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Sustainable diets in institutional food services. A sociotechnical study of legumes serving, cooking and sourcing in France.

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Abstract
The nutritional values of legumes, food group including pulses and soya, contribute to healthy diets and allow animal-based protein intake reduction. Moreover, increasing their cultivation reduces fertilizers' uses and so, greenhouse gases emissions. But legumes consumption is very low and changing eating habits remains difficult. Institutional food services (IFS) are an important lever to promote new food practices. Through IFS stakeholders open-ended interviews, and more than 500 answers of IFS kitchens from a survey we built, we conducted a sociotechnical analysis of the main levers and brakes of legumes development. Diets sustainability was analyzed mainly through: i) frequency, diversity of legumes served; ii) cooking practices and alternative dishes development; iii) legumes' sourcing through supply chain organization and quality labels. The results are effective for authorities and IFS sector in planning legumes promotion. The analytical framework can be adapted for any other food groups to analyze sustainability transition dynamics in IFS sector.

Keywords: catering, food services, pulses, soya, protein consumption, alternative dishes

1. Introduction

Environmental and healthy diets is a major challenge for agrofood systems (e.g. Tilman and Clark, 2014; IPES-Food 2016). According to the FAO's definition of sustainable diets *("with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations"*, Burlingame and Dernini 2012) one main issue is to promote eating habits that are good for both human and environmental health. That is, the challenge is to develop "environmental nutrition" (Sabaté, 2019). Hence, the sustainability transition of agrofood systems calls for more integrative conception of food and agricultural systems (Garnett, 2011; Hallström et al., 2015; Meynard et al., 2017).

Among the levers of sustainability agrofood transition, developing legumes present clear environmental and nutritional benefits, as highlighted during the International Year of Pulses (IYP) of the United Nations in 2016. They contribute, on the environmental side, to reduce greenhouse gases emissions (e.g. Peoples et al., 2019), and on the nutritional side, to increase nutrients equilibria for consumers (proteins, fibres, etc.) particularly as regards new issues on animal-based consumption reduction (Vainio et al., 2016; Hallström, 2015; Marlow et al., 2015). Nevertheless, re-launching legumes in Western countries faces lock-ins, both in production and consumption, compared to major global crops such as wheat, that are widely produced and

consumed (Magrini et al., 2016, 2018). The consumption of legumes (concerning a large variety of crops such as soya, lentils, beans, chickpeas, etc.) is very low in western countries: 4,7 kg/year/cap in Europe and only 2 kg/year/cap in France. Ways to accelerate this consumption remains difficult as changing food habits is not easy. Longer cooking times, an old-fashioned image, and digestive issues (flatulence), combined with the lack of innovative pulse-based foodstuffs, are often cited to explain their low consumption in the West (FAO, 2016; Niva et al. 2017; van der Weele et al., 2019). In addition, the challenge is also to promote more legumes cultivation in France, in order that the increase in consumption goes hand in hand with sustainable farming system with legumes, and not with an increase of imports which are already high (50% to 70% of pulses are imported in France).

This paper investigates a specific sector in which issues about sustainable diets are little analyzed: food services or named catering[1]. Food services sector is an expanding sector influencing food habits, and also impacting agrofood systems through their food supply chain organization. Traditionally, catering has been divided into two categories (Bourlakis and Weightman, 2003; Edwards 2013): i) the "profit sector" that comprises profit-orientated establishments such as restaurants, fast-food chain outlets, cafes, takeaways, pubs, leisure and travel catering outlets; ii) and the "cost food services sector", which, broadly speaking, refers to not-for-profit catering activities for business, education and health care, often designed as IFS "institutional food services" (or "institutional catering services"). IFS are frequented daily pupils, students, patients, the elderly and employees in schools, universities, hospitals, retirement homes or workplaces. Therefore, IFS present a stronger influence in food habits, rather than the profit-oriented sector where the client can choose the place. In that sense, IFS' users (usually named "guests") are often described as "captive". In Europe, IFS sector employs over 600,000 people and delivers over 6 billion meals each year (FoodServiceEurope). This equates to 67 million consumers served every day, or one in four meals eaten away from home (FoodServiceEurope).

But the organisation of this sector is complex, which requires a more comprehensive analysis of its sociotechnical regime in order to analyze the transition process that could be achieved to shift towards more sustainable diets. The present study is based on France being the European country with the highest number of meals served through IFS sector (for €20 billion turnover in 2013 reported by Thoby, 2017). Using the terms employed by Stahlbrand (2016) and data from professional reports (e.g. Xerfi, 2015), French IFS sector is divided in two models (as most other western European countries): i) the *contracting-out model* (40% of the IFS market in France, the most important in Europe) with around 1,000 private companies, under contract with institutions or companies that don't want to manage their catering services ; ii) the *self-catered model* (60% of the French IFS market), where institutions or companies manage their own catering services. On the one hand, the *contracting-out* market is oligopolistic, dominated by a few national wide and historical caterers that absorb smaller firms: Elior (French), Sodexo (French), and Compass Group (British) hold 70% of the contracts in France. Other companies are more anchored regionally and share the remaining market; and in recent decades, new businesses appeared, most of the time with new quality standards (for instance, developing organic products and/or products more linked

[1] As explained by Edwards (2013), 'food services' (UK spelling and 'foodservice' for American spelling) or 'catering' terms design a large industry sector delineated as "the serviced provision of food and beverages (meals) purchased out of the home but which may be consumed both in and out of the home", and "commonly classified into two sectors: firstly, the profit, private or commercial sector and secondly, the cost, public or welfare/institutional sector, both of which are integral and growing components of most economies." (p223 and see Figure A1 in Appendix). This definition shows the various terms that could be employed in IFS. For our study we propose to use the term "institutional food/catering services" linked to Education and Employee feeding, the main guest categories under the scope of our investigation.

to regional food systems). On the other hand, the *self-catered* market appears more "fragmented" and highly depend on the institutions managing their own catering services. Whatever the model chosen, catering services address a great variety of guests, in number but also in type: from more than 10,000 meals per day for metropolitan schools or big administrations, to only a few meals for a retirement home in a rural town. Then, the IFS sector is also usually divided into "segments", each with their own features and guests' expectations: Business and Administration, Healthcare and Eldercare, Defense and Penitentiary, Childcare centers and Education. Hence, as the IFS sector appears as a dual market with two types of caterers - the *contracting-out model* and the *self-catered model* – a question arises: how the transformative process towards sustainability operates in this sector regarding its specific sociotechnical system? It requires further investigation to better understand its dynamics.

In addition, if several studies advance IFS as a facilitator to promote sustainable agrofood systems (Edwards, 2013; Graça et al., 2019; Jones et al., 2019), few ones examine it with a combined view of both environmental and nutritional issues. Most of those studies deal either with the questions of waste reduction (e.g. Martin-Rios, et al., 2018); food safety (e.g. De Boeck et al., 2019); nutritional and dietary standards in meals (e.g., Vieux et al., 2013, 2018); healthy food (e.g. Decataldo and Fiore, 2018, on the way school canteens prevent from obesity risk); local food supply (Stahlbrand, 2016; Orlando et al. 2019). But none considers the sustainability of diets in a more integrative way, considering both the eating ways of consumers and the sourcing ways of the canteens to challenge agrofood sustainability. In other words, no previous study considered both the nutritional and environmental dimensions of diets, that Sabaté (2019) recently delineated as "environmental nutrition". Hence, one objective of our study is to tackle this integrative approach through the specific case study of legumes development in the French IFS sector.

