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Farmers' preferences for short food supply chain attributes

A discrete choice experiment on the sector of fresh vegetables in Wallonia, Belgium

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CONTENT

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LIST OF ACRONYMS

€	Euro
%	Percent
AFN	Alternative Food Networks
AGS	Alternative Guarantee Systems
ANA	Attribute non-attendance
ASC	Alternative-specific constant
BIC	Bayesian Information Criteria
CAIC	Consistent Akaike Information Criteria
CL	Conditional logit
CSA	Community Supported Agriculture
DCE	Discrete choice experiment
ETP	Équivalent Temps Plein
EU	European Union
FTE	Full time equivalent
GASAP	Groupe d'achats solidaires de l'agriculture paysanne
GHG	Greenhouse gases
ha	Hectare
IFOAM	International Federation of Organic Agricultural Movements
kg	Kilograms
LC	Latent class
LFS	Local Food Systems
MGL	Market gardening on large areas
MGM	Market gardening on medium areas
MGS	Market gardening on small areas
MXL	Mixed logit
PGS	Participatory Guarantee Systems

SD	Standard deviation
SFSC	Short Food Supply Chain
UK	United Kingdom
USA	United States of America
VFC	Vegetables in combination with field crops
WTA	Willingness to accept

LIST OF EQUATIONS

1 INTRODUCTION

Modern agriculture and food production were strongly impacted by the process of industrialisation and globalisation of supply chains across the world, especially in middle- and high-income countries, like in the European Union (EU). Global supply chains that provide to big supermarket chains became the universal and most common marketing channels for agricultural producers and the most common channels to provide consumers (Langeard and Peterson 1975; Malak-Rawlikowska et al. 2019). The process of globalisation went hand in hand with an increase in regulations and standards for food production, including certification for organic production (Renting et al. 2003).

These developments in the agri-food sector created a 'squeeze' on farmers' economic margins, on the one side from decreasing prices and limitations in the possibility to increase the gross value of production. On the other side, increasing production costs from certification and control processes, which are commonly required for example for selling in supermarkets, further enhanced pressure on farmers' income (Renting et al. 2003; Van der Ploeg et al. 2000). Further, the growing distance between producers and consumers caused an increasing alienation of the general population from the agricultural production (Kneafsey et al. 2013). Additionally, the pressure on the environment and climate grew, for example resulting from increasing emissions of greenhouse gases (GHG) in agricultural production, processing, and distribution (Crippa et al. 2021).

Facing these pressures, more and more farmers look for ways to survive and to offer the perspective for an alternative path. A trend towards the re-localisation of food production can be observed in Europe which has led to the development of various kinds of channels with shorter distribution. These are regularly described by the term 'Short Food Supply Chains (SFSCs)' and exist alongside the more common long channels (Malak-Rawlikowska et al. 2019; Renting et al. 2003; Van Gameren et al. 2015). Due to the large variety in short food channels, there are strong differences in the size and types that developed in each country. Farmers have different reasons for implementing SFSCs, including to diversify their marketing strategies and improve their financial revenues by achieving a higher value added for their products (for example through direct selling or organic production) (Renting et al. 2003). An additional factor in the development of SFSCs is the consumers' awareness for environmental problems and food safety scandals, as they often associate local production to sustainability and safety (Edwards-Jones et al. 2008; Renting et al. 2003). Further, SFSCs are perceived as an alternative to the common long, globalised food distribution and thus could present an important contribution for

transitioning the agri-food system towards more sustainability (Malak-Rawlikowska et al. 2019).

Approaching from the opposite direction, decreasing the production costs, for example with the help of alternative certification mechanisms, is another promising attempt for farmers to capture a larger part of the economic margin (Renting et al. 2003). Alternative guarantee systems (AGS) represent an alternative way of ensuring the compliance with production standards, for example organic or agroecological production, and claim to be cheaper and more inclusive to small-scale farmers compared to external certification by a third-party, which is the common practice for guaranteeing organic standards in the EU (i.e., via the EU organic certification) (Sacchi 2016; Zanasi et al. 2009). In the past decade, AGS started to be increasingly developed, for example participatory guarantee systems (PGS) for organic production which are actively supported by organisations like the International Federation of Organic Agricultural Movements (IFOAM Organic International). They claim that PGS can allow farmers to reduce the costs related to the certification of their produce while achieving price premiums for their products at the same time (IFOAM 2020). While PGS are already well developed in numerous countries, especially in South America and Asia, where they are also often accepted as official certification mechanism, they are not yet legally recognised for organic certification in the EU (IFOAM n.d.). Nevertheless, these systems are implemented in some European countries, such as Spain (Cuéllar-Padilla and Ganuza-Fernandez 2018; López Cifuentes et al. 2018) or Italy (Sacchi 2016) and are gaining interest of farmers in other countries, including Belgium.

In the Walloon Region, in the south of Belgium, this certification mechanism is starting to be developed as first trainings on the topic are conducted among farmers. However, it is not yet used by farmers or recognised by authorities. SFSCs, on the other hand, are very commonly implemented in Wallonia, especially with respect to the vegetable sector for the fresh market (as opposed to the production for the industry). This sector is characterised by mainly small-scale farmers of which most are organic certified (Dumont 2017; Chavagne and Dombret 2021). It thus demonstrates the attempt of small farmers to alleviate the pressures resulting from globalised supply chains to ensure their viability and competitiveness, by diversifying towards SFSCs and organic production.

While there is a large interest of researchers when it comes to consumer preferences for SFSCs and acceptance of different types of them in the EU, studies focussing on farmers' preferences for different SFSCs are rare. For AGS on the other hand, research is abundantly available in the context of developing countries while rarely existent for European countries. Therefore, this

study aims at contributing to the few studies on farmers' preferences for SFSCs and AGS in Europe[1] and serves as a first approach to focus on the producer side of SFSCs and their preferences for such in the European context. Furthermore, it attempts to deliver an insight into farmers' preferences for certification mechanisms which could support further development of AGS in the EU.

The rest of the thesis is structured as follows: Section 2 details the research objectives, the problematics they are based on, and the overall methodological approach. In section 3, a literature review on SFSCs and AGS, focussing mainly on Europe, is presented. Moreover, relevant terms in the context of this thesis are defined and the structure of the sector for fresh vegetables in Wallonia is characterised. Section 4 then follows with an overview over the data and methods used. The hypotheses derived from the literature review and exploratory interviews with farmers are presented. Further, the design of the survey, including the questionnaire and DCE are described, and the econometric analysis is explained. In section 5, the results from the data analysis are presented while section 6 contains a discussion of the results. Section 7 draws the conclusion, including limitations of the study, and gives recommendations for further research and to policy makers.

[1] See BENEDEK et al. (2018), DEMARTINI et al. (2017) and SAMOGGIA et al. (2019) for SFSCs in Europe and CUÉLLAR-PADILLA and CALLE-COLLADO (2011), CUÉLLAR-PADILLA and GANUZA-FERNANDEZ (2018), LOPÉZ CIFUENTES et al. (2018), SACCHI (2016) and SACCHI (2019) for AGS in Europe.

2 RESEARCH BACKGROUND AND OBJECTIVES

This section gives an overview of the challenges farmers face due to the current structure of the agri-food sector. Further, research questions and objectives resulting from the presented problematics are stated as well as the overall methodological approach used in this study to explore them.

2.1 Challenges in the Agri-Food Sector and Supply Chains

Up until the industrialisation of Europe, which allowed for longer distance transport and technical progress, the main supply channels for agricultural products and food were direct sales to the consumers, for example at the farm level or on markets. But it was not until the 1960s that mass distribution of agricultural products through supermarkets reached Western Europe (Langeard and Peterson 1975; Malak-Rawlikowska et al. 2019). This process was enhanced by the intensification of agricultural production in the EU, reinforced by the Common Agricultural Policy of the EU which supported agricultural producers under the premise of increasing food supply and thereby food security (Van Gameren et al. 2015). This transformation of food supply chains from rather local and short to longer and globalised chains, increased the pressure on small intermediaries and small-scale farmers, ultimately forcing many of them out of the market. This is illustrated by the significant changes in the structure of the agricultural sector which are characterised by a decreasing number of farmers and at the same time an increase in average farm sizes (European Commission 2013a). Further, the rural population increasingly migrated to urban centres. These developments brought about a large distance between the stakeholders within value chains, both on a physical and social level (Vittersø et al. 2019). This overall delinking between the stages of producing, processing and finally consuming food products led to the necessity of providing some guarantees for product quality based on institutionalised and standardised processes, as it does not allow the previous way of perceiving food quality, which was mainly based on a social relation between the stakeholders and personal observations. Additionally, many new regulations, for example for environment, animal-welfare or sanitary aspects were introduced as a result (Renting et al. 2003).

