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Food open-air markets in Paris: transportation environmental issues

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Abstract

Food consumption habits have changed significantly in recent years due to the emergence of new distribution methods; such as shorter food supply chains. Today, consumers have access to a wide range of ways to do their groceries: online, through farm cooperatives and specialized stores. Historical vectors of food supply and representing a French-style "Art de Vivre", local markets seem unshakeable and continue to play an important role in the lives of French citizens who seek to shop local. Faced with new consumer demands, local markets are looking to adapt to the changing habits of their customers, particularly in terms of environmental impacts. More specifically, Parisian markets are affected by the increasingly restrictive transportation environmental standards enforced by the city. Despite this, very few studies have been conducted on the real impact of the transport of food markets, which supply Parisians on a daily basis. They stand out from their regional counterparts, as the Ile-de-France region is not self-sufficient to feed all of its inhabitants, which results in only a small share of merchandise being sourced from local producers. Largely dependent on national agriculture and imports, the presence of the world's largest fresh products market (Rungis International Market) reflects a steadily increasing need for one of the world's most populous agglomerations. By means of a quantitative study, this article provides an initial assessment of the environmental impact of the regular maintenance of food markets and suggests potential development possibilities to maintain their activities while reducing their carbon footprint.

Keywords: open-air markets; environmental impacts; short food supply chain; food transportation.

1. Introduction

From 1994 to 2011, the share of food (excluding drinks) as a primary and therefore necessary need has remained stable in the French peoples' budgets despite the economic crisis of 2008 (ANSES, 2017). The French spend an average of 16% of their monthly budget on food (Larochette and Joan, 2015), and are becoming increasingly demanding when selecting their products, as certain criteria such as proximity and environmental impact take on greater importance.

To meet these demands, various studies conducted over the past twenty years by organizations such as the INRA (National Institute of Agronomic Research), CREDOC (Research Centre for the Study and Observation of Conditions of Life) and ADEME (French Environment and Energy Management Agency) have demonstrated a large diversification of available food products, due to the development of new short supply chain distribution channels and the development of partnerships between large retailers and local producers. Faced with this new competition, food markets attempt to keep their place and are subject to changes.

Known under different forms and appellations (open-air markets, covered markets, etc.), food markets take place when a group of professionals (known as "nomadic" traders who can be permanent or temporary subscribers) gather in a public space made available by the local council in exchange for a fee, to sell provisions, non-food goods and products such as meats, cheeses and breads (Marechal, 2008). These indoor or outdoor spaces follow their own

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regulations, which govern opening hours, specific attributes (specialized produce, organic, etc.) and type of management (outsourced or not).

To what extent can these markets hold their ground in view of the significant development of short food supply chains and the predominance of large-scale retailers? What improvements could be made to ensure them a secure future while preserving their historical image built over many centuries, all the while keeping the carbon footprint to a minimum?

In this article, conventional supply chains will not be studied. Focus will be carried out on the development of short food supply chains and local food markets in Paris. Firstly, a review of the current state of research will highlight national and local consumption trends for the different food distribution channels. Subsequently, an assessment outlining the challenges faced by Parisian food markets will be conducted in order to establish the position that this mode of distribution holds among Parisians. A quantitative study will attempt to provide an initial impact evaluation of Parisian "open-air" markets on the environment. The framework analysis will make it possible to suggest viable means of progression to ensure a future for these local markets when faced with increasing competition from other channels of distribution, while remaining more respectful of the environment.

2. Food consumption in France: the current practices

French consumption habits have been the object of numerous studies for decades done by public institutions (i.e. CREDOC, INRA, AGRESTE), highlighting their evolution according to various social, economic and environmental factors. A study conducted by CREDOC in 2010 (CREDOC, 2010), showed that from 2007 to 2010, the French chose to buy produce according to 4 main criteria: product quality, price, geographical proximity of the store and product variety.

The first criterion, quality, is a very subjective notion, as "*the judgment of quality is that of a consumer anchored in a context in which his representations are permeable – and therefore subject to time, with specific social and economic characteristics, such as age or socio-occupational category, and cognitive skills that contribute further to forging his representations and guiding his interpretation of quality*." (Tavoularis et al., 2015). Price, as a second criterion, is also a guiding factor in the consumer's choice. A strong competitor to quality over recent years, it is more or less significant depending on the period (during a crisis, for example) and on the socio-occupational category.