To investigate this sector, we relied on transition studies literature, allowing a comprehensive analysis of various dimensions such as market structure, consumers habits and institutions (regulations, norms, beliefs), as well as material artefacts and infrastructures. This literature has also paved the way to better distinguish between sociotechnical system from the incumbent regime and the ones from niches-innovation that are developing and proposing more radical or transformative innovations. Since the seminal works of Rip and Kemp (1998) or Geels (e.g., 2002, 2004) with the Multi-Level Perspective (MLP), transition studies strongly developed, particularly for the transport or energy sectors, but little research had been done for food sector (Markard et al., 2012), and much less for IFS (Stahlbrand, 2016). Hence, the aim of our study is to conduct a first investigation into the French IFS sector, by building an analytical framework based on the MLP approach, paying specific attention to identify various types of actors: the incumbent ones that shaped the sector's rules at a national level, and more minor ones, newcomers or niche networks in building that contribute to set up new rules. Our objective is to understand how those various actors develop sustainability diets through their food practices concerning mainly: i) the frequency and diversity of legumes served; ii) the cooking practices and alternative dishes development with legumes; iii) the legumes' sourcing through supply chain organization and quality labels. Our framework provides a fruitful starting point for investigating transition issues in IFS sector; as it could be adapted to any other food category[2] or geographical context to allow future comparative studies.

[2] Moreover, our framework will allow for a comparative analysis across food products categories when dealing with agrofood system. The analysis is meant to identify the factors that may foster and hinder the eating of the food product considered, here with an application on legumes in catering sector.

To conduct this study we use several sources of information. Open-ended interviews, literature and reports on the IFS sector, and an on-line survey we built and addressed in 2019 to all IFS caterers in France, from which we got more than 500 responses. All those results provide a qualitative prediction regarding the potential of legumes in diets and the levers to action to develop them in a sustainable way. In a political context where new plant-protein development strategies are developed in France and other European countries, those results will help policy-makers to define adequate policies in order to favor more legumes.

Section 2 presents the theoretical framework based on a sociotechnical analysis. Section 3 explains the methodology followed. Section 4 presents and discusses the results. Section 5 concludes.

2. Theoretical framework: a sociotechnical analysis of the drivers of sustainability transition in IFS sector

We propose a prospective transition framework as a heuristic device to assess the potential of legumes development in IFS sector. Firstly, we present its sociotechnical regime (2.1), questioning the ways to distinguish incumbent and niche actors in IFS (2.2). Secondly, we pay specific attention to three dimensions of sustainable diets: *sourcing* through the organization of supply chain (2.3), *serving* depending on the consumer preferences and dietary guidelines (2.4), *cooking* including technical and food safety constraints (2.5). The framework we built, visually depicted in Fig. 1, aims to be generic and can be adapted to any food group that could challenge diets' sustainability in IFS sector.

2.1 Mapping the sociotechnical regime of the IFS sector

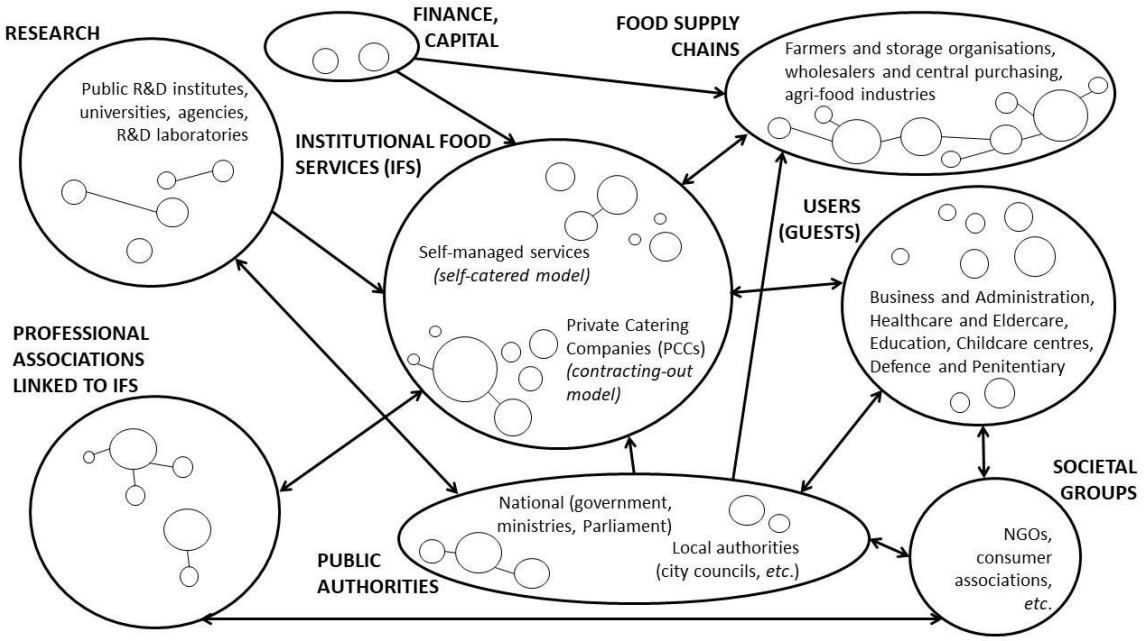
Changes result from a coevolution of the main dimensions of the sociotechnical regime often analyzed from a sector point of view, through the MLP approach (e.g. Geels, 2002, 2005). For agrofood sector, particular interest is on the interconnected innovations between agriculture and food (Elzen and Barbier, 2012; Bui et al., 2016; Lascialfari et al., 2019). For instance, by analyzing the development of pulses-based food products in western food industry, Lascialfari et al. (2019) examined the drivers of innovation through six main dimensions of sociotechnical regime: the market/user preferences (consumers), the scientific knowledge required to develop new food products, the food processing technologies, the infrastructures linked to agricultural supply chains and retailers, the policies-institutions of agriculture and food; and paid specific attention to niche-innovations firms compared to incumbent ones.

Those main dimensions provide a relatively straightforward way of ordering and simplifying the analysis of complex transformations of sectors both in production and consumption. MLP approach stresses on the co-evolution of those dimensions through various actors shaping the rules of the sector. Hence, to map the IFS regime (Figure 1), we considered: the firms proposing food services and their suppliers, the professional groups advocating for the *contracting-out* and *self-catered* models, the public authorities[3] that regulate the activities and define societal goals, the

[3] Among the various types of actors in the sociotechnical regime, Geels considers a unique group that represents the public authorities in which he associates the "executive branches" (for instance in Geels 2004, 2005). We prefer to distinguish the actors that are specifically from public authorities, that is public administration, government agencies, politicians elected, from the ones that represents the private sector such as trade unions, sector executives branches. The latter are chosen or elected by the firms operating in the sector. In different public

users and societal groups supporting guests' interests, environmental and societal goals, the research institutes shaping the scientific knowledge, in addition to the actors that ensure the provision of capital. All this network of actors contribute to the definition of the rules and ways the provision of food is ensured in canteens for various types of guests (schools, business and administration, hospitals, retirement homes and other collective places).