Today, the agri-industrial food system in the EU and its foundations of standardised, capitalistic and productivity driven production techniques are under increasing pressure as they caused many large challenges concerning economic, social and environmental dimensions (Van Gameren et al. 2015). First of all, economic challenges arose as the decreasing economic

margins for farmers increased the pressure on agricultural producers' income, resulting both from a reduction in the gross value of production and an increase of the costs (Van der Ploeg et al. 2000). The possibility to sustain farm incomes by increasing production and adapting better technologies, as described by the technological treadmill (Cochrane 1979), has reached its limits due to saturated markets, forcing farmers to look for new ways and niches to secure their income (Renting et al. 2003).

Additionally, the increase in standards and regulations imposed on producers by policies or the food industry causes the production costs to rise (Renting et al. 2003), as described by the regulatory treadmill (Ward 1993). In the EU, the common mechanism to guarantee compliance with said standards or regulations (e.g., organic certification) is based on the control by a third-party (European Commission 2008). This guarantee system is criticised as the related bureaucratic and financial burdens could specifically disadvantage small-scale farmers who cannot benefit from economies of scale and thus exclude them from accessing higher quality markets that offer premium prices (Dolan and Humphrey 2000; Gibbon 2003; Zanasi et al. 2009).

The technological treadmill:

COCHRANE (1979) argues that non-risk averse farmers start to adopt new production technologies allowing them to generate higher net returns from higher output and lower costs. Due to this, more farmers adopt the technique which causes the total output on the market to rise and the price to go down. Additionally, the value of assets such as land grows due to investments from higher net returns and rents and as a consequence, production costs rise. While the first adopters benefit from higher returns, the other producers are caught up in the treadmill and forced to start adopting the technique due to decreasing commodity prices to avoid being pushed out of the market.

The regulatory treadmill:

The regulatory treadmill describes the impact of rising regulatory pressures on farms, for example due to higher demands for conservation and recreational spaces in rural areas. This again increases land prices and thus the production costs (Ward 1993).

Secondly, social challenges became present in relation to food security and safety as well as to public health issues and healthy nutrition (Meybeck and Gitz 2017). Due to the increasing distance between producers and consumers, the consumers' knowledge about where, from whom and how their food is produced decreased continuously (Kneafsey et al. 2013). Furthermore, the overall public concern regarding modern food production increased due to the outbreak of diseases or heightened interest in environmental issues, including those caused by agriculture. Recurring food related scandals caused mistrust and doubt towards the ability of the agri-food industry to provide safe and healthy products (Renting et al. 2003; Van Gameren et al. 2015).

Thirdly, agriculture is also a main driver for many environmental and climate change issues. The concern for these issues in the European public especially increased during the past years as a result of, for example the heat waves and droughts in the past summers, which could be directly experienced by the society (Jakučionytė-Skodienė and Liobikienė 2021). The current way in which the globalised and industrial agri-food sector produces and distributes its products contributes strongly to the global GHG emissions and thus has direct consequences for climate change (Crippa et al. 2021). In this context, the European Commission proposed SFSCs as a possible subject for programs within Rural Development objectives, amongst others due to their potential for reducing negative impacts on the environment, for example carbon dioxide (CO_2) emissions (European Commission 2013b).

2.2 Research Questions

Recognising the challenges faced by small-scale producers in Europe, SFSCs as well as AGS are identified as promising solutions as they allow to gain price premiums from diversifying and accessing niche markets for certified produce. Moreover, positive impacts on rural development and the society as well as potential benefits for the environment are recognised in the literature. In the Belgian region of Wallonia, the agricultural sector for the production of fresh vegetables is characterised by mainly very small-scale and organic producers who are strongly engaged in SFSCs (Dumont 2017). Following regional political initiatives that claim interest in supporting this local production and the existence of SFSCs (Public Service Wallonia n.d.) as well as EU scale policy proposals for the support of such producers (European Commission 2013b), it is crucial to gain knowledge on the preferences of farmers for SFSCs, as they exist in a vast variety characterised by many attributes. Additionally, as AGS, in this case PGS, also start trainings and information events in Belgium and caught interest of many

producers, investigating them is especially interesting in this context to support the development process based on farmers' preferences.

Thus, this thesis aims at contributing to the research on farmers' preferences for SFSCs and control systems for production requirements (e.g., organic or agro-ecological such as no tillage, wind breaks, etc.) in Europe by conducting research on vegetable farmers for the fresh market in Wallonia. The two main research questions the following thesis is based on are:

a) **"Which attributes of SFSCs are preferred by vegetable farmers for the fresh market in Wallonia?"**
b) **"Which characteristics of vegetable farmers for the fresh market in Wallonia influence their preferences for SFSC attributes?".**

The research objective is to improve the design and support for SFSCs commercialisation systems and marketing as well as for AGS. Therefore, the goal is to identify the SFSCs that are preferred most by producers and possible differences in these preferences and their origin. With respect to AGS, the study additionally aims at assessing the importance of a label and preferences towards internal versus external control mechanisms.

The obtained results could help to develop different rural development policies or specifically support already existing initiatives. For example, marketing or processing cooperatives could be supported, either those with or without internal or external control or with or without label, depending on the preferences obtained. Institutional procurement policies, for example contracts with schools or hospitals, could be adapted if producers care about the selling volume but less about direct contact to the consumers. Improvements could be made with respect to setting up farmers' markets if producers care about having a direct contact with consumers and do not mind driving to an off-farm location. Another possible support that could be justified by the results is the funding of private initiatives with consumers' commitment like box schemes or Community Supported Agriculture (CSA) (e.g., through grants) for those farmers who value direct contacts including a longer-term commitment of the consumers.

2.3 Methodological Approach

This section provides details on the methodology on which the following research is built upon. To start, a thorough literature review on SFSCs and AGS and their respective benefits and challenges was conducted, mainly focussing on Europe (see section 3). In addition to this, the Walloon sector for fresh vegetables was characterised and classified into different production

systems (see section 3.4) to serve as a base for the following research and the analysis of its results. Based on the literature review, a first set of SFSC attributes deemed important for vegetable farmers was identified.

The literature review revealed a lack of research on SFSCs in the specific area of Wallonia, Belgium. Thus, four semi-structured interviews were conducted with Belgian farmers as a qualitative measure to explore producers' current marketing practices and their motives behind them (see section 4.1). The information gathered in the interviews was used to narrow down the most important attributes of SFSCs to the five final ones. Several hypotheses were derived regarding farmers' preferences for these attributes and for possible heterogeneity resulting from differences in farmers' characteristics (see section 4.2). Then, a survey was designed, composed of a questionnaire and a discrete choice experiment (DCE). The questionnaire included questions on important farmer characteristics and their production and marketing strategies (see section 4.3). A DCE was chosen to allow to explore farmers' preferences for the five SFSC attributes in a hypothetical scenario (see section 4.4). In combination, the survey allowed to research the connection between preferences and farmer characteristics. The survey was launched online from March to May 2021. Finally, an econometric analysis was used to analyse the obtained data (see section 4.5).

3 LITERATURE REVIEW

In this section, a literature review on SFSCs and AGS is given. Both terms are defined in the context of this study and their socio-economic and environmental impacts are discussed. After that, an overview over the sector of fresh vegetables for the market in Wallonia is given and the different production systems of vegetable farmers in this sector as well as associated characteristics are presented.

3.1 Short Food Supply Chains

A variety of terms and definitions exists with respect to food chains that are considered as alternative to the conventional supply chains in high-income countries nowadays. In the following, the terms that are most commonly used in the literature are distinguished and the definition for SFSCs used in this thesis is stated.

The broadest term used is Alternative Food Networks (AFN) which functions as an umbrella term describing recently emerging networks that re-embed production in a more local and social context as alternatives to long, global and industrialised systems (Murdoch et al. 2000; Renting et al. 2003). VENN et al. (2006) add that the term "has developed into something of an all-encompassing term applied to a vast array of emerging food schemes and initiatives that in multiple, and often very diverse, ways are seeking to reconfigure producer-consumer relations" (Venn et al. 2006, p. 256). Besides, very common but more specific terms are Local Food Systems (LFS) and Short Food Supply Chains (SFSCs). Both are characterised by a higher level of proximity, for LFS with respect to spatial proximity and for SFSCs for social proximity (Renting et al. 2003). LFS are defined as systems where the production and processing activities, as well as selling and consumption of the products, occur within a smaller geographical area of a radius of around 20 to 100 kilometres (Kneafsey et al. 2013; Malak-Rawlikowska et al. 2019). SFSCs on the other hand, concern the relations between the different parties involved in production and processing processes as well as the distribution and consumption of products. It rather describes supply chains with a reduced number of intermediaries involved and is often used as an opposite term for long supply chains. Resulting from less or no intermediaries, the products in SFSCs can be identified and traced back to a specific farmer (Kneafsey et al. 2013; Malak-Rawlikowska et al. 2019; Renting et al. 2003). The European Commission additionally includes the characteristic of local proximity in their definition of SFSCs within the Regulation No 1305/2013. They define a SFSC as "a supply chain involving a limited number of economic

operators, committed to co-operation, local economic development, and close geographical and social relations between producers, processors and consumers" (European Commission 2013c, p. 499).