The results of the CREDOC study indicate that French consumers connect quality of the product to taste, appearance and price, but also to the knowledge of its origin and the guarantee that the product was sourced with respect for the environment. These last two elements constitute important factors for consumers today (CREDOC, 2010). These results demonstrate the complexity of the food market and the difficulty to satisfy all criteria, as some of them interplay. For example, value for money is most commonly proportional, as the higher the "quality" of the product, the more expensive it is, which is the case for "organic" produce.

The consumer is spoilt for choice with an array of supply systems to satisfy his food needs. Until 2010, the selection of food supply options was stable. In 1st place: supermarkets and large-scale retailers, in 2nd place: small retailers, in 3rd place: markets, and in 4th place: hard-discount stores. The choice of location depends on the consumer's characteristics, such as age, the offers available near his home, and his socio-occupational category. For example, a Parisian will purchase more in markets and local shops, whereas in cities with better access to supermarkets and superstores, purchases will more often be made in large-scale stores.

Consumers are therefore multichannel, but large and medium-sized stores still remain the most visited, with 65% of purchases made here (ADEME, 2017).

2.1. Definition of short food supply chains

Always striving for quality, fair prices (both for the consumer and the producer – a win-win situation) and geographical proximity, other distribution channels known as "short food supply chains" have seen the light of day in recent years. In 2015, these short supply chains involved 1 in 5 producers, or 21% of farmers (ADEME, 2017).

- How to define a short food supply chain? There are many definitions, but two were retained for this article.

- The definition of the European Union: "*A supply chain formed by a limited number of economic operators who focus on the promotion of the cooperation, the regional development and the tight social and territorial relationships between producers and consumers*" (De Fazio, 2016).
- And that of ADEME: "*Short supply chains are sales done directly to the consumer or using an intermediary" and "Close proximity distribution indicates a limited distance between the place of production and that of consumption (usually under 150 km)*" (ADEME, 2012).

2.2. How much of the French's groceries are purchased in short supply chains?

In 2013, the share of groceries purchased through short food supply chain systems in France was 10% and has been on constant rise ever since. The survey, conducted in 2013 for the CODIA project "Commercial Opportunity and Dialogue with Society", divided French short supply chains up as so: Open-air markets 37%, Farm shops 16%, Farmers' markets 9%, Producer-owned shops 9%, Small, medium and large retailers both 8%, Resellers on the market 9%, AMAP and organic stores both 4% (CODIA, 2014). Open-air markets are by far the most popular. Growing consumer enthusiasm for short food supply chains is reflected in a quest for Taste, Freshness and Human Relations.

2.3. Who are the consumers purchasing in short food supply chains?

As mentioned at the beginning of this study, changes in consumption patterns depend on the socio-economic and environmental conditions of the consumer, which strongly influence these choices. Furthermore, it is noteworthy that elderly, retired and often isolated people prefer to visit markets as they are located close to their homes and allow them to maintain social ties. Figure 1 presents a summary of the buyers of short supply chains in France.

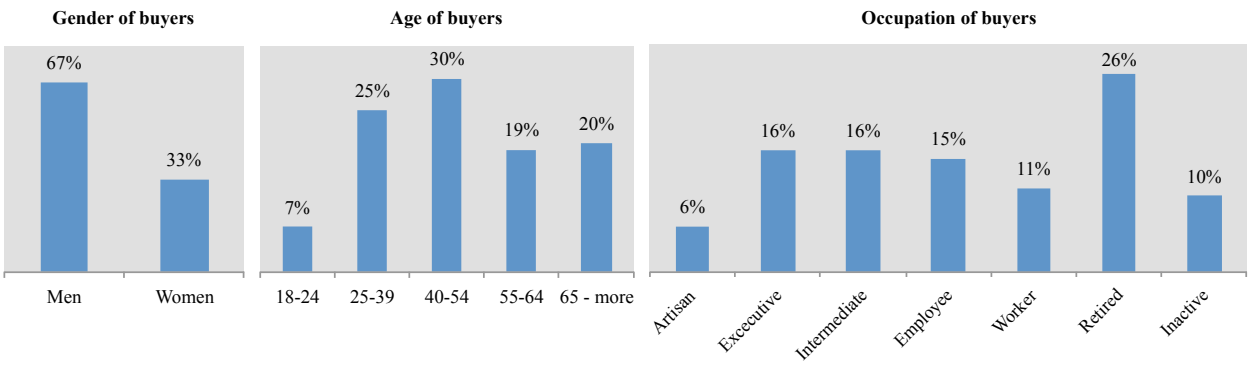

Fig. 1. Profiles of short supply chain buyers. Source (CODIA, 2014).