Figure 1. The sociotechnical regime (adapted from Geels, 2005) for the IFS sector



Proposition 1: the way IFS sector is structured through the main types of actors define the way rules are shaped and adopted.

2.2 The IFS dual market mirroring the incumbent vs. niche actors?

The MLP framework pays specific attention to two types of actors: the incumbent firms and the niche-innovation actors. The incumbent firms have limited incentives to address sustainability through radical innovations, which present more risk and often require important changes in knowledge, skills, processes, and organizations (Geels, 2014), in addition to the externality problems that eco-innovation generates (Rennings, 2000). These factors are intensified in the food sector, as it is characterized by strong conservative attitudes (Triguero et al. 2013; Galizzi and Venturini, 2012). Consequently, incumbent firms prefer continuing on the same path and incremental change. Niche operators are more open to propose path-breaking innovation. In food industry, Lascialfari et al. (2019) observed, for instance, that the most radical pulses-based food concept introduced over the last ten years was proposed by a start-up ('mopur' product).

As mentioned in the introduction, the IFS sector is divided into two main models: *contracting-out* and *self-catered*. *Contracting-out* concerns more incumbent caterers constituting an oligopolistic market, while *self-catered* appears more as a less structured "patchwork" of caterers, creating more space for various ideation and innovation. Analyzing this sector requires to understand

instances those two types of actors could participate together, but finally the ultimate public decisions are of the responsibility of public actors.

which institutions (i.e. rules) are common or different for these seemingly opposite models. Do arenas exist in which they have common discussions that could lead to common visions on sustainable diets? Inversely, do the networks of those actors are separated? Does this dual market lead to establish an opposition between niche and incumbent operators? Incumbent actors are not only PCCs (Private Catering Companies) as the market is historically self-catered: for example, Elior (1st PCC in France) was founded in 1991. Self-catered model also includes historical actors, but the question remains by which network those self-catered operators are structured. Therefore, for our analysis, it is necessary to better understand the dual market *versus* the incumbent and niche-innovation actors. One way could be to consider which are the labels developed by those actors, as abels are a form of protection of niche-innovation (Smith and Raven, 2012).

By analyzing IFS initiatives, such as labels, from the two models actors (*contracting-out* vs *self-catered*), we want to pay attention to agency (Stahlbrand, 2016). Indeed, agency and power are important concepts to explain the ability of actors to change, as explained by Smith et al. (2005):

> *"How do actors come together and find a mutual understanding of a transition context, and agree over the best course of action for a regime? The challenge here is to analyse how contrasting visions and expectations enrol actors into coalitions of support, come to define their interests, and shape the way that they seek to respond to selection pressures or shape their collective adaptive capacity." (Smith et al., 2005:1503)*

Therefore, a regime's capacity to change is strongly linked to its network's structure and development that influences actors' visions and expectations, especially through face-to-face interactions in common arenas. One issue remains to understand if the dual market between *contracting-out* and *self-catered* models is an obstacle to the diffusion of ideas from the initiatives that could be undertaken from those two types of actors.

Proposition 2: the networks that structure contracting-out and self-catered actors impact the emergence and diffusion of innovations in IFS sector, whose one output is the production of new labels

2.3 Supply chain organizations and sourcing

Caterers must organize their foodstuff's supply in order to cook for a high number of guests. If modern agrofood system favoured large purchase platforms (central purchasing, wholesalers), shorter supply chains and local distribution networks are a current reinforcing trend. As underlined by Orlando et al. (2019), food self-reliance, local markets and short supply chains are supported by European Union policies (e.g. Bresso, 2011; Kneafsey et al., 2013; current EU rural development policy 2014–2020) and promoted by consumers. If globally 80% of food is estimated to be produced and marketed at local level, in Europe this share is only about 20%.

In France, recent consumer surveys highlights local food as a central purchase criterion. Those developments aim to counteract the negative externalities of globalization (e.g. dependence on foreign goods and international markets prices, energy and GHG emissions consumption for transportation, etc.). The EU strategy, as well as in France through the "PAT" (Territorial Food Plan, defined by public authorities to promote local food), are targeted at promoting a food system re-organization and re-localization, that improve the local economic sustainability and social cohesion.

In addition, the separation between consumer and producer, with the inclusion of several levels of intermediaries, reduced product's value retained by farmers. Orlando et al. (2019:152) underlined the gap between the rises in food costs (3.6% a year, since 1996), in consumer prices (3.3% a year), and in prices for farmers (2.1% a year). But the rising consumer's interest on food transparency led to a willingness to pay higher prices for local products, with significant premium for producers (Carpio and Isengildina-Massa, 2008). Nowadays, especially in Education IFS segment, some actors consider *"creative procurement policy, which takes a holistic view of the food chain"* as a strategic target to calibrate production and consumption at the local level (Morgan and Sonnino, 2007). They are strongly promoted by some IFS initiatives like in Mouans-Sarthoux city in France: the school IFS are self-catered with 100% organic foodstuff and mainly with local food, and often highlighted as a model for local food policies (Pérole et al., 2018).

As regards more specifically legumes, French farmers (like European ones) face a strong international competition with importation. In France 70% of the legumes consumption is imported (data from the interprofessional organisation, Terres Univia). For farmers, producing legumes at a low price is not of economic interest compared to high margin get on major crops such as wheat (Magrini et al., 2016). Therefore, the less there are intermediaries in the supply chain of caterers, the more common interest price could be found for farmers. In addition, in order to develop an offer with more diversified dishes for guests, caterers could rely on a variety of legumes supply chain, being under labels or not. In France, more than one third of pulses production is under public labels linked to geographical identification (Voisin et al., 2013).

In addition, an advantage for legumes is to be easily stored, without seasonally consumption habits. More recently, new food products have been developed to facilitate the consumption of pulses like ready to cook pulses. For the food industry, using the channel of IFS is a targeted strategy to make a new product known by the consumer (Lascialfari et al., 2019).

Proposition 3: Logistics organization and ways to sourcing legumes, as raw materials or ready-prepared , impact legumes development in IFS sector

2.4 Serving legumes: a trade-off between consumers preferences and dietary guidelines

Consumption is influenced by the recommended daily nutrients intake (dietary guidelines) diffused by public authorities and that are used by caterers to define their menus. Concerning legumes consumption, no specific promotion had been done by the past (see Magrini et al., 2018 for a brief history on that point). But since 2019, the French public dietary guidelines on pulses consumption has changed arguing "to eat pulses at least twice a week". Yet nutritional rules are recommendations and not compulsory: caterers are free to adapt nutritional rules and to be proactive or not in promoting sustainable diets with more legumes. Therefore, how caterers challenge these new guidelines could depend on the network on which their organization relies. For instance, the professional association "FoodServiceEurope" gathering several European PCCs' representatives proposed in 2017 a specific dietary guidelines (Model School Food Standard) in which legumes are promoted as an alternative to meat products.
But food consumption habits depend also on various variables, such as gender, age, price, education and culture (see Graça et al., 2019 for a recent review of the literature). Hence, canteens adapt their meals to the clients characteristics and expectations. More precisely, Tsui and Morillo (2016) advanced cooks (or the supervisors of kitchens) like central actors in managing all those

dimensions impacting meals composition. Particularly their study underlines that beyond dietary guidelines, cooks take into account various preferences of consumers in order to maximize "food consumption and enjoyment". Hence if the perception of legumes is badly valued by consumers, cooks will be little motivated to propose legumes regularly; and then, the skills of cooks will be determinant to achieve tasty meals with legumes.