SFSCs in the context of this study are defined as follows: SFSCs are all supply chains with only one or no intermediary between the farmer and the consumer. The focus is set on social proximity, nonetheless, a reduced number of intermediaries often implies local proximity as well.

3.1.1 Different Types of Short Food Supply Chains

Many different marketing channels can be classified as SFSCs, such as direct selling, pick-yourself-schemes, farmers markets, roadside selling, food boxes or selling via farmer cooperatives or purchasing groups.

Table 1: Overview over short food supply chain types

SFSCs	Relation to consumer	Intermediaries	Example
Selling with one intermediary	No direct contact	Max. 1	Purchasing groups; farmer cooperatives; contracts with schools, hospitals, caterers, restaurants, etc.
Direct selling on-farm	Direct contact	None	Farm shops; pick-your-own schemes
Direct selling off-farm	Direct contact	None	Farmers markets; box schemes with delivery

SFSCs can be separated in direct selling on- and off-farm and selling with one intermediary, for example via farmer cooperatives (see Table 1). Selling with one intermediary includes farmer cooperatives or purchasing groups whose activities and tasks differ between the variety of existing groups. In general, purchasing groups are established by consumers to directly acquire products from producers and are often based on shared ethical beliefs about consumption and production (Cembalo et al. 2013; Fonte 2013). In the case of GASAP ("groupe d'achats solidaires de l'agriculture paysanne"), a Belgian solidarity purchasing group, producers and consumers are connected through a contract and consumers pay in advance to receive a certain amount of produce over the contract period. The products are then regularly placed at delivery points where they are collected by the consumers (Manganelli and Moulaert 2018).

Direct selling on-farm includes, for example, selling in a farm shop or using pick-your-own schemes like CSA. CSA is "based on long term partnership between one or several producers and their consumers where consumers are associated to a more or less large extent with the producers' decisions and labour" (Kneafsey et al. 2013, p. 14). SPROUL and KROPP (2015) describe that CSA contracts assure selling part of the production to the customers before the harvest and thus allow to share production risks between farmer and consumers. The farmers then manage their fields dependent on the expectations and wishes of the members and resulting from the sense of community in the CSA, the customers are often willing to pay a higher price (Brehm and Eisenhauer 2008; Samoggia et al. 2019). Direct selling in a farm shop on the other hand generally requires more frequent involvement of the producer and does not imply longer-term commitments of consumers. As opposed to CSA, the farmer is also still responsible for the harvest of his products. Direct selling off-farm also comes in various forms, among those farmers' markets or box schemes with delivery where boxes with vegetables are delivered to the consumers at a pick-up point. Direct selling on- as well as off-farm both imply direct contact to the consumer while selling with one intermediary does not.

3.1.2 Characteristics of Farmers Participating in Short Food Supply Chains in the EU

Within the past years, several studies have been conducted focusing on farmers' participation in different SFSCs. A variety of characteristics were identified that are often associated with farmers marketing through SFSCs. In this section, the literature findings on these characteristics for farmers in the EU are summarised.

First of all, several trends with respect to individual characteristics of producers can be found. STANCO et al. (2019) conducted face-to-face interviews with 60 participants (farmers and consumers) of farmers' markets in the South of Italy to research farmers' and consumers' characteristics and attitudes with respect to farmers' markets. Their interviews show that mainly male farmers, who are on average 45 years old and have obtained a high school degree, participate at these markets. SAMOGGIA et al. (2019), who conducted interviews face-to-face, by telephone and online with 35 CSA farmers, 21 from the USA and 14 from Hungary, find that the participating farmers, are generally young, with nearly 25% in the age range of 25 to 34 and around 40% between 35 to 44 years old. Further, they obtain that the level of education of the Hungarian CSA farmers is above a high school degree, and over half of the participants have a Bachelor's degree or higher. The authors do not find the prevalence of a specific gender within their participants. BENEDEK et al. (2018) conducted a survey with 156 farmers on 20

markets (conventional and organic as well as farmers' markets) in Hungary to analyse factors that impact farmers' participation in SFSCs. They find that more educated farmers with a lower commitment to a specific market and preferences for direct selling prefer farmers' markets as part of their strategy for risk reduction and diversification while small-scale farmers with lower education and less orientation towards the future rather prefer conventional markets. Furthermore, STANCO et al. (2019) state that farming experience of several years (mean of 21.91 years) are common for the researched farmers' markets and SAMMOGIA et al. (2019) show that farmers' experience with CSA is evenly distributed ranging from only one to ten and more years.

Besides individual characteristics, some common farm and production characteristics can be identified. RENTING et al. (2003) show that SFSCs are mainly used by medium-scale farms because often a certain level of production is required, for example to fund investments, making the participation unfeasible for very small farmers. Larger volumes on the other hand tend to not work well with the specific marketing structures of SFSCs which generally involve selling to a larger number of buyers, thus making SFSCs more unattractive for large scale farmers. In addition, KNEAFSEY et al. (2013) find that mainly small-scale farms are involved in SFSCs, most of which farm on an area below 10 ha. They further reveal that most SFSCs are used to sell a large variety of products, with vegetables and fruits most commonly sold. Similarly, DEMARTINI et al. (2017) predominantly find small farms participating in SFSCs selling heterogenous products. They identify marketing on farmers' markets, farm shops, under CSA or through local food shops as the most important sales channels.

To sum it up, farmers who participate in SFSCs in Europe tend to be younger and well-educated with varying farming experiences. They mainly own small and medium-sized farms and sell a wide variety of produce through diverse marketing channels.

3.2 Impacts of Short Food Supply Chains

SFSCs, as compared to the more industrial and longer supply chains, are commonly associated to the delivery of economic, social and environmental benefits. They are connected to more localised production, which is assumed to be more ethical, fair and sustainable. KNEAFSEY et al. (2013), who conducted an extensive systematic literature review on SFSCs and LFS, explain that these associations reflect the overall critical view of the society on the distribution of power in the food production and distribution system. Still, the simple association of SFSCs with those

socio-economic and environmental advantages due to their local scale does not inherently make them true. This problem is also addressed by BORN and PURCELL (2006). The authors criticise this so-called 'local trap' which assumes that local-scale food systems are inherently better and more desirable than global systems. They highlight that the effect of supporting LFS depends on those who are empowered in the process. Their practices and goals determine the impacts of localising or shortening the supply chain, which can be positive as well as negative. KNEAFSEY et al. (2013) further highlight that overall, "the existence of reliable qualitative and quantitative indicators on the impacts of LFS/SFSCs is somewhat patchy, mainly because of a lack of longitudinal studies which establish baseline data" (Kneafsey et al. 2013, p. 27). VENN et al. (2006) criticise that most papers researching AFN focus on very specific case studies, thus their results often are not generally transferable to other AFN in a different geographical context. Moreover, research on AFN within a wider scale and scope is rare which is attributable to methodological challenges that come along with cross-country comparative studies that focus on very small enterprises which makes the collection of data extremely difficult. Additionally, it is criticised that studies often not clearly differentiate between the different forms of AFN or SFSCs and their impacts (Kneafsey et al. 2013). Similarly, BORN and PURCELL (2006) reinforce that the outcome of a certain food system highly depends on its context which reiterates the importance of taking the specific local situation and the agenda of those benefiting from localisation into consideration, before promoting shorter or more local supply chains. EDWARDS-JONES et al. (2008) further caution about the high interaction of impacts generated by consumers' choices on the environment and socio-economic systems. The explicit choice for local food can have beneficial impacts on the local economy or farmers while, at the same time, this implicit decision against other regions can lead to wider implications for the regions' development or environment.

In the following, findings regarding the impacts of SFSCs are presented. Taking the above-mentioned criticisms of SFSCs' benefits and the associated local trap into consideration, the mentioned papers were chosen due to their comparability with the population and area of interest in this study (vegetable farmers for the fresh market in Wallonia) as well as with respect to the SFSCs researched.

3.2.1 Economic Impacts of Short Food Supply Chains

Referring to farmers' motivations and goals behind implementing SFSCs, some studies find that economic benefits are often ranked as less important than social or environmental goals

(Kneafsey et al. 2013) while others suggest that economic and financial benefits are considered as central (Malak-Rawlikowska et al. 2019; Samoggia et al. 2019). Numerous claims with respect to the economic benefits of SFSCs for farmers have been made, which can be separated into impacts on the farm level and wider impacts on the local economy and rural development.

With respect to economic benefits at the farm level, most papers suggest a positive impact on the farmers' income based on different mechanisms. First, it is suggested that by selling via SFSCs, producers receive a higher share of the economic margin due to the elimination of intermediaries. Another frequently proposed mechanism is that value is added to the products through diversification of selling strategies (Renting et al. 2003; Sacchi 2016).