2.4. Strengths and weaknesses of short food supply chains

The emergence of short food supply chains is supported by the development of an « Eat Local » ideal, supported by a desire to eat healthily, protect the environment and support local economy. According to the Committee on Economic and Monetary Affairs: "Today, all signs point to the benefits of developing high quality short food supply chains, close to our homes. There is high demand for these products, with firstly a desire to strengthen social bonds, as more and more of the French people seek to give a purpose to their consumption, but also in terms of health and the environment" (Allain, 2015).

From an environmental point of view, it turns out that short supply chains do not necessarily equal a reduction in greenhouse gas emissions. According to the ADEME, we need to put things into perspective. Taking into consideration the differences between the weight carried and the number of trips required by the producer to sell his products is essential: "Large quantities transported over great distances, in an optimized manner, may produce less

greenhouse gas emissions per ton transported than many small quantities, carried over short distances in light trucks that return empty" (ADEME, 2012).

The study of numerous documents on short supply chain models (Aggestam et al., 2017; Canfora, 2016; Chiffoleau, 2010; Giampietri et al., 2018; Sellitto et al., 2018) led to the following SWOT analysis:

Table 1. SWOT analysis of the evolution of short supply chains.

Opportunities	Threats
• Develop the distribution of local agricultural production; • Research the complementarity with established stores; • Attract tourism: local products support regional marketing; • Development of partnerships between large supermarkets and local producers.	• New players on the online retail market; • Weak market shares, due to low product diversification possibilities: concerns only fresh produce (fruit, vegetables and fish) and some processed (meats, etc.); • Shifts in food consumption behavior.
Strengths	**Weaknesses**
• Socio-economic support to local markets; • Producer/customer ties reinforced by geographical proximity; • Healthier, better quality produce, often cheaper, with known origin and production conditions; • Immediate payment for the producer.	• Environmental impact of greenhouse gas emissions to be put into perspective when considering low volumes transported and distances travelled; • Difficulties managing these distribution methods (farmers are not always trained for direct sales); • Need for customer loyalty and client portfolio; • Significant regional disparity; • Lack of commercial visibility.

3. Markets, an ancestral way of trade that remains

What is a market? Research papers and documents on the subject do not use one single definition, as there can be so many variations. However, the following definition matches our observations: "A regular gathering of traders and street vendors for the sale of provisions and other goods in exchange for money, in a space dependent on public sector. Multiple terms can be used to describe this: "retail market", "market fair", "open-air market" and "street market". These terms designate either food, non-food or mixed markets." (Marechal, 2008).

For several centuries, these markets have contributed to the hustle and bustle of neighborhood life, while carrying out their primary function: supplying local inhabitants with food produce. They are considered to be the most ancient method of direct-to-consumer sales, and have since preserved their immutable, recognizable form. As the author points out in his study (Nordin, 1993), it is difficult to measure the exact extent of non-sedentary retail (lack of reliable statistics) due to its fluctuating terminology, multiple forms and periodic nature (Laclavere, 2016). However, studies estimate the share of these markets to be between 7% and 50% of total retail turnover, depending on the area and the products studied (Nordin, 1993). In addition, "the Ministry of Industry, Trade and Craft estimates that 30% of French households attend markets and 12.5% make purchases there twice a week" (Cour des comptes, 1991).

During the 70s, as large-scale retailers emerged rapidly and agricultural methods were modernized – reducing the need for direct-to-consumer sales – a decline in local markets seemed inevitable (Navarro, 2012). Several studies, supported by regional surveys, have observed a drop in attendance and a shift relative to new lifestyle standards. Paradoxically, the number of new market openings is significant, as sixty-odd new markets have been established in regions with high population growth, such as Seine-et-Marne and the Yvelines (Delaporte, 2000). Although in decline due to the increasing development of medium and large-scale retailers, studies estimate that today, local markets take second place for consumer purchases of fruit and vegetables, thus confirming this method of distribution's major role in the eyes of the consumer. According to several authors this may be explained by the implementation of specific policies to maintain and promote the French "Art de Vivre" (Albert, 2015). Many regional and local authorities have come to understand the importance of these markets, the "driving forces of urban dynamic" (Mabille, 2015) and their image in the eyes of the locals (Henry, 2018). The image of open-air markets is

so powerful that certain supermarket chains have even created special spaces to sell fruits and vegetables, copying the codes and architectural models of these markets to attract customers who are used to this type of shopping. More generally, these markets are perceived by consumers as lively places to shop, offering fresh, quality produce at fair prices.