> *"The views and practices of both cooks and supervisors about what constitutes good' food extend beyond a purely nutritional view of goodness to include the importance of addressing hunger and clients' food preferences, among other factors. Cooks address these by interacting with clients and altering recipes and menus in a range of ways to maximize the likelihood of food consumption and enjoyment." (Tsui and Morillo, 2016)*

Concerning legumes eating, one main current issue is linked to animal-based consumption reduction (e.g. van der Weele et al., 2019; Niva et al., 2017); and legumes are also strongly promoted in NGOs reports (WWF and ECO2 Initiative, 2017; Greenpeace, 2017; Poux and Aubert, 2018). Recent studies have shown that vegetarians consume more legumes for their richness in protein (Figueira et al. 2019). Health influences also eating habits: for instance, persons with diabetes could consume more pulses to regulate it. Environmental awareness influences consumption: it is shown that consumers of organic products consume more legumes that the average population (Solagro, 2019). Therefore, in function of the guests' segments served and perception of their expectations, caterers can adapt the frequency of legumes served. In France, 34% of consumers declare to be flexitarian (Kantar Worldpanel, 2017), that could lead to an increase of legumes consumption. But legumes are challenged by other alternatives (van der Weerle et al., 2019), making the future of legumes quite uncertain, without solutions to encompass some problems quoted by consumers such as gas, flatulence problems old-fashion image, etc. (Magrini et al., 2018).

Finally, considering all the above-mentioned aspects, and the dual market between contracting-out and self-management, do we observe differences in the promotion of sustainable diets and more particularly as regards legumes eating through the way users are involved in meal composition?

Proposition 4: Legumes eating in IFS resulted from a trade-off between the dietary guidelines and consumers preferences.

2.5 Cooking legumes : cooks' skills, technical and food safety brakes

As above-mentioned, pulses suffer from cooking disadvantages due to their soaking or cooking times longer (for most of them) than for other plant products. In addition, some consumers encounter residual digestibility problems (even after correct soaking time) but specific cooking recipes such as spices use and cooking time could solve this issue. The ability of kitchens to serve more legumes will then depend on the skills of cooks to prepare appetizing legumes-based meals. Their knowledge of recipes, notably to insert legumes in alternatives dishes aimed at reducing meat consumption, should be an important driver to develop knowledge, as mentioned by the review of Garça et al. (2019) on the drivers of meat reduction concerning the recipes knowledge and cooking skills of consumers.

Another type of constraints could be linked to the organization of the cooking chain. Two models of catering services are differentiated from each other by the place where the foods are prepared and delivered (Fusi et al., 2016): i) the "deferred system" (central kitchens send out completed dishes or pre-processed ingredients/meals to satellites sites) and "cook-served system" (the meals

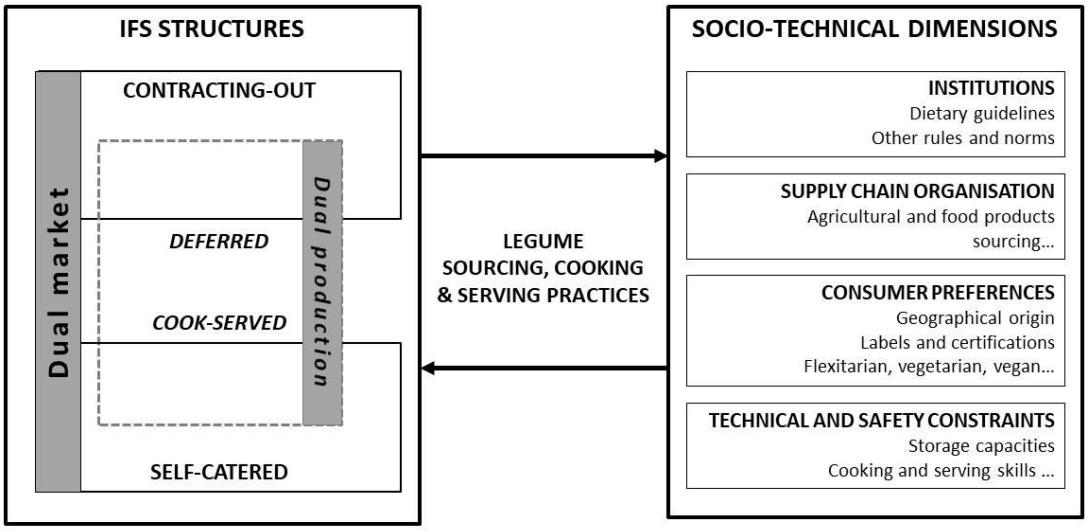
are cooked and serve on the same site). When the catering services adopts the deferred system, the cook-warm chain could impact the taste and quality of the legumes-based dishes; giving the fact that the time difference between the preparation in the catering center and the consumption can be several hours or days, depending on the method used to preserve the food (Fusi et al., 2016). Hence, various technical constraints according to cook-served or deferred system, in addition to the ones linked to safety constraints, could conduct to different strategies in the choice of raw materials and dishes to be served with legumes. But, if some technical constraints exist for every operator, the various structures in which their embedded could allow us to tackle differently some technological or logistics constraints. Then, crossed with the institutional model (*contracted-out vs self-catered*) we can observe various ways in legumes practices.

Proposition 5: Cooks' skills, technical and safety constraints impact the way to promote legume consumption and are differently challenged by caterers.

2.6 Synthesis

Based on this review on main dimensions shaping legumes sourcing, cooking and serving practices in IFS sector (Figure 2), the aim of our study is to understand which are the current practices of caterers, which are the brakes and opportunities for legumes development. We empirically investigate those questions through a large survey centered on the practices and perceptions of cooks and supervisors in kitchens, completed by other sources of information.

Figure 2. Synthesis of the analytical framework on legumes practices in IFS sector



3. Research design

Literature review was focused on specific sociotechnical dimensions (Fig. 1) from which we drew up several propositions to investigate. This research was designed by combining interpretative and qualitative research (Yin, 2003) based on open-ended interviews (3.1) and on a quantitative analysis through a national survey (France) we created and organized (3.2). Such a design was deemed most appropriate given that few studies exist on IFS, and that our specific interest is to understand legumes practices, currently under many new debates but without empirical surveys on that subject.

3.1 Qualitative approach on IFS sector

First, to get an overview, a desk study was conducted as part of a broader study about the way nutritional rules are established in France; and especially about how IFS could adopt them. Based on web searching we identified the main actors that intervene in the IFS sector (Figure 3), in particular the professional associations that represent catering operators, allowing us to contact them for open-ended interviews. Those interviews allowed us to better understand the market structure and the various dimensions influencing menus' composition. Insights from one interview led to new questions for the next interview. All interviews were conducted face-to-face or using Skype or phone, between March 2018 and July 2019, recorded and transcribed (in total 54 interviews realized, around one to three hours for each one), from which *verbatims* will be used to complete or illustrate the quantitative data collected from the survey.