Many studies base these claims on qualitative methods and stated experiences of farmers. MALAK-RAWLIKOWSKA et al. (2019), for example, find that the majority of farmers who participated in their survey (n=186) evaluates selling in short chains as positive and indicates that one goal of participation in SFSCs is to occupy market niches to capture a higher market share. Similarly, SACCHI (2016), who studied the Campi Aperti network in Italy, finds that direct selling was implemented as a strategy to reduce intermediaries and thus lower transaction costs and increase producer prices.

Aside from positive economic impacts of SFSCs, producers also perceive some challenging aspects, mainly due to higher time requirements outside from production activities caused by the diversification of their activities (i.e., direct selling that requires additional interaction with consumers). In this context, KNEAFSEY et al. (2013) recognise potentially high workload for small farmers as challenging. Furthermore, the volumes sold to one buyer are often lower in SFSCs, which is seen as negative by farmers as they generally prefer the possibility of selling large quantities as well as entering long-term contracts (Malak-Rawlikowska et al. 2019).

Besides these rather qualitative results, a handful of studies exist that attempt to deliver quantitative data on price premium and income increases for farmers resulting from the participation in SFSCs. MALAK-RAWLIKOWSKA et al. (2019) conducted a quantitative sustainability assessment in seven countries (six EU countries and Vietnam). They implemented a producer survey with a sample of 208 food producers (186 farmers), who used both SFSCs and longer food supply chains. Their aim was to detect the types of supply chains farmers participate in and to collect data for their sustainability assessment. The results of their study reveal that SFSCs are able to capture a higher average price premium (72.2% compared to 16.7% in long chains). Additionally, the study shows that most farmers use a mix of supply chains which in return offers consumers to choose from a variety of market options. Similarly,

ILBERY and MAYE (2005) state that many small-scale producers that use alternative supply chains are not able to solely rely on SFSCs and thus sell through both short and long supply chains.

SFSCs are also suggested to contribute positively to the local economy and rural development. The underlying mechanisms are multiplier effects such as enhanced demand for local services and thus higher sales as well as increased labour demands resulting from the lower number of intermediaries, which allow to locally retain the added value (DuPuis and Goodman 2005; Kneafsey et al. 2013). Similarly, RENTING et al. (2003) put forward that particularly SFSCs that allow direct contact to the consumer, for example direct selling at a farm shop or CSA, are promising tools with respect to the contribution to rural development. It is argued that SFSCs mobilise synergies as well as multiplier effects between rural development practices which can considerably increase the value added to the local economy (Renting et al. 2003; Van der Ploeg et al. 2000).

Several studies in the United States of America (USA) have demonstrated these multiplier effects of SFSCs on the local economy. HENNEBERRY et al. (2009) studied Oklahoma farmers' markets and state an aggregate multiplier of 1.78 on gross sales (i.e., an increase of $1.78 in the state's economy from all direct and secondary effects of a $1 increase in the total gross sales of the farmers' market) and of 1.66 on personal income (i.e., an increase of $1 in the personal income on the farmers' market leads to a $1.66 increase in personal income in the economy of the state). Further, OTTO and VARNER (2005) find multipliers of 1.58 on gross sales (i.e., an increase of $1.58 in the state's economy from all direct and secondary effects of a $1 increase in the total gross sales of the farmers' market) and 1.47 on personal income (i.e., an increase of $1 in the personal income on the farmers' market leads to a $1.47 increase in personal income in the economy of the state) generated by Iowa farmers' markets based on sales reports of consumers and vendors. Additionally, some studies describe positive multiplier effects related to employment opportunities generated by SFSCs (Henneberry et al. 2009; Mundler and Laughrea 2016; Otto and Varner 2005). HENNEBERRY et al. (2009) for example find an aggregate multiplier of 1.41 on employment.

3.2.2 Social Impacts of Short Food Supply Chains

The main social benefits resulting from SFSCs are claimed to be the increase in social interactions resulting in trust relationships and knowledge exchange between farmers and

consumers, which in turn induce behavioural changes. These claims concerning the social impacts of SFSCs are mainly supported by literature based on qualitative methods.

KIRWAN (2004), who researched farmers' markets in the UK, discovers that the face-to-face interaction of farmers and their customers builds up trust between them. Building lasting relationships based on trust is highlighted as a core characteristic of SFSCs and one of the main motivations of farmers to engage in such. Further, SAMOGGIA et al. (2019) conducted face-to-face, telephone and online interviews with 35 CSA farmers from the USA and Hungary. The participants see their engagement in CSA as a multidimensional purpose to contribute to environmental protection while at the same time producing quality food and establishing a network with other participants. Overall, their results indicate that the product and community benefits resulting from the CSA are most important for the farmers. KNEAFSEY et al. (2013) conducted case studies in Austria, France and Hungary on different SFSC models, among those direct selling on a family farm, online selling and local delivery via a producer-consumer cooperative and a local food shop. They identify social values, direct contact to the consumer and the provision of quality products as farmers main objectives. Farmers specifically highlight collaborative and collective action as well as shared ethical and moral values and a relationship based on local proximity and trust as important. Similar results were obtained by VITTERSØ et al. (2019) who conducted customer surveys and in-depth interviews with key stakeholders of SFSCs from Italy, Hungary, Poland, Norway, the United Kingdom (UK) and France, most of which implement direct selling without intermediaries. The authors find that while SFSCs are very heterogenous, consumers and producers perceive that they contribute to collaboration and communication on a closer level which strengthens their identification with the locality and improves community building, independent of their organisation.

On the other hand, several papers suggest issues of inclusiveness and social equity. MACIAS (2008) highlights that SFSCs, especially if the products sold are produced under organic standards, are often associated with higher prices which constitute an entry barrier for some consumer groups. Thus, the participation in such channels tends to differ between societal classes, often dominated by people with a high socio-economic profile. Similarly, HINRICHS and KREMER (2002), who researched a CSA in the USA, discover that participants tend to disproportionally fall into 'higher' categories with respect to their education, household income and occupation. MACIAS (2008) concludes that there is notable potential for developing alternative channels "beyond the interest of a small group of people who […] currently have a

rather predictable profile with regard to race, social class, and educational background" (Macias 2008, p. 1099).

Furthermore, social exclusion might also concern farmers' participation. ZWART and MATHIJS (2020) studied the Belgian Voedselteams, consisting of food buying groups, and find that a membership is often associated with additional voluntary activities causing further time and effort requirements. The authors observed that these additional investments potentially discourage farmers' participation as potential participants decided not to become a member of a food team or only after they retire. They add that by improving the professionalism and routines of the activities conducted, these requirements for time and effort can be reduced and thus lead to the attraction of more participants.

Besides the aspect of community building, partly resulting from trust relationships, knowledge exchange between the supply chain actors and thus an improvement in the consumers' knowledge and understanding of agricultural production and associated issues are argued as benefits of SFSCs. From this, the possibility of induced behaviour changes is seen as another beneficial social impact. STANCO et al. (2019) conducted face-to-face interviews with overall 60 consumers and farmers of farmers' markets in the South of Italy to investigate the characteristics of farmers and consumers as well as their opinions on farmers' markets. They identify that farmers' motivation for participating in farmers' markets is mainly to create a direct and lasting relation with consumers because this allows them to directly communicate the authenticity and quality of the production and products to their customers. TORJUSEN et al. (2008) conducted a survey on two organic box schemes in Norway as well as one in Denmark. Their results show that the participants in the schemes improved their knowledge about food and the production system behind it. This enhancement of information can evoke further behavioural change of the consumers. The other way around, consumers can convey their preferences and wishes to the farmers who then can align their production with the consumers' interests. For example, SAMOGGIA et al. (2019) find that farmers try to manage their CSA consistent with the expectations of their community. In this context, TREGEAR and NESS (2005) highlight the importance of meeting consumers expectations for successful marketing, not only to encourage repeated purchase from interested customers but also to reach those buying less frequently.

Nonetheless, for functioning SFSCs it is necessary that both consumers' and producers' needs are fulfilled. KIRWAN (2006) researched farmers' markets in the UK and discover that the reason for participation differs fundamentally between consumers and farmers while "both sets

of participants were apparently aware of each others' primary requirements" (Kirwan 2006, p. 310). While farmers perceive the possibility to earn more as the greatest benefit, consumers participate to buy food they consider as fresher and of better quality. Still, the non-economic, social benefits are perceived as positive and important, also because it allows producers and consumers to "work out between themselves how they can each achieve what they want from their interaction" (Kirwan 2006, p. 310). Similarly, ALBRECHT and SMITHERS (2018), who researched the motivation behind producers' and consumers' participation in direct selling of meat in Southwestern Ontario in Canada, find that both groups pursue a reconnection for differing reasons. They state that in the setting of selling without intermediaries, consumers and producers have to negotiate between their different expectations and build up a relation of trust. Through SFSCs, both parties get the ability of satisfying their own self-interested motives, for farmers mainly more profitability and control and for consumers more health related aspects.