4. Overview of open-air markets in Paris

The Palu market, founded before the 6th century (Brière, 1950) was the first market to set up in the heart of *Lutèce* (on the *Ile de la Cité*). Since then, the number of markets in the city has continued to rise, with a total of 60 at the start of the 20th century. Today, Paris boasts 95 markets (all types included, such as flea markets and specialized markets that are not included in this study). The City Council distinguishes between two types of market: covered (housed in permanent structures) and open-air (outdoor). Seventy-one of the latter (and most common) are spread all over the city. These allow Parisians to carry out their grocery shopping on a regular basis while staying close to home. Contrastingly, the number of covered markets has been cut in half, dropping from about 30 a couple of centuries ago to only 10 today (the *Marché de Enfants Rouges* is the oldest but still the most visited). This decrease can be explained by the higher cost of such markets (Nordin, 1993) in comparison to open-air markets which are much easier to install.

Fig. 2. Geographical distribution of Parisian markets (Source: Paris City Hall).

In 2000, there were 15,000 permanent and 6,000 temporary subscribers on French markets, 18% of which were in Paris. The typical configuration of a Parisian market is as follows: two-thirds of temporary traders offer food produce and one-third sells manufactured goods (Delaporte, 2000). During a visit for the purpose of this study, this observation was verified (cf. appendix 1), but must be put into perspective. This configuration may vary depending on the day (weekday or weekend), as some subscribers may choose not to work the market if they feel it will not be profitable enough for them (Delaporte, 2000; Navarro, 2012). Unlike the majority of French markets, which are run by local authorities, the Paris city council assigns the management of these markets to businesses (concessionaires). In Paris, four of these companies share the city's 78 markets, ensuring retailer management, equipment maintenance (tents, electrical boxes, water sources), cleaning of the premises, garbage disposal (Radisson, 2016) and the activities on site.

As mentioned previously, an overall decrease in market attendance can be observed, from both traders and customers (Cour des comptes, 1991). However, this decline does not appear to have affected Parisian markets, as they continue to experience strong growth (Delaporte, 2000), proven by the opening of five new markets in three

years (Chapuis, 2015). Although this data is confirmed by recent studies, it should be considered alongside other more general elements: a decreasing average shopping cart due to the current economic context (an estimated 15% decrease in family budgets) and a reduced diversity of supply especially with certain types of food artisans, considered as "driving forces of a market" (Negrouche, 2016). Furthermore, the Rungis International Market and its economic model contribute to preserving the charm of Parisian markets, which provide a wide variety of quality produce at attractive prices. The majority of nomadic traders do in fact offer food produce sourced at Rungis. Although the rural code stipulates that at least 10% of the space should be allocated to local producers (Navarro, 2012), the vast majority of foodstuff sold at Parisian markets is not sourced regionally, as producers opt to sell their products through other local channels of distribution (AMAP, fixed points of sale, farm shops, etc.).

5. Significance of markets in urban development

For years, studies and reports have agreed on the fact that markets are genuine assets for towns and cities. "Open-air markets contribute to the economic drive of the community" (Navarro, 2012), allowing traders to sell their products at minimal costs without having to invest in an expensive shop front. Furthermore, markets with nomadic traders and their producers seem to be a positive addition to what the permanent traders have to offer. On market days, there is a real dynamic urban atmosphere, benefiting the local community and reflecting its identity: "Essential to urban life, markets are seen as a real tool for the planning and economic development of the community, and are an undeniable instrument for social cohesion" (Mabille, 2015). Geographical proximity, accessibility and versatility are also important, as statistics show that a high number of elderly folk or people with no means of transport attend markets on a regular basis to get out of the house and "socialize".