Other sources were included to triangulate data as much as possible. Since IYP (2016) and over the 2018-2019 period of renewal of the French dietary guidelines, the ongoing debate around legumes/pulses development in newspapers and public reports from NGOs was closely followed by collecting relevant articles and reports. Hence, our data collection included policy documents, press releases and websites of different caterers or professional representatives and other stakeholders challenging the question of sustainable diets, mainly through the development of alternatives dishes and/or legumes eating.

In addition, the authors participate regularly to various seminars and congress about sustainable diets or legumes development. This debate reflected the (institutional) dynamics around both legumes development for more sustainable diets, but also more largely the question of the provision of food, links between farmers and consumers, plant-based food, etc. Legumes are then appearing linked to broader considerations. Main collected data sources are detailed in the appendix.

3.2 An original survey addressed to IFS kitchens

Collected information during the first stage of this study helped us identify professional terminology and the way to formulate questions of interest in a broader survey we built and addressed to IFS kitchens (production sites) between April and August 2019. As underlined by Tsui and Morillo (2016), cooks (but also kitchen managers or purchasing and nutrition managers) are recognized to have a major role in IFS; and we considered them as relevant information providers on the various dimensions we investigated, such as consumer expectations or technical brakes.

The survey was organized through 12 sections:

1. Description of the production site (kitchen): cook–served or deferred production system, localization, served segments, quantity and frequency of meals, etc.
2. Legumes serving: frequency, diversity, labels
3. Legumes sourcing and purchasing: legumes-based products types, supply chain organization, geographical origin, structure's policy on food sourcing
4. Knowledge as regards nutritional intakes of legumes
5. Legumes in alternative dishes
6. Perceptions on guests' expectations regarding legumes
7. Difficulties encountered with legumes
8. Areas for improvement regarding legumes
9. Kitchen's sustainable food initiatives
10. Other general information: employees, price invoiced to the guest, etc.
11. Other general information: menus elaboration and dietary guidelines followed
12. Other general information: networks and partnerships

The complete survey is available on request. It was tested with several operators previously interviewed and with four kitchen managers (of various types) not previously interviewed to confirm the relevance and clarity of the questions asked. The survey circulated through an online software (LimeSurvey) managed by INRA. It was spread at a national scale through various channels: public authorities, volunteers we identified during the interviews, the newsletters of main IFS operators and through the professional associations of the IFS sector. We got 568 usable answers including 397 complete. However, some non-compulsory questions, designed to get some additive information, were not necessarily answered, and so some propositions will be investigated through a smaller number of respondents. Compared to data collected from other sources (professional reports), the representativeness of answers presents a small bias as regards the two IFS models (Table 1). On the 568 respondents, we have 128 contracting-out sites (22,5%) and 440 self-catered sites (77,5%), conducting to a slight over-representation of self-catered. This is one limit of the study, but that does not interfere with the general trends we can infer by combining quantitative (survey) and qualitative (interviews) data for this first exploratory analysis. This higher number of answers from *self-catered* operators could reveal a greater awareness of legumes issues as it was the main subject of the survey.
As regards the type of production model (Table 2) and the size of the kitchens interviewed, we get a suitable diversity of sites from kitchens serving less than 80 meals per week to the biggest ones serving more 15,000 meals a week. Concerning segments, some PCCs are specialized in specific segments, especially for Healthcare and Childcare (for instance "Croc la Vie" company). Otherwise, most caterers operate on several segments.

Table 1. Share of* contracting-out *and* self-catered *models in France and in the conducted survey

Data source	Market share	Conducted survey	Answers	Market share	Conducted survey	Answers	Total
MODEL / SEGMENT	**CONTRACTING-OUT**			**SELF-CATERED**			**BOTH**
ALL	40%	22,5%	128	60%	77,5%	440	568
EDUCATION	28%	14%	59 (25)	72%	86%	369 (289)	428
BUSINESS AND ADMINISTRATION	72%	44%	35 (20)	28%	56%	44 (11)	79
HEALTHCARE AND ELDERCARE	18%	53%	61 (43)	82%	47%	54 (25)	109
CHILDCARE CENTRES	10%*	25%	34 (2)	90%	75%	100 (28)	134
DEFENCE AND PENITENTIARY	10%*	50%	1 (0)	90%	50%	1 (0)	2

Market share from Xerfi, 2015. * Estimated market share from data collected through the open-ended interviews
Lecture : the number of answers from caterers serving only this segment is reported into parenthesis.

There are no official definition of IFS segments but they are usually divided in 5 subsections that can differ but Education and Business & Administration remain the same while the other subsections vary (Xerfi, 2015 ; Perret et al., 2017). We chose the following : Education (primary, secondary and high schools, and higher education), Business and Administration (private companies and public institutions), Healthcare and Eldercare (hospitals, clinics, and retirement homes), Childcare centres (crèches), Defence and Penitentiary (army, police, prisons).

Table 2. Number of answers in the conducted survey according to production sites (kitchens) and their IFS models

Type of production site	Central kitchen	On-site kitchen	Mixed	Central kitchen	On-site kitchen	Mixed	Central kitchen	On-site kitchen	Mixed
MODEL / SEGMENT	**CONTRACTING-OUT**			**SELF-CATERED**			**BOTH**		
ALL	47	76	5	119	316	5	166	392	10
EDUCATION	38	16	5	88	276	5	126	292	10

BUSINESS AND ADMINISTRATION	9	22	4	28	16	0	37	38	4
HEALTHCARE AND ELDERCARE	16	41	4	37	16	1	53	57	5
CHILDCARE CENTRES	24	7	3	67	32	1	91	39	4
DEFENCE AND PENITENTIARY	1	/	/	1	/	/	2	/	/

"Mixed" means that the respondents have both central kitchen(s) (serving other sites) and on-site kitchens (serving the guests of the site).

Concerning the representation of main PCC in the survey. Another limit is the imbalance response rate according to those companies (Table 3).

Table 3. Contracting-out kitchens that declared the name of their company

PCC name	Number of respondents	Ranking in France *(Xerfi, 2015)*	Number of meals per year (millions) *(Xerfi, 2015)*
Elior	10	1	351,3
Sodexo	30	2	332,4
Compass	1	3	203,0
API Restauration	22	5	104,8
Dupont Restauration	1	6	40,8
Newrest	10	7	no data available
Convivio	1	8	30,1
MRS	0	9	12,5
Subtotal	75		

Note: the 4th main PCC in France is "Servair" which only operates for airline catering and beyond our scope.
43 respondents did not declare the name of their company. The remaining respondents concern other smaller companies.