3.2.3 Environmental Impacts of Short Food Supply Chains

Agriculture itself and food supply chains are big contributors to many environmental problems, such as pollution, declining biodiversity, or climate change. Further, agriculture contributes to the pollution and degradation of the environment and biodiversity by discharging chemical inputs like fertilisers, pesticides, or herbicides. SFSCs and local production are often claimed to be more environmentally friendly and sustainable, due to less transportation of the products or more sustainable production techniques implemented.

To begin with, SFSCs are regularly associated with more ecologically sustainable production methods, such as less pesticides and fertilisers used, water conservation, or practices to enhance biodiversity (Kneafsey et al. 2013). Nonetheless, these measures are not inherently implied in SFSCs, and are rather connected to organic or agroecological farming, for which beneficial effects on biodiversity can be expected (Hole et al. 2005). It is thus important to be aware that not all farms using SFSCs are organic ones and not all organic farms use SFSCs.

Besides, SFSCs are commonly claimed to contribute less to climate change than global food chains due to lower GHG emissions associated with food transportation and less energy used for storage (Kneafsey et al. 2013). Most papers researching this impact use the concepts of food miles or the carbon footprint. Food miles are the "distance measured in kilometres travelled both by products as transported from the farm by farmer or intermediaries, and the consumers after purchasing goods, which is accounted for every kilogram of the product" (Malak-Rawlikowska et al. 2019, p. 9). The carbon footprint measures the GHG emissions emitted, for

example during the production or transport of a good, as CO_2 equivalent (Malak-Rawlikowska et al. 2019). VAN HAUWERMEIREN et al. (2007) conducted a lifecycle analysis restricted to the energy use and CO_2 emissions from marketing processes including transport, processing and storage for several food items and supply systems. Their results show higher CO_2 emissions and energy use in almost all SFSCs compared to mainstream food systems. Differences between the chains are strongly influenced by the efficiency of the transport mode used by consumers, the transport mode used for imports of products, and the local production practices (i.e., using heated greenhouses versus open air production). Nonetheless, the authors claim that SFSCs can contribute to climate change mitigation if they "consistently sell in-season products that are homegrown in open air or unheated greenhouses and when they are efficient enough in optimizing their transport and storage through diminishing the transport distance and storage time to a strict minimum and by increasing the stored and traded quantities" (Van Hauwermeiren et al. 2007, p. 33). In a similar context, MALAK-RAWLIKOWSKA et al. (2019) assessed food miles and the carbon footprint as indicators for environmental sustainability of food supply chains. Their results show that SFSCs have on average over three times higher food miles than long chains, of which pick-your-own and on-farm sales followed by farmers' markets exhibited the highest values. This is attributed to the high consumer participation in the transport of relatively small quantities in these channels. A similar result was found with respect to the carbon footprint, as short chains reveal higher values than long chains, which is mainly attributed to a more effective use of transportation in long chains. The authors conclude that when analysing GHG emissions caused in transportation and distribution, it is necessary to consider both producers' and consumers' contribution.

With respect to such research, several papers criticise the methods used to examine the contribution of supply chains to global warming. The main criticism with respect to food miles is that it is not a proper indicator for GHG emissions caused by a good. KNEAFSEY et al. (2013) and EDWARDS-JONES et al. (2008) state that the total emissions produced are not well reflected in this concept as it only focusses on emissions produced during transportation and ignores those from production, storage or processing. With regard to life cycle assessments, which are commonly used to assess the GHG emissions of a product, researchers criticise that their outcomes are strongly influenced by which activities along the supply chain are considered. Furthermore, production practices vary largely between farms, countries and seasons and therefore also influence and contribute to differences in the environmental impact of SFSCs (Edwards-Jones et al. 2008).

POORE and NEMECEK (2018), who researched environmental impacts of different foods, additionally highlight the importance of consumers for achieving environmental improvements through dietary changes and avoiding purchases from high-impact producers. They recommend the communication of the impacts created by a product and the production processes from the producers to the consumers to enable and support these processes. SFSCs could present a mechanism that allows this exchange and thus could also positively impact the environment.

To summarise, it is not possible to categorically determine if SFSCs have a lesser environmental impact than long supply chains because of the variation of results depending on the product, season, farming, transport and storage methods as well as the methods and assumptions made in the data collection and analysis. Still, the expected fostering of direct contact between consumers and producers as well as the knowledge exchange can impact consumer behaviour towards more environmentally friendly consumption decisions.

3.3 Quality Guarantee Systems and Certification Schemes

There are several different guarantee systems to assure the compliance with certain production requirements, for example for organic or agroecological certifications. These production requirements can range from environmental standards, like no tillage and reduced or no pesticide use, to social standards such as fair wage for workers. The success of guarantee systems is based on their ability to create consumer trust in their control mechanism (Zanasi et al. 2009). Guarantee systems can be classified, based on the formalisation of the relationship between their producers and consumers, from informal to very formal ones. In informal guarantee systems, usually a set of rather uncertain and unwritten rules is imposed through a mutual relationship between the involved actors, for example farmer and consumers, while formal guarantee systems typically are based on written rules which are enforced by an external party (Farrell 2005).

3.3.1 Informal Guarantee Systems

A totally informal guarantee system concerns, for example, direct selling to the consumer where the products are bought directly on the farm. In this case, the guarantee results from the trust of consumers based on the direct contact and relation to the farmers. Informal approaches function more effectively in situations with small physical as well as cultural distance between the actors. The direct relationship allows strong social control which in turn discourages dishonest

behaviour. This again enhances trust of the consumer (Zanasi et al. 2009). Guarantee systems with low formalisation are overall more elastic and quicker with respect to adapting to changing circumstances (e.g., consumer concerns or preferences) and are more in favour of information exchange. As they are usually based on unclear and unofficial understandings rather than formally agreed rules, the provided expectations about the behaviour of participants are more uncertain (Farrell 2005; Zanasi et al. 2009).

3.3.2 External Control

The highest level of formalisation is reached with an external certification by a third-party which is "provided by certification bodies officially appointed by accreditation institutions" (Zanasi et al. 2009, p. 56). This mechanism is generally grounded on a catalogue of production standards or requirements and used for national and international trade as it is associated with products of higher value. The high level of formality leads to higher costs associated, resulting from external control bodies (Zanasi et al. 2009). Further, it makes the certification less elastic thus harder to change and adapt to new circumstances, as well as narrower in scope. On the other hand, contractual agreements on production requirements can be realised on a bigger spatial scale due to the standardised mechanisms and also provide clearer guidance on the behaviour that can be expected from the involved parties (Farrell 2005; Zanasi et al. 2009). The EU organic certification, for example, is based on an external control mechanism to guarantee the compliance with their catalogue of organic standards (European Commission 2008).

A variety of impacts of external control mechanisms on small-holder farmers is presented in the literature, mostly with respect to developing countries. First, the related standards can lead to a reduction in transaction costs due to less information asymmetries which could improve the access of smaller or less efficient farmers to higher-value chains (Hudson and Jones 2003; Jaffee and Masakure 2005; Vandemoortele et al. 2012). Moreover, positive impacts of high-standard trade, for example on farmers' income and poverty alleviation are found, resulting from, for example, access to niche markets (Maertens and Swinnen 2009; Hatanaka et al. 2005; Michida and Nabeshima 2017). On the other hand, the fix and transaction costs of production increase or shift to the producers because of the external assessment of conformity with the requirements. This creates advantages for bigger producers as they can benefit from economies of scale (Dolan and Humphrey 2000; Gibbon 2003).

Due to these opposing impacts created by external guarantee systems, the impact on small farmers depends on the specific standards, as well as the situation of the agricultural sector in

each country or region (Beghin et al 2015). For example, if the agricultural sector consists of small as well as larger farms, the small ones are excluded with a higher probability while if the sector consists mainly of small farmers, high-standard production is rather inclusive (Reardon et al. 2009; Vandemoortele et al. 2012). Some studies even conclude that small farmers can only be included with sufficient support from the outside, for instance, from public-private partnerships, policy makers or collective action (Boselie et al. 2003; Henson et al. 2011; Kersting and Wollni 2012; Narrod et al. 2009; Okello et al. 2011).

3.3.3 Internal Control

An intermediate stage of formalisation is given by participatory and collective certification mechanisms. They are expected to give a guarantee for the compliance with certain production requirements, build on producers' and stakeholders' participation which is based on social trust relationships that encourage knowledge exchange (López Cifuentes et al. 2018; Zanasi et al. 2009). Such internal control mechanisms for certification offer several advantages over the currently common practice in high-income countries of certifying based on external control by a third party.

One of the most developed and implemented initiatives of this internal control mechanism are PGS for organic production founded by IFOAM Organics International. They are relatively commonly promoted in a variety of developing countries while their presence in Europe is still scarce and so is the related research (IFOAM n.d.; IFOAM 2020). In the following, the existing literature on PGS in Europe and their results are summarized. Overall, the studies on PGS in Europe mainly highlight their positive social impacts. Economic benefits and challenges are also mentioned while the impact of PGS on the environment is only covered sparsely in the reviewed literature.