As well as being a driving force of dynamic urban life, markets and short supply chains in general also allow regional agricultural projects to grow. Food sovereignty was introduced into French law in 2014, stipulating: "Local autonomy in production is one of the objectives of the food and agricultural policy". A European project enables cities to work together and develop integrated solutions to common urban challenges. Financed by the European Union, with over 7000 active stakeholders across 500 towns and cities, "Urbact Markets" aims to understand and explore the role of urban markets as key drivers of change in terms of local economic development, regeneration and sustainable living (Costa et al., 2015). In 2015, nine cities actively took part in the first study, and an exchange system has since been put into place to allow cities to share their experiences. This project supports the idea that markets play an important role in urban development. These elements are identified in numerous studies:

- Social and economic roles in urban development, a consideration for consumer needs and the promotion of nomadic traders;
- Attracting tourists and encouraging them to discover the area;
- Participating in France's influence on the rest of the world with the French "savoir-vivre" by opening international markets based on the French model: for example, French Markets in the USA are managed by the *Bensidoun group*, one of the leading concessionaires for Parisian markets.

6. Environmental issues

Consumer enthusiasm for short supply chains is undeniable and has led certain people to question the veracity of these distribution systems' presumed virtues (Aggestam et al., 2017; Canfora, 2016). Numerous studies have been conducted on the environmental impact of these short supply chains (ADEME, IAU, etc.) in an attempt to evaluate how energy-efficient they actually are, but no work appears to have been conducted on Parisian markets. Yet each year Parisian antipollution policies are tightened, as measures against diesel-run vehicles in particular have shown to be more restrictive than on a national level: "If these measures are to be applied all over the country in 2040, it makes sense that Paris, already leading in this sector, should be the first to go ahead" (Mandard, 2017). These measures oblige drivers to add a "Crit-air" sticker on their vehicles, classifying them into categories according to their level of atmospheric pollutants. Each city can then enforce their own restrictions, even banning certain vehicles. The policy reflects several studies conducted over the past few years to try to decrease Greenhouse Gas (GHG) and fine particles emissions brought on by these activities.

It is therefore essential to consider this aspect, which will pose an additional threat for Parisian markets. Although certain exemptions and support systems do exist for vehicles transporting perishable goods to markets in Paris (Platiau, 2017), the strict environmental policies enforced in the next few years may ban all polluting vehicles, including those transporting market goods.

What impact do Parisian markets have on the environment? Analyzing early data confirmed the complexity of this task. As mentioned previously, these markets are unique: attendance, regularity and size are all variable. The synergies revolving around them must also be considered.

7. Study of the transportation environmental impacts of open-air markets in Paris

7.1. Proposed methodology

The methodology applied here is inspired by that of the ADEME, according to its "Target CO2" frame of reference (ADEME, 2016). The conducted study chose to define a simple perimeter in order to **obtain an estimation of the environmental impact of the transportation of goods for the supply of open-air markets in Paris**:

- 71 markets organized at least twice a week, 50 weeks a year;
- An inventory of the number of types of vehicles used for three markets with an extrapolation of the results for all remaining markets;
- 40 kilometers travelled per day per vehicle on market days (80 kilometers each week) with average consumption data per type of vehicle (manufacturer information);
- A vehicle loading rate of 60% for the outward journey and 10% for the return for an average load of 1000kg (using utility vehicles with payload capacities from 500kg to 1400kg);
- All vehicles are considered as diesel-fueled in all three categories of Light Commercial Vehicles (LCV) without distinction (LCV = GVW < 3,5 tons);
- A CO2e equivalent to 3.17kg CO2e/liter from the Carbon Base (ADEME, 2016) to measure GHGs.
- Data of atmospheric pollutants (HC + NOx) from the EURO standards (European Union regulations) and multiple studies for the emissions of CO2 summarized in the French transportation report 2017 (Service de l'observation et des statistiques SOeS, 2017).

7.2. Results of the environmental study

This initial study allowed us to gather the following results over one year:

Table 2. Data relative to the environmental impact of supplying 71 open-air markets in Paris (twice a week, 50 weeks a year on average).

Total diesel consumption (liters)	Total CO2 (g)	Total HC + NOx emissions (mg)	Carbon dioxide equivalent (CO2e) in relation to consumption (kg)	Distance travelled in a year (km)
1 874 400	3 024 600 000	7 128 400 000	5 941 848	14 200 000

When comparing these results with the study of the « Airparif » association in 2015 with data from 2012, the observation is as follows:

- NOx (nitrogen oxides) emissions related to road traffic in Paris amount to 5 280 tons. The NOx emissions caused by the running of these markets is below 0.15% (7.1 tons calculated);
- Emissions of GHGs (CO2) related to road traffic in Paris amount to 1350 kilotons. The GHG emissions caused by these markets are below 0.22% (3 kilotons calculated).