4. Results and discussion

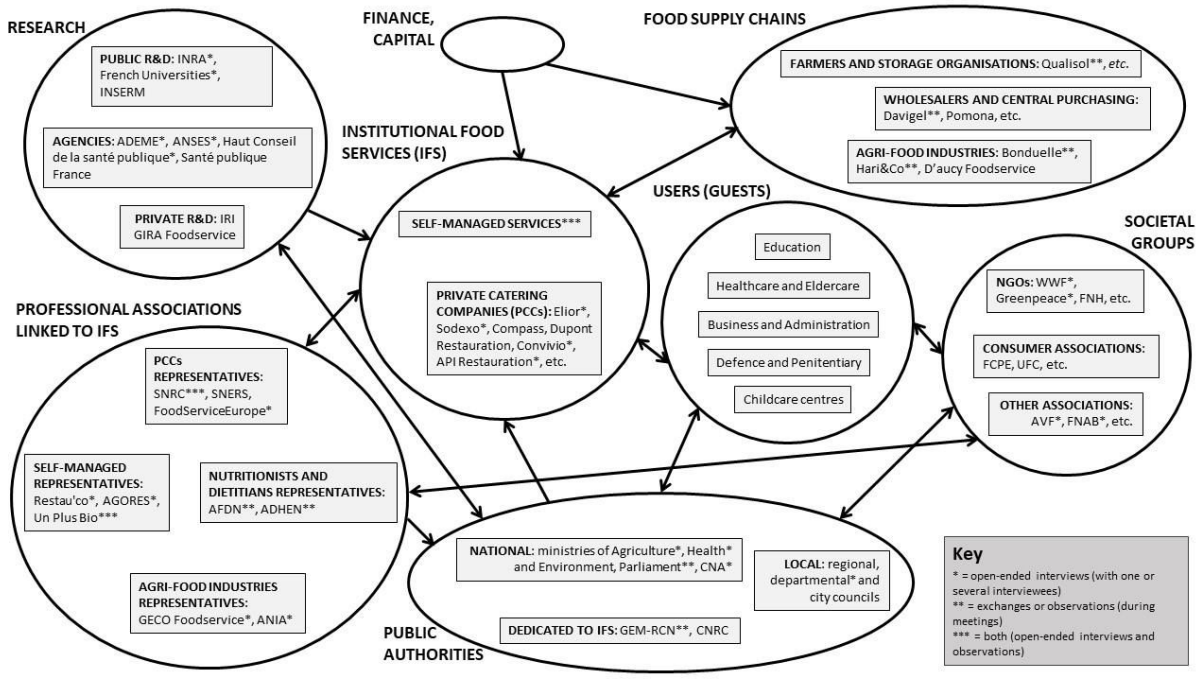
Following the analytical framework provided in section 2, we analyze the information collected via open-ended interviews and the grid-survey to answer the propositions drew up in section 2.

4.1 Mapping the sociotechnical regime of the IFS in France

From all the information collected and based on the generic Figure 1, Figure 3 presents an inventory of the main stakeholders shaping the IFS sociotechnical regime in France. The ones

with an * indicate that an open-ended interview has been conducted with them. We observed a clear cut off between *contracting-out* and *self-catered* actors for several reasons.

Figure 3. The stakeholders of the sociotechnical regime of IFS sector in France



Name of the organisations detailed in the appendix (see "Direct-collecting data sources").

First, they belong to different professional associations. On one side, *contracting-out* market is represented through two federations: the SNRC (National Union of IFS) created in 1963 and the SNERS (National Union of Restaurant and Services Companies) created in 1985. As historical actor, SNRC has a higher weight in visibility and representativeness: it brings together the largest PCCs (such as Sodexo, Elior). It has several committees, including the Nutrition Committee, which invites all dietitians and nutritionists from the PCCs represented. The SNERS is less visible and represents smaller PCCs, who often only operate in France. On the other side, the institutional representation of the *self-catered* market is very different. There is no "federation", but several associations or networks. RESTAU'CO (created in 1966) on the one hand, which has a desire to bring together all the stakeholders of the self-catered market (ie, suppliers, cooks, prescribers, guests). On the other hand, AGORES (created in 1986), which is a representative of the local authorities, essentially for childcare, education and administration segments, but not including segments such as healthcare and business. Recently, a new network emerged through a new association: UN PLUS BIO (created in 2002), which brings together all stakeholders who want to develop organic products in canteens. Actors belonging to this last association are most often local officials.

> *"Nous ne sommes que des professionnels qui mettons du temps bénévole. On est bien souvent détachés par nos collectivités pour ce temps-là. Afin de créer des échanges, mettre en lumière les bonnes pratiques. [...] Notre champ d'action c'est les collectivités territoriales : mairie, conseils généraux, régionaux, intercommunalité. On n'est pas sur le champ très large de l'ensemble de la restauration collective à AGORES. On n'a pas de représentant dans les milieux hospitalier et carcérale, ou d'entreprise." - Kitchen manager and member of the AGORES association*

Second, only two arenas are common for those different professional associations:
(1) the “French Markets Study Group - IFS and Nutrition” (commonly named GEM-RCN and created by the Ministry of Finances created by the end of 1990s). Its main mission is to define recommended practices for IFS concerning meals composition based on the national dietary guidelines (defined by health authorities). In that way, GEM-RCN is an arena in which caterers discuss and the understanding of the dietary guidelines to be applied in IFS sector. Since 2015, this arena had been progressively substituted by the second arena mentioned hereafter.
(2) the “National Council of Institutional Food Services" (CNRC) created in 2019 by the Ministry of Agriculture and Food. Its main mission is to work on the implementation of specific measures from the EGalim law (2018) in the IFS sector; and to pursue the discussion of dietary guidelines in IFS. A wider variety of stakeholders participate to the CNRC through different colleges: IFS representatives' college, farmers' college, guests and civil society's college, etc.

Based on the survey conducted, we observed various involvement of caterers towards professional organizations (Table 3). Based on 230 answers to this question, the majority of caterers declare never exchanging with those associations, while a few have regular discussions (Table 3).

Table 4. Sites (kitchens) discussing with professional associations of IFS sector in the survey (n=236)

MODEL PROFESSIONAL ASSOCIATIONS	**CONTRACTING-OUT**			**SELF-CATERED**			**BOTH**		
	Never	**Occasionaly**	**Regularly**	**Never**	**Occasionaly**	**Regularly**	**Never**	**Occasionaly**	**Regularly**
AGORES	25	2	3	137	31	38	162	33	41
RESTAU'CO	25	4	1	146	38	22	171	42	23
SNERS	26	2	2	179	4	0	205	6	2
SNRC	25	4	7	177	9	3	202	13	10
UN PLUS BIO	27	1	1	147	35	16	174	36	17

Thirdly, various labels are developed in IFS sector. Based on 423 answers to this question, 56% declared that their kitchen site was engaged in a sustainable food initiative. Among them 114 declared owning an eco-label (122 not). Table 5 describes the various eco-labels declared by kitchen sites engaged in a sustainable food initiative. Those sustainable food initiatives create various arenas for discussion and adoption of sustainable practices. We observed that both contracting-out and self-catered adopt those initiatives, without specific relation between an eco-label and the type of catering model. We observe that food label initiatives linked to local food is a little more frequent for self-catered.