With respect to the economic impacts of PGS, the main benefits identified are a lower level of bureaucracy and less costs associated, compared to certification by a third-party. LÓPEZ CIFUENTES et al. (2018), who studied PGS in Spain using semi-structured and structured interviews with 34 regional key actors, state that the participants consider marketing advantages and lower bureaucracy as important reasons to implement PGS. On the other hand, lower costs or the possibility for higher income are considered as less or not important. Just as LÓPEZ CIFUENTES et al. (2018), SACCHI (2016), who analysed the development and changes of the Campi Aperti network in Italy as an alternative food network based on PGS principles, highlights that PGS require less paperwork and are more flexible and affordable.

Several challenges related to PGS are stated in the literature. LÓPEZ CIFUENTES et al. (2018) identify that, as PGS are not legally accepted as an organic certification mechanism in the EU, PGS farmers are not able to sell their products as officially organic. The internal control further requires more time commitment from the participating farmers as many activities depend on a high amount of voluntary work (Cuéllar-Padilla and Ganuza-Fernandez 2018). This is in line with CUÉLLAR-PADILLA and CALLE-COLLADO (2011) who conducted an analysis of a Participatory Action Research system implemented in Andalusia, Spain, and find that due to the higher time requirements, there is a high likelihood that part-time producers will participate less compared to full-time producers. Finally, LÓPEZ CIFUENTES et al. (2018) remark that PGS producers often struggle with low member and consumer participation.

On the other hand, a variety of positive social impacts of participatory approaches were identified, among those the community building and knowledge exchange as well as more transparency and inclusion. LÓPEZ CIFUENTES et al. (2018) state that participants describe PGS as an instrument for social change as well as more interactive, fair and more adapted to reality. Those are also the most important reasons for farmers to implement PGS and participating producers state that related expectations (e.g., regarding the quality of the products, the control mechanism, education, transparency or individual satisfaction) are fulfilled. In a similar way, SACCHI (2016) describes the researched PGS as "a valuable example of social innovation" (Sacchi 2016, p.4) as it not only contributed to the capacity building of farmers, education and the improvement of quantity and quality of their production but also largely enabled social processes like mutual support, social inclusion or the empowerment of farmers. SACCHI (2019) further researched the adoption of PGS in Italy based on three focus groups with representatives from alternative agri-food networks that adopt or are planning on adopting PGS. The focus groups emphasise that PGS allow knowledge and resource exchange which leads to spill-over effects such as the facilitation of social processes. The participants additionally adhere to PGS schemes because they go beyond third-party certification and guarantee organic quality production standards for the consumers as well as support social sustainability, for example by assuring fair wages for the farmers or protecting workers' rights (Sacchi 2019). CUÉLLAR-PADILLA and GANUZA-FERNANDEZ (2018) come to similar results showing that the PGS initiatives use horizontality to improve the interaction and exchange between producers and often also consumers while they are usually closely connected with a specific region. In this social context, CUÉLLAR-PADILLA and CALLE-COLLADO (2011) focus on the change PGS evoked in its participants. Their results show that the participants initially had not much knowledge regarding guarantee systems for organic certification outside of external third-party

mechanisms and portrayed a rather passive attitude which the participatory approach was able to partially reverse. Social learning processes allow a transformation of the concept and the practice of organic certification and improve the relationships between participants through mutual recognition and trust. This social change directly implies an empowerment and increased self-confidence as well as better group abilities, for example regarding organisation and management. Besides these positive aspects, CUÉLLAR-PADILLA and GANUZA-FERNANDEZ (2018) highlight that the requirement for voluntary effort and community building also presents core challenges for PGS. If members lack sufficient technical and organisational skills or are not sufficiently participating in the development and implementation of the PGS, a successful functioning is threatened.

To summarise, a variety of socio-economic benefits, for example consumer-producer relations, and challenges, such as higher time requirements, resulting from PGS are demonstrated and farmers' motivation to participate is mainly based on social benefits.

3.4 Vegetables in Wallonia

The research of this thesis concerns the sector for fresh vegetables in Wallonia, Belgium. In the past, this sector has not received much attention from researchers, except for Dr. Antoinette Dumont who conducted an extensive study in 2017 within her doctoral thesis on working conditions of farmers producing vegetables for the fresh market in Wallonia (Dumont 2017). The following section introduces the classification of vegetable production systems in Wallonia developed by Dr. Dumont and gives an overview over the general structure and situation of the vegetable sector.

Table 2: Classification of production systems for fresh vegetables in Wallonia

System	Gross vegetable production area (in ha)	Average area per vegetable species (in ha)	FTE/farm	FTE/ha of gross vegetable production area	Typical vegetable species and number of species cultivated
MGS	< 2.5	< 0.1	C: 0.5 – 3	C: 0.25 – 2.5	Multiple
			O: 2 – 4	O: 1.5 – 2.5	C: 20 – 30
					O: 25 – 45
MGM	2 – 10	0.1 – 0.5	C: 2 – 6	C: 0.5 – 2.5	Multiple
			O: 8 – 12	O: 1.5 – 5	C: 40 – 50
					O: 30 – 45
MGL	12 – 38	C: 1 – 10	C: 8 – 10	0.25 – 1	Multiple
		O: 0.25 – 0.75	O: 5 – 14		C: 3 – 13
					O: 25 – 35
VFC	C: > 18	> 3	C: 1 – 3	C: < 0.1	Carrots, potatoes, beans, …
	O: > 25		O: 3 – 5	O: < 0.2	C: 2 – 8
					O: 5 – 10

Note: C: Conventional farms, O: Organic certified farms; MGS = market gardening on small areas, MGM = market gardening on medium areas, MGL = market gardening on large areas, VFC = growing vegetables in combination with field crops; FTE = full time equivalent

Source: Own depiction based on DUMONT (2017) and DUMONT and BARET (2017).

In the Walloon region, around 364 producers of vegetables for the fresh food market were identified by DUMONT (2017). She classifies the vegetable production systems for the fresh market in Wallonia into four categories based on the following techno-economic characteristics (see Table 2): the gross vegetable production area in hectare (ha) ("Superficie brute de légumes [ha]"), the average area per vegetable species in ha ("Superficie moyenne développée par légume [ha]"), the number of full-time equivalent (FTE) jobs per farm ("Equivalent Temps Plein (ETP)/Exploitation"), the number of FTE per hectare of gross vegetable production area ("ETP/ha brut de légumes"), the typical vegetable species and number of species cultivated ("Légumes typiques et nombre de légumes cultivés") as well as the proportion of motorisation ("Proportion d'opérations d'implantation et de récolte motorisées"). Based on these indicators, the four categories distinguished in Wallonia are (English translation following DUMONT AND BARET (2017)): market gardening on small areas (MGS) ("Le Maraîchage sur Petites Surfaces"), market gardening on medium areas (MGM) ("Le Maraîchage sur Moyennes Surfaces"), market gardening on large areas (MGL) ("Le Maraîchage sur Grandes Surfaces") and growing vegetables in combination with field crops (VFC) ("Les Producteurs en Grande Culture"). All of the four technical orientations are observed for farmers using conventional as well as organic agricultural practices. The presented classification characteristics try to capture an overall orientation of the production systems, meaning that not each producer always fulfils all categories of one system. Nonetheless, a farmer generally covers most characteristics of one system which makes it possible to sort them into these four systems (Dumont 2017).

DUMONT AND BARET (2017) further conducted interviews with 60 stakeholders (vegetable farmers, experts, farm advisors) in Wallonia. Their results show that most farmers can be classified as MGS producers and a majority established relatively recently, which also explains why more producers with farming experience below 10 years are found in the MGS and MGM production systems. Furthermore, MGS and MGM producers are to a large extent younger compared to larger production systems. Also, conventional MGS, MGM and MGL producers have generally lower education levels than organic producers. The authors further describe that fresh vegetable farmers in Wallonia, especially organic ones, only have "limited access to information and training" (Dumont and Baret 2017, p. 57) and that conventional producers tend to receive more support, for example from research centres. Additionally, they state that the "sharing of experience or information among producers, except for some marketing activities and some exchange of knowledge among agroecological MGS and MGM producers" (Dumont and Baret 2017, p. 57) is limited. Across all systems, producers generally employ workers, even if only for short periods. In comparison to the other production systems, MGS producers only

have few employees, mainly for seasonal work, and additionally use volunteers, for instance family workers or members of buying groups.

With respect to organic producers in this sector, more statistics are available based on a sector study conducted by Biowallonie in 2020 (Chavagne and Dombret 2021). Their results suggest that the number of organic producers for the fresh market is increasing constantly, with the majority of the population in 2020 being small scale (around 226 that fall under the category of MGS), some middle scale producers (around 54 that fall under the category of MGM) and only a few farming a large-scale vegetable area (around 28 under the category of MGL and VFC).

With respect to marketing strategies, most vegetable producers in Wallonia use diverse marketing channels for their produce and sell, at least partly, through SFSCs (Dumont and Baret 2017). The most commonly used marketing channels differ between the four identified production systems as well as between organic and conventional producers within one system. Table 3 gives an overview over each production system and the typical marketing routes implemented by the respective producers. The presented channels "are those through which at least 50% of the producers in the production system sell more than 20% of their vegetables" (Dumont and Baret 2017, p. 56).

Table 3: Most common marketing channels of the production systems

System	Marketing channels
Market gardening on small areas (MGS)	C: Small farm store O: Collective buying groups; farmer cooperative
Market gardening on medium areas (MGM)	C: Farm store; retailer O: Farm store; local market
Market gardening on large areas (MGL)	C: Supermarket; farm store O: Farm store; wholesaler
Growing vegetables in combination with field crops (VFC)	C: Auction O: Supermarket; wholesaler

Note: C: conventional; O: organic

Source: Own depiction after DUMONT and BARET 2017.

Organic MGS producers mainly organise direct selling among a group of producers, for example through collective buying groups or farmer cooperatives. Examples for such groups in Belgium are GASAP ("groupe d'achats solidaires de l'agriculture paysanne"), a buyer group promoting direct selling to support local agriculture and a partnership between consumers and producers (GASAP n.d.); Agricovert, which is an agricultural cooperative between producers and consumers with collective distribution of the products (Agricovert n.d.); or "La ruche qui

dit oui!" which promotes direct selling via online channels and direct contact between producers and consumers at the collection point (La ruche qui dit oui! n.d.). Conventional MGS farmers on the other hand, use small farm stores as their main marketing route. On-farm shops are also one of the main marketing strategies of MGM and MGL producers (both organic and conventional). In addition, organic MGM producers regularly sell at local markets, whereas conventional ones rather sell to retailers. Conventional MGL producers additionally market their products through supermarkets and organic MGL producers via wholesalers. Conventional VFC producers' main marketing route are auctions while the organic VFC farmers mainly sell through supermarkets and wholesalers (Dumont and Baret 2017).

Similarly, the Biowallonie sector study finds that most of the farmers sell through wholesales (e.g., Biofresh, Bionaturals), SFSCs with one intermediary (e.g., canteen kitchens like "cuisines bruxelloises"), direct selling without intermediaries or purchasing groups. Less frequently, their products are sold via distribution companies and big supermarkets (e.g., Carrefour, Delhaize). The sector study further shows that for most organic vegetables a price premium can be gained. The size of the premium nevertheless depends on the vegetable species. For example, a 1.9 times higher price could be gained for organic chicory or broccoli in Belgium in 2017 compared to their non-organic equivalents, while the premium was only 1.5 for carrots (Chavagne and Dombret 2021).

With respect to the political setting for vegetable farmers in Wallonia, the public service of Wallonia ("Wallonie service public") states that they aim to encourage the development of SFSCs to support the local economy and the relationship between consumers and producers (Public Service Wallonia n.d.). However, the situation of those farmers who are most dependent on SFSCs does not always align with this goal. DUMONT and BARET (2017) identify that "MGS producers feel that they do not earn enough money and half of them feel they lack any means of increasing their current income" (Dumont and Baret 2017, p. 59) and some even consider it as "impossible to live only on the income from vegetable production" (Dumont and Baret 2017, p. 60). The authors state that MGS producers lack viability in the market, while MGM producers are better protected as they preferably sell through channels that lead to less competition, for example farm stores and local markets compared to vegetable boxes used by MGS farmers. Contrary to MGS producers, the organic MGM producers are still able to increase their income and thus perceive the rather low vegetable prices as less negative. Similarly, MGL farmers seem to prefer the prices they can obtain in SFSCs whereas they think that prices in supermarkets are insufficient.

To summarise, the sector for the production of fresh vegetables for the market in the region of Wallonia is characterised by its mainly small-scale farmers and a large number of farmers following organic or agroecological principles. SFSCs are very relevant in this context, since they present the main marketing channels for most farmers across the different production systems, but especially for those small farmers.

4 DATA AND METHODS

In this section, the data collection process and the methods used to analyse the collected data are presented. First, the interviews with farmers from the target population are described, including a summary of the obtained results. Then, the research hypotheses derived from both the literature review and the farmer interviews are stated. To research these hypotheses, a survey composed of a questionnaire and a DCE was designed. The survey was issued from the beginning of March 2021 until mid-May 2021 in French as a self-administered online survey on the platform "lime survey", due to the restrictions of Covid-19 and to allow more flexibility to the farmers considering their time constraints. It was sent to overall 16 organisations[2] with access to a list of vegetable farmers in the designated area who distributed the survey to the farmers. Some overlap between the different contact lists is very likely. Both the questionnaire and the DCE are presented in more detail in the following. Lastly, the econometric analysis is elaborated.

4.1 Interviews

Between November 2020 and February 2021 four Belgian farmers were interviewed to get an insight into their views and opinions on organic certification, SFSCs and their marketing choices in general. The interviews were held online through video conferences on Zoom in English and French, depending on the farmer's preference and language skills. The interviewed producers vary in size and farming practices. Three farmers mainly produce vegetables and the fourth one focuses on the production of lamb meat while additionally farming fruit trees and beehives. Among the vegetable farmers, two produce on a very small area with 0.5 ha (production system of MGS) and one on a large area of 500 ha (production system of VFC) while the other producer farms on an area of 20 ha. The latter one is entirely organic certified and so is one of the MGS farmers, the other is not. The VFC farmer has an organic certification for 250 ha including their entire vegetable production.

[2] The organisations the survey was sent to: Biowallonie, Le Centre Interprofessionnel Maraîcher (CIM), Le Mouvement d'Action Paysanne (MAP), La Fédération Wallonne de l'Agriculture (Commission Productions Végétales), La Coopérative Bio de Hesbaye (CETA), Paysans Artisans, La Province de Liège, Le Centre provincial de l'agriculture et de ruralité du Brabant wallon, Hainaut Développement, L'Office Provincial Agricole de la Province de Namur, La ruche qui dit oui, Accueil Champêtre Wallonie, La Fédération Rurale Wallonne, Le GAL Culturalité, Maraicherensemble-pro (Facebook group), Agri-Info (Facebook group).

Table 4: Summary of the farmer interviews

	Benefits	Challenges
Organic Certification	• Assures organic standards to customers that do not know the producer/ without established relationship to producer • Allows access to niche markets • Products can be sold at a higher price	• Power of certification is not in the hands of the producers (top-down mechanism) • Farmers not allowed to justify their actions/ their specific situation is not considered • Obtained by many farmers with very different production techniques → does not reflect the actual production/ lacks to correctly inform consumer • Obtained premium only covers additional costs caused by the certification • Certification costs increase prices and make produce less affordable for consumers
PGS	• Active participation of farmers • More democratic, inclusive and social • More tolerant/ better adapted to farmers' situation • Specific production practices of participating farmers are reflected	• Currently not established in Wallonia • If higher standards decided, could potentially reduce farmers' decision freedom • Adds another label which could further confuse consumers
SFSCs	• More transparency • Consumer contact • Can communicate production standards to consumer • Foster mutual understanding • For CSA: reduced workload, higher income, higher planning security	• Comparably lower volumes sold to many buyers
Farmer cooperative	• Facilitates cooperation between farmers • Information and knowledge exchange	• Additional time requirements • Confrontations due to different opinions/ disagreements
Covid-19	• Increased number of customers (mainly during first lockdown)	

Table 4 provides an overview over the opinions the farmers stated during the interviews on the topics of organic certification, PGS, SFSCs, producer cooperatives and on the impact of the Covid-19 pandemic. With respect to organic certification, most farmers voiced a rather critical view. The MGS farmer without certification stated that they do not consider a label as necessary due to their close contact to the consumers via CSA. Furthermore, the farmer has a background of working in the certification industry and criticises that the power of the certification is not in the hands of the producer. They would prefer a more participatory approach like PGS as they assume it to be more tolerating and adapted to the actual situation of the farmers. But until this is established in practice, the costs are considered as too high. The organic certified MGS farmer states that their main motivation for getting certified was to assure organic standards to costumers that do not know them well, for example when selling at a local shop. They do not receive compensation or a premium due to the certification, but they do not mind as they would follow the required standards also without certification. Nevertheless, they mentioned that they prefer to have direct contact to the consumers to directly convey their farming methods to them as third-party certification is used by many farmers with different production standards so that the specific production behind the product is not fully reflected by the organic label. On the other hand, they fear that PGS, if they assure stricter standards than the EU label, would again restrict them and other farmers in their decision freedom. The livestock farmer is critical towards the organisation of the organic certification because it is top-down and does not consider the specific situation of the farmers and also does not allow them to justify their actions. Further, it was stressed that the premium received only allows to cover the additional costs incurred due to the certification. Additionally, the producer is strongly motivated to offer products of organic quality at affordable prices and hence criticises that the additional certification costs are in the end carried by the consumers. Instead, if the costs would be covered by the state, organic products could become more affordable. Thus, PGS are considered as a more democratic, inclusive and social system where producers can participate more actively and help set up the requirements.

The motivation of the VFC farmer for getting the organic certification focusses more on economic benefits as they saw the opportunity to enter a market with just very few producers in the late 90s, which allowed to sell the vegetables at a higher price. The value of this price premium received when selling the vegetables as organic depends on the vegetable species. With respect to leek, they do not consider this premium as very important because, as the farmer washes and packages the leek themselves, most of the added value results from these processing activities. For carrots and potatoes on the other hand, they earn 5 to 10% more on the selling

price thanks to the organic certification. Additionally, they gain a premium per hectare for organic production from the EU. In the farmer's opinion, the premium compensates for the certification costs, but they criticise that buyers issue lower prices because they know that the farmers receive these premiums. With respect to PGS, they were mostly not in favour because they think already too many labels exist and only confuse the consumers.

All interviewees sell exclusively through SFSCs, except for the VFC farmer, who is only marginally involved in SFSCs with selling a few boxes per week to small-scale clients. If SFSCs are well developed and would allow to sell at least 30% of the production to a small number of clients (for example to catering or public institutions), they would consider participating. The livestock farmer sells the produce through direct selling on-farm and via a cooperative shop. Both MGS farmers use CSA, one exclusively while the other also sells directly on-farm, at a farmers' market and via a farmer cooperative. The latter claims that this allows to reduce their workload and thus makes farming more compatible with their social life. Additionally, they can achieve around double of the price that other comparably small-scale farmers receive and benefit from higher income security due to the consumers paying in advance for an entire year.

All farmers highlight the importance of transparency and consumer contact and while the smaller farmers prefer closer relations and communication to foster mutual understanding, the VFC farmer focuses on the ability of the consumer to trace back the product to its grower.

All interviewed farmers are part of a producer group or cooperative. They all positively highlight the possibility for exchange of information and knowledge as well as the facilitation of general cooperation, for example for investments or bulk orders. As critical points, additional time requirements and confrontations between the farmers were stated.

When asked about the impact of the Covid-19 pandemic on their sales, the MGS farmers experienced rather positive impacts with respect to the number of customers, even though some of the additional consumers went back to buying in their previous supply channels after a while.

4.2 Research Hypotheses

In the following, the research hypotheses are derived from the findings in the literature review as well as from the insights gained during the farmer interviews discussed in detail in section 4.1. First, general hypotheses concerning farmers' preferences resulting from the attributes of SFSCs offered in the DCE are stated.

As mentioned before, MALAK-RAWLIKOWSKA et al. (2019) reveal that farmers see it as an advantage of long food supply chains that they allow to sell larger quantities compared to SFSCs. Two of the interviewed farmers also mentioned the importance of the selling volume for them, and specifically with respect to SFSCs, as they often do not allow to sell a large volume at once. This is also in line with RENTING et al. (2003) stating that the specific marketing structures of SFSCs make selling larger volumes more difficult. I therefore hypothesise that:

Hypothesis 1a. Farmers prefer to be able to sell larger volumes via SFSCs.

KIRWAN (2004)'s study shows that one of the main goals of participating in farmers' markets is to establish better relationships with the consumers. The research of KNEAFSEY et al. (2013) and STANCO et al. (2019) comes to similar results stating that direct contact to the consumer and building lasting relations is one of the core objectives for farmers to implement SFSCs. All interviewed farmers, whether they use SFSCs or not, highlight the importance they see in direct consumer contact and exchange. The farmers express an overall preference for the traceability of the products to the producer. I therefore hypothesise that:

Hypothesis 1b. Farmers prefer direct selling to consumers over no direct selling.

With respect to guarantee systems, all interviewed farmers advocate for more participatory approaches for guaranteeing production standards and say that they would prefer such mechanisms over the current standard of third-party certification. SACCHI (2019), who researched the adoption of PGS in Italy, finds that the participants implemented PGS schemes because they go beyond third-party certification and also support social sustainability. I therefore hypothesise that:

Hypothesis 1c. Farmers prefer internal control mechanisms over external control.

SPROUL and KROPP (2015) find that implementing CSA allows farmers to reduce financial risks and achieve higher planning security, since it requires financial commitment of its members before the harvest. Farmers who participate in CSA also highlight this as one of its advantages, alongside of lower time requirements for the producer due to the higher autonomy of the consumers (Samoggia et al. 2019). Further, the literature review as well as the farmer interviews reveal the importance of establishing a relationship to the consumer for the farmer, which is only possible if consumers commit to buying through a certain SFSC channel, for instance, direct selling on-farm or farmers' markets, for a longer period of time. I therefore hypothesise that:

Hypothesis 1d. Farmers prefer commitment of the buyers over no commitment.

Furthermore, hypotheses with respect to the expected heterogeneity in farmers' preferences resulting from their different characteristics are made.

RENTING et al. (2003) found that large volumes often do not work well with the specific marketing structures of SFSCs. One large scale producer (VFC) mentioned the importance of the volume several times within the interview while the other producers, who exclusively sold via SFSCs, did not talk much about the volume. One MGS only mentioned that they market part of their produce via a cooperative (besides several direct selling channels) to be able to sell a larger amount at once. I therefore hypothesise that:

Hypothesis 2a. For large farms (MGM, MGL, VFC) the assured volume sold under SFSCs is more important than for smaller farmers (MGS).

ZANASI et al. (2009) state that the high level of formality related to third-party certification leads to higher associated costs. Additionally, the third-party certification mechanism is not easily modified, less elastic and narrower in scope, which makes it less attractive to smaller farmers. Thus, internal control mechanisms which strongly decrease or even eliminate the costs of external control bodies and lower the requirements for paperwork would be especially interesting for those small farmers. Moreover, third-party certification allows to implement contracts at a bigger scale, making them more feasible for larger farms (López Cifuentes et al. 2018; Zanasi et al. 2009). I therefore hypothesise that:

Hypothesis 2b. Large farmers (MGM, MGL and VFC) have a higher preference for external control than smaller farmers (MGS).

As explained in section 3.1.2, authors generally find that younger, more educated farmers prefer selling through direct-to-consumer SFSCs (e.g., farmers' markets) as part of their strategy for diversification and risk-sharing, while less educated farmers prefer conventional channels (Benedek et al. 2018; Sammogia et al. 2019; Stanco et al. 2019). I therefore hypothesise that:

Hypothesis 2c. Younger and more educated farmers prefer direct selling to the consumer more than older and less educated farmers.

Finally, the literature review suggests that SFSCs in Europe are more frequently used by small-scale farmers compared to larger ones (Demartini et al. 2017; Kneafsey et al. 2013). Further, DUMONT and BARET (2017) show that large vegetable farmers in Wallonia frequently use farm shops to sell their vegetables while marketing channels with intermediaries, such as supermarkets, retailers or wholesalers, are also among the most important channels. For small-scale farmers, the main marketing channels are small farm stores for conventional farmers

whereas organic small-scale farmers frequently use farmer cooperatives or collective buying groups. With respect to the farmer interviews, all small-scale interviewees use direct selling channels, mostly on-farm but some also off-farm, whereas the VFC farmer does not sell through these channels. While the insights from DUMONT and BARET (2017) suggest a general preference for direct selling to the consumer for nearly all production systems, the additional results from the interviews indicate that this preference could be higher for small farmers. I therefore hypothesise that:

Hypothesis 2d. Small farmers (MGS) prefer direct selling more compared to large (MGM, MGL and VFC) farmers.

4.3 Questionnaire

The questionnaire was split into three modules regrouping questions on demographic, production and marketing characteristics of the participants. The questions on production and marketing were asked before the DCE while the demographic characteristics were collected afterwards. The questionnaire was split up to allow participants to start and end with questions that were relatively quick and simple to answer. The chosen questions are based on the literature review and the results of the face-to-face interviews. The overall number of questions was restricted to the ones necessary to answer the research questions to keep the survey as short as possible.

The questions in the module on the farmers' characteristics are presented in Appendix 1. They include the region of the farm, gender, age, education, farming experience with vegetables, the membership in a farmer cooperative and whether the farmer had an additional professional activity outside of agriculture (off-farm job).

For production characteristics, the vegetable area cultivated (in ha), number of vegetable species cultivated, farming activity besides vegetables, number of employees (FTE) as well as the farm total revenue (in € per year) and the approximate share of vegetables over the farm total revenue (in %) were asked (see Appendix 2). All these characteristics are needed to classify the farmers based on DUMONT (2017)'s production system classification (introduced in section 3.4). The offered answer options thus are also based on this classification. The options for farming activities besides vegetables are based on those most commonly mentioned in the conducted farmer interviews. All questions on production characteristics refer to the production period in 2020.

Instead of asking for farmers' income, the farm's total revenue was