Reporting this data per ton-kilometer, or "tkm", an environmental indicator frequently used in transportation research, the following observation can be made: the environmental performance of LCVs in this case study is at 561gCO/tkm, 10 times higher than the reported average observed for transportation by heavy duty vehicles (DGTIM, 2016) during a study conducted by the Ministry of Ecology.

Overall, the proposed estimation appears to provide results consistent with those published by specialized organizations. A comparison with quantitative research on the environmental impact of other short food supply chains would make it possible to say which of these is more respectful of the environment. However, it is clear that the use of LCVs will always be less energy efficient than heavy-duty vehicles.

Tables 3 and 4 present the data collected for this study.

Table 3. Data of the Crit'air vignettes of the vendors present in the Parisian open-air markets.

	Vehicles of market vendors (< 3,5T PTAC)			
Type of vignette "Crit'air"	2	3	4	5
Average number of vehicles per market day	15	10	10	15
% of light-duty vehicles (LCVs)	30%	20%	20%	30%
Estimated average Consumption of Diesel L / 100	8	12	15	18
Estimated average Co2 emissions (g/km)	150	190	230	280
Average HC + NOx (mg/km)	200	300	560	900

Table 4. Data of the Parisian open-air markets.

Average number of vehicles per market	50
Kilometers driven per vehicle per week	80
Number of weeks in a year	50
CO2 equivalent per liter of diesel	3,17
Number of open-air markets in Paris	71
Average incoming load per vehicle (kg)	600
Average outgoing load per vehicle (kg)	100

Table 5. Environmental impact results for 1 market.

Type of vignette "Crit'air"	2	3	4	5	**Total**
Kilometers per week	1 200	800	800	1 200	**4 000**
Kilometers per year	60 000	40 000	40 000	60 000	**200 000**
Consumption of Diesel (L)	4 800	4 800	6 000	10 800	**26 400**
CO2 emissions (g)	9 000 000	7 600 000	9 200 000	16 800 000	**42 600 000**
HC + NOx (mg)	12 000 000	12 000 000	22 400 000	54 000 000	**100 400 000**
kgCO2 based on the consumption	15 216	15 216	19 020	34 236	**83 688**

Table 6. Environmental impact results for 71 markets.

Type of vignette "Crit'air"	2	3	4	5	**Total**
Kilometers per week	85 200	56 800	56 800	85 200	**284 000**
Kilometers per year	4 260 000	2 840 000	2 840 000	4 260 000	**14 200 000**
Consumption of Diesel (L)	340 800	340 800	426 000	766 800	**1 874 400**
CO2 emissions (g)	639 000 000	539 600 000	653 200 000	1 192 800 000	**3 024 600 000**
HC + NOx (mg)	852 000 000	852 000 000	1 590 400 000	3 834 000 000	**7 128 400 000**
kgCO2 based on the consumption	1 080 336	1 080 336	1 350 420	2 430 756	**5 941 848**

The SWOT analysis below proposes a summary of these results:

Table 7. SWOT analysis on the development of open-air markets in the city of Paris.

Opportunities	Threats
• Develop the distribution of local agricultural production; • Healthy diet and local food supply supported by the Paris Food Policy; • Quality as a first-choice criterion for foodstuff in the eyes of consumers; • The French "art de vivre", tourism, and international outreach with the French Market concept; • The search for cooperation with local shops in the market area; • Training and support for the sustainable development of nomadic traders; • Take part in the European "Urban Markets" project to develop solutions to urban challenges.	• Present economic conjuncture; • Competition from other short supply chain systems (AMAP, local farm shops); • Environmental policies instated by the City of Paris (impacting transportation and logistics); • Consumer awareness of environmental impact; • New online sales channels (Amazon Fresh, etc.) • Fuel price increases and national policies on diesel engines.
Strengths	**Weaknesses**
• The image of the French "Art de Vivre" and tourism; • Prospects for local agriculture; • Geographical locations ensure food supply to areas lacking in permanent grocery stores; • Possibility to purchase in small quantities; • Historical dimension and a reputation for providing quality products at fair prices; • First changes made to improve market appeal.	• License fee costs on the increase; • Time constraints which no longer meet consumer needs; • Declining interest in markets due to a lack of butchers, cheese mongers, bakers and other food shops; • The development of nomadic sales professions; • Lengthy procedures for markets to achieve compliance; • Only 10% of market stalls are local or short supply chain producers; • Narrow selection of product categories for visitors.