Table 5. Sustainable food initiative and eco-labels in IFS sector (n=353)

	Catering-out	**Self-catered**	**All**
Engaged in a sustainable food initiative (*If Yes, number engaged in an eco-label)*	46 No 52 Yes *(21)*	141 No 184 Yes *(93)*	187 No 236 Yes *(114)*
Among the 114 sites engaged with an eco-label:* ** Some sites are engaged in several labels			
"En cuisine" label	6	18	24
"Mon restau responsable" label	6	28	34
"Territoire BIO engagé" label	4	18	22
"Ici je mange local" label	6	38	44
Other labels	2	12	14

4.2 Main trends in legumes serving

Frequency

First we observed a diversity of frequencies in legumes serving (Figure 4) but 57% of caterers serve legumes less than twice a week, that is below the current dietary guidelines. Even though most of them serve only lunch for 5 days a week (5 meals), this frequency does not seem enough to help users shift towards more legumes consumption giving the fact that the private consumption of legumes is very low. Badji et al. (2019) estimate the consumption of pulses in France around 3,6 kg/capita per year. On the opposite, 22% of caterers serve legumes more than twice a week, and even every day for some of them (8%). On the whole, contracting-out kitchens serve legumes more frequently. This could be explained by more frequent links with their professional associations which communicate on dietary guidelines.

Table 6. Legumes serving frequency in IFS sector (n=568)

Frequency	**Contracting-out**	**Self-catered**	**Both (total)**
Less than twice a week	45% *(57)*	61% *(269)*	57% *(326)*
Twice a week	19% *(24)*	18% *(78)*	18% *(102)*
More than twice a week	21% *(27)*	12% *(54)*	14% *(81)*
Everyday	15% *(19)*	7% *(29)*	8% *(48)*
Do not know	1% *(1)*	2% *(10)*	2% *(11)*

Moreover, legumes serving frequency is lower for Education segment (64% serve less than twice a week) compared with Business and Administration (46% serve less than twice a week). Higher frequencies are often seen in Business or Healthcare segments. Healthcare and Eldercare segment presents the highest legumes serving frequency (41% serve legumes more than twice a week), probably due to a higher awareness of their nutritional interest and the fact that legumes are more common for the elderly.

Comparing *contracting-out* and *self-catered* services, the former present higher frequency of serving in Business and Healthcare, but equal frequency in Education. As regards the type of production, on-site kitchens present higher frequencies. It seems that caterers proposing alternative dishes for a longer time also serve legumes more frequently (34% of caterers proposing alternative dishes for more than 5 years serve legumes more than twice a week, while it is only 22% for the caterers proposing alternative dishes for more than 2 years).

As explained in section 2.4, serving legumes result from a trade-off between giving enjoyment for guests and providing food with good nutritional profile. On one hand, most respondents estimate that legumes present a low popularity among guests, particularly among children and teenagers. Indeed, for the Education segment, only 12% of respondents consider legumes popular, against one quarter for Business and Healthcare segments. In addition, we observe that *low popularity* is correlated with *low frequency* serving. Those results confirm the lack of consumer attractiveness for legumes, but a stronger engagement of Business segment in serving legumes. On another hand, more than 90% of respondents consider that legumes contribute to healthier and more sustainable diets; and 99% agree with the need of promoting legumes as a main lever to favor shift change for consumers. This counterbalance could explain why legumes are still served in canteens. In addition, if digestive discomfort was often advanced in previous studies to explain low consumption in pulses, only 60% agree with this argument.

This frequency could be linked to the perception of nutritional interest in legumes by cooks. Most of them recognize their richness both on fiber and protein, confirming that even if legumes are not very popular among consumers, they remain an interesting food for cooks. Moreover, we observe that kitchens involved with IFS quality label, such as “Ici je mange local” or “Territoire BIO engagé” present higher frequencies in serving legumes. But this result must be taken carefully as we dispose of a few respondents.

Variety

But legumes are unequally served according to the species. Lentils are the most regularly served (75% of respondents regularly served lentils), followed by beans (60%), chickpea (30%), soya (15%), split peas (12%); and fababean has the last position with only 5% of respondents serving them regularly. Another interesting result is that 58% of respondents declare never serving fababeans, 37% for soya, and 33% for split pea, 10% for chickpea. Those results show that there is a high diversity of practices in serving according to legume species. Many respondents mentioned their will to improve the variety of legumes they propose :

> *« On va augmenter la lentille corail, la lentille Beluga, tout ça. [...] [L'objectif] C'est d'arriver à le faire distribuer et faire comprendre à nos distributeurs qu'il faut aller vers une variété de légumineuses pour avoir une offre différente. » - A dietitian in a PCC.*

Considering a post-calculated score of legumes serve diversity according to the different legumes served through the various elements constituted a meal, we observe various profiles. Some caterers present high score while other very low score and it is correlated with the frequency of serving.

4.3 Main trends in legumes cooking

Capabilities, type of product use and technical constraints

If most respondents consider legumes not popular, they also see them as "traditional food". However, 80% of them advance that legumes remain an *interesting* and *innovative* product. For instance, 83% agree with the need to have more legumes-based ingredients (such as flour or pasta) and also more variety in legume grains (94%), while only 39% call for more cooked (processed) legumes products or dishes. Respondents recognize that legumes cooking could be increased but that having more recipes at their disposal will help (99% of respondents agreeing on this point). They also emphasized the need of training for cooks (91%).

Capabilities and skills are required to develop legumes in diets. For instance, we observe that low popularity consideration is strongly correlated with the recognition of cooks having difficulties to associate legumes in dishes, while the ones declaring high popularity confirm also not having difficulties in cooking them. Indeed, we observe a split between respondents: one half consider that cooking legumes is difficult while another half not.

However, in some kitchens, especially central kitchens, legumes can represent a technical constraint that is solved by using canned, vacuum packed or ready-prepared products or dishes :

> *« Nous on est amenés à utiliser beaucoup de 4e et 5e gammes, notamment dans nos cuisines centrales, par praticité en fait. On ne peut pas toujours tremper les légumineuses … » - A dietitian in a PCC.*

Alternative dishes

The development of alternative dishes is quite recent: only 13% of the respondents serve them for more than 5 years, and 23% for more than 2 years. For 40% it exists for less than two years or is under current planning. It is among Business segment that alternative dishes exist since a longer period. One quarter of the respondents systematically use legumes for alternative dishes, and more than 50% regularly, most often in association with cereals. Therefore, alternative dishes remain an important driver of legumes development. Legumes can be a source of innovation and they become more common, even in components where they are usually absent such as desserts :

> *« Avant on ne voyait pas du tout de mousse au chocolat vegan avec du jus de pois chiche, aujourd'hui on fait partout dans tous les segments. Et ça passe très très bien, quand c'est bien fait, en général il n'y a pas de soucis. » - A dietitian in a PCC.*

4.4 Main trends in legumes sourcing

Types of supply chain

Wholesaling or central purchasing is the main type of supply chain, regularly used by 66% of the respondents (only 24% declared never using this sourcing). Nevertheless, some caterers regularly

use alternative supply chains such as direct purchase with a farmer (10%) or with an agricultural cooperative (7%).

Geographical origin

Around 80% of the respondents indicate that the main geographical origins of purchased legumes are national or regional. Less than 20% use mainly European or global sourcing. We observe that on site-production system use more frequently regional or national sourcing that the deferred system. This sourcing is under important shift as nearly 70% of respondents declare direct purchase with farmers as a priority action to conduct in the next years; and for more 90% developing regional sourcing is also a major priority.

> *« Il faut qu'on ait des réponses assez claires, comme les clients peuvent le demander sur la protéine animale, où on est très regardant sur l'origine, les modes d'abattage, les modes de production, il y aura la même problématique sur le monde végétal. C'est-à-dire d'où ça vient, les origines, OGM, sans OGM, toutes ces thématiques-là doivent être réglées dès le départ. » - A dietitian in a PCC.*

Labels in sourcing legumes

For more than 85% of the respondents developing organic sourcing is a priority for the coming years, given the fact that organic sourcing is already the main sourcing for 30 to 50% of respondents depending on the type of species.

5. Conclusion

Changes in collective meal contexts (e.g. canteens, restaurants) are an important driver of sustainability transition of the food system. This study was a first exploratory analysis on legumes serving, cooking and sourcing practices in IFS. Those results reveal similarities between all caterers while other dimensions unveil a significant heterogeneity on practices, particularly as regards capabilities and perceptions of difficulties in cooking legumes. In addition, legumes development seem positively linked to caterers' engagement in sustainable food approaches. Therefore encouraging such initiatives could favor, in the future, legumes development.

Further investigation must be conducted in order to sharpen the understanding of the brakes and levers on legumes development, according to the variety of species and cooks' working conditions and environment. In addition, the analytical framework could be adapted to other sustainable food practices or food groups.

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Appendix

Direct-collecting data sources (2018-2019)

OPEN-ENDED INTERVIEWS (TOTAL : 54)		
NAME OF THE ORGANISATION	**PROFILE OF THE INTERVIEWEE.S (NUMBER OF INTERVIEWS)**	**MONTH, YEAR ; DURATION OF THE INTERVIEW**
A Toulouse middle school canteen	Chef (1)	June 2018 ; 1h30
AFDN (French Association of Nutritionists and Dietitians)	Member (1)	April 2018 ; 1h30
AGORES (French National Association of Self-managed Food Services Managers)	National manager (1) ; Dietitian (1)	Janvier 2019 ; 1h30
AgroParisTech	Research director (1)	June 2018 ; 1h30
Angem (Association of Italian Private Catering Companies)	Employee (1)	March 2019 ; 1h30
ANIA (French National Association of Agri-food Industries)	Department director (1)	July 2018 ; 2h
Anses (French Agency for Food, Environmental and Occupational Health & Safety)	Unit manager (1)	May 2018 ; 1h30
API Restauration	Dietitian (1)	March 2019 ; 1h
AVF (French Vegetarian Association)	Project manager (1) ; member of the Nutrition commission (1)	May + June 2018 ; 2h + 1h
Beau-Joly Institute	Manager (1)	June 2018 ; 1h30
Chef trainer	(1)	July 2019 ; 1h30
CNA (Food National Council)	Study manager (1)	June 2018 ; 1h30
Convivio	Unit manager (1)	April 2019 ; 1h
Croc la Vie	Dietitian (1)	March 2019 ; 1h
Departmental Laboratory EVA 31	Project manager (1)	June 2018 ; 1h
Dutch Ministry of Agriculture	Senior official (1)	January 2019 ; 1h30
Ecocert	Unit manager (1) ; Project manager (1)	January 2019 ; 1h30
Elior Group	Unit manager (1)	March 2019 ; 1h
FNAB (French National Federation of Organic Agriculture)	Project manager (1)	January 2019 ; 1h
FoodServiceEurope	Employee (1)	January 2019 ; 1h
Garig	Unit manager (1)	March 2019 ; 1h

GECO Food Service (French National Association of Institutional Food Services Industries)	Manager (2)	July 2018 ; 2h
General practitioner	(1)	May 2018 ; 1h30
Greenpeace France	Project manager (1)	June 2018 ; 1h30
Haute-Garonne Departmental Council	Unit director (1) ; Project manager (1)	June 2019 ; 1h30
INRA (French National Institute of Agricultural Research)	Research director (5) ; Research manager (1)	March + April + May + June 2018 ; 1h + 1h + 1h30 + 2h30 + 1h + 1h30
INSERM (French National Institute of Health and Medical Research)	Research director (1) ; Research manager (2)	April + May + June 2018 ; 1h30 + 1h30
French Ministry of Agriculture and Food	Senior official (1)	May 2018 ; 1h30
French Ministry of Solidarities and Health	Senior official (1)	June 2018 ; 1h
Nantes City Council	Project manager (1)	June 2018 ; 1h30
Protéines France	Project manager (1)	April 2018 ; 1h
Restau'co (French Interprofessional Association of Self-managed Food Services)	Manager (1)	January 2019 ; 1h
Restoria	Dietitian (1)	March 2019 ; 1h
Sodexo	Unit director (2)	June 2018 + March 2019 ; 1h30 + 1h
Terres Inovia (French Technical Institute of Oils and Plant Proteins)	Manager (1)	April 2018 ; 2h
Terres Univia (French Interprofessional Association of Oils and Plant Proteins)	Project manager (1)	May 2018 ; 1h30
Triballat Noyal	Unit director (1)	June 2018 ; 1h30
Un Plus Bio (French association promoting organic canteens)	Employee (2)	June 2018 + January 2019 ; 1h + 1h
Veneca (Association of Dutch Private Catering Companies)	Employee (1)	March 2019 ; 1h
WWF France (World Wildlife Fund)	Project manager (1)	June 2018 ; 1h30

MEETINGS AND OBSERVATIONS (TOTAL : 8)		
ORGANISER.S	**TOPIC**	**PLACE ; DATE ; NUMBER OF PARTICIPANTS**

WWF France (World Wildlife Fund) ; INRA (French National Institute of Agricultural Research)	"Plant protein valorisation workshop: What contributions can companies make to increase the share of plant proteins in the food supply? Sharing the experience of our partners"	AgroParisTech ; 7th february 2018 ; 100
Restau'co (French Interprofessional Association of Self-managed Food Services)	Institutional Food Services Fair	Paris Expo ; 11th april 2018 ; 4500
GEM-RCN (French Markets Study Group - IFS and Nutrition)	Quarterly meeting	AFDN ; 17th april 2018 ; 20
National Assembly (French Parliament)	Opening plenary session of the debates regarding the EGalim law (N°2018-938)	National Assembly ; 22th may 2018 ; 200
Interbio Occitanie ; Agriculture Chamber of Occitanie	First symposium on organic and local supply for institutional food services	Pamiers ; 22th may 2019 ; 50
Samantha Cazebonne (French MP)	Symposium on weekly vegetarian menus in school canteens (EGalim law)	National Assembly ; 14th june 2019 ; 300
SNRC (French National Association of Private Catering Companies)	Round-table on innovation	Lyon ; 1st july 2019 ; 20
Un Plus Bio (Association promoting organic canteens)	Technical meeting regarding vegetarian meals and legumes	Toulouse ; 2nd july 2019 ; 40

ONLINE SURVEY (FRANCE)		
NAME OF THE SURVEY	**START DATE - DEADLINE ; DURATION OF THE SURVEY**	**NUMBER OF USABLE ANSWERS**
Les légumineuses en restauration collective (Legumes in Institutional Food Services)	26th april 2019 – 19th august 2019 ; From 20 to 30 minutes	568