	(0.054)
High_education_Farmer	1.563	0.532	1.476	0.5
	(1.741)	(0.595)	(1.711)	(0.582)
Diversification	0.131	0.045	0.103	0.035
	(0.144)	(0.049)	(0.145)	(0.049)
Not_family_setting_installation	0.075	0.025	0.108	0.037
	(0.129)	(0.044)	(0.130)	(0.044)
FTE_Family Labor	-0.262***	-0.089***	-0.261***	-0.088***
	(0.073)	(0.027)	(0.073)	(0.026)
On farm sales	0.248**	0.084**	0.248**	0.084**
	(0.109)	(0.037)	(0.107)	(0.036)
Micro-farms			0.066	0.023
			(0.157)	(0.053)
Small-Farms			0.278*	0.094*
			(0.151)	(0.052)
Medium-Farms			0.492**	0.167**
			(0.198)	(0.069)
Constant	-9.067		-18.055	
	(13.237)		(13.659)	
Observations	1,492		1,492	
alpha	-0.572 (0.285)		-0.674 (0.294)	
lnalpha	-0.572** (0.286)		-0.674** (0.294)	
Log Likelihood	-751.806		-748.977	
Pseudo R2	0.240		0.243	
AIC	1563.613		1561.953	

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Note: All these variables are in logarithmic form.

Table 12: Estimates for the generalized poisson model

	Dependent variable : Count Vente Hors Ferme			
	Model 1		Model 2	
VARIABLES	Coefficients	Av. marg. eff.	Coefficients	Av. marg. eff.
Market_FR	0.252**	0.089**	0.237**	0.083**
	(0.113)	(0.041)	(0.113)	(0.041)
Market_Income_FR	-1.843***	-0.649***	-1.761***	-0.62***
	(0.619)	(0.226)	(0.608)	(0.221)
Market_Flemish	0.072**	0.025**	0.074**	0.026**
	(0.035)	(0.012)	(0.035)	(0.012)
Market_Walloon	0.018	0.006	0.019	0.007
	(0.033)	(0.012)	(0.033)	(0.012)
Proxy for environmental sensitivity	1.219***	0.429***	1.169***	0.412***
	(0.289)	(0.108)	(0.295)	(0.109)
Tourism	0.131***	0.046***	0.135***	0.048***
	(0.038)	(0.013)	(0.039)	(0.014)
POP_15_29	3.926***	1.383***	4.106***	1.447***
	(0.702)	(0.257)	(0.681)	(0.254)
POP_30_44	-1.959*	-0.69*	-1.881*	-0.663*
	(1.086)	(0.382)	(1.086)	(0.382)
POP_45_59	-3.153***	-1.111***	-3.138***	-1.106***
	(0.792)	(0.274)	(0.816)	(0.282)
POP_more60	4.411***	1.554***	4.487***	1.581***
	(0.982)	(0.361)	(0.973)	(0.36)
Supply_FR	-0.366*	-0.129*	-0.341*	-0.12*
	(0.201)	(0.071)	(0.203)	(0.072)
SGP	-0.134	-0.047		
	(0.207)	(0.073)		
OTEX_Bovine	0.080	0.028	0.080	0.028
	(0.104)	(0.037)	(0.105)	(0.037)
OTEX_ Sheep_Goats_Herbivores	-0.064	-0.023	-0.046	-0.016
	(0.100)	(0.035)	(0.104)	(0.037)
OTEX_ Swine_Poultry	0.092	0.032	0.091	0.032
	(0.059)	(0.021)	(0.059)	(0.021)
OTEX_Polyculture_Livestock	0.127	0.045	0.106	0.037
	(0.103)	(0.036)	(0.104)	(0.037)
OTEX_Gardening_Horticulture_Viticulture	0.203***	0.072***	0.205***	0.072***
	(0.068)	(0.024)	(0.068)	(0.024)
Organic agriculture	0.301***	0.106***	0.286***	0.101***
	(0.078)	(0.028)	(0.080)	(0.028)
Label or Others	0.051	0.018	0.050	0.018
	(0.085)	(0.03)	(0.083)	(0.029)
Quality or environmental initiatives	0.190**	0.067**	0.202**	0.071**
	(0.083)	(0.03)	(0.083)	(0.029)
Experience	0.510	0.18	0.496	0.175
	(0.378)	(0.134)	(0.382)	(0.135)
Full_Time_Equivalent	-0.611***	-0.215***	-0.600***	-0.212***
	(0.206)	(0.075)	(0.208)	(0.076)
Female labor	0.226	0.08	0.265*	0.093*
	(0.150)	(0.053)	(0.150)	(0.053)
High_education_Farmer	0.924	0.326	0.871	0.307
	(1.744)	(0.614)	(1.765)	(0.622)
Diversification	0.052	0.018	0.032	0.011
	(0.130)	(0.046)	(0.134)	(0.047)
Not_family_setting_installation	0.037	0.013	0.056	0.02
	(0.129)	(0.045)	(0.130)	(0.046)
FTE_Family Labor	-0.195***	-0.069***	-0.199***	-0.07***
	(0.070)	(0.025)	(0.070)	(0.026)
On farm sales	0.258**	0.091**	0.272***	0.096***
	(0.102)	(0.036)	(0.102)	(0.035)
Micro-farms			0.078	0.028
			(0.149)	(0.052)
Small-Farms			0.164	0.058
			(0.133)	(0.047)
Medium-Farms			0.378**	0.133**
			(0.185)	(0.066)
Constant	-2.489		-7.600	
	(11.114)		(10.839)	
Observations	1,493		1,493	
delta	0.158 (0.0318)		0.151(0.0314)	
atanhdelta	0.159***(0.033)		0.152***(0.032)	
Log Likelihood	-754.825		-752.755	
Pseudo R2	0.2498		0.2518	
AIC	1569.651		1569.511	

Robust standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Note: All these variables are in logarithmic form.