7.3. Recommendations

Several recommendations can be made from the results of this study:

7.3.1. Encourage the replacement of older vehicles

Theoretically, atmospheric pollutants and GHG emissions could be significantly reduced if all LCVs were replaced by vehicles complying with EURO 6 standards. This is only theoretical, however, as the 9,000€/vehicle/merchant financial aid proposed by the Paris city council doesn't necessarily allow them to include this in their expenses. Additionally, the use of diesel LCVs appears increasingly compromised in larger cities, as anti-pollution measures become progressively restrictive (147g/CO2 limit in 2020), even facing a potential ban by 2030, making this an ill-advised investment. Table 8 quantifies the impacts of 2 possible vehicle replacement strategies:

Table 8. Impacts estimation of different fleet replacement strategies.

	Total Diesel Consumption (L)	Total CO2 (g)	Total HC + NOx (mg)	Kg CO2e
Possible decrease if Crit'air 5 LCVs are replaced with Crit'air 2	23%	18%	42%	23%

Possible decrease if Crit'air 4 & 5 LCVs are replaced with Crit'air 2	33%	26%	56%	33%

The arrival of new technologies such as electric vehicles or vehicles running on LNG/CNG could eventually bring on a total transformation. But investing in these types of vehicles is often inaccessible (+40,000€) and could bring on other issues such as a lack of amenities (particularly for LNG/CNG vehicles which lack a sufficient network of stations). Today the use of LNG/CNG vehicles seems to be the most suitable short-term solution to reduce air pollutant and CO2 emissions at an acceptable cost.

7.3.2. Create a food logistics hub in the heart of Paris

The "New Covent Garden" project in London proves that alternative logistical solutions do exist, provided that they are developed in compliance with urban planning (land availability, road infrastructures, partners, etc.). Shifting part of the Rungis International Market and creating a logistics platform in Paris for fresh produce could reduce emissions produced by LCVs in their last few kilometers. This would also be relevant to the Rungis International sustainable development strategy for logistical activity.

7.3.3. Conduct a comprehensive study to propose alternative logistical and environmental solutions

Considering the entirety of the environmental impacts would be substantial. Paris could approach and participate in projects such as "Urbact Markets" to carry out more comprehensive studies and receive feedback from cities such as London. The creation of task force would put this subject in the center of Parisian urban life, as there are high stakes at play.

8. Conclusion

The review of the current state of research carried out in this study brought to light the evolution of French consumer criteria when selecting products: a preference for quality, healthy eating and responsible purchasing. Consumers today believe it important to consider the environmental impact of their grocery shopping. This has resulted in the development of multiple "short food supply chain" systems and seems to have greatly contributed to the maintenance of "open-air" markets, the oldest of all short supply chain systems.

Considered a driving force for urban life, their development is a major challenge for towns and cities. More and more studies and task forces are making them the focus of their research to help them combat the arrival of new food distribution channels. Street markets also play an important role in the social and economic development of the community, collaborating effectively with permanent stores by offering a variety of diverse produce, particularly in Paris. Highly dependent on the Rungis market for supplies, short supply chain development seems to have reversed the downward trend in farming of agricultural lands in the Greater Paris area. Although the advantages of this type of project appear to meet consumer demands, the environmental advantages of these distribution channels must be examined further.

The results of the study conducted on "open-air" markets show that emissions related to the transportation of goods (in ton-kilometers), by light commercial vehicles running on diesel are ten times higher than emissions produced by heavy duty vehicles. This concept is important, as massifying flows would reduce the environmental impact of road transport but would remain incompatible with nomadic trader activity. With this initial approach, it seems that Paris could benefit from further examining the environmental impacts of these markets. This would allow the city to meet target goals for greenhouse gas emission reductions by 2030 while preserving the French-style "art-de-vivre", without affecting the livelihoods of nomadic market traders. To achieve this, solutions such as increasing bonuses for replacing old, heavily polluting vehicles and creating a food hub in the heart of Paris could be considered after a more in-depth study to verify feasibility and viability. Joining the "Urbact Market" network could also bring added value to the promotion of Parisian food markets. By meeting consumer demands and actively increasing local and international outreach, these markets must now begin an energy transition to maintain interest. But shouldn't this transition be considered with major retailers and state actors so that the sector can combat global warming collectively?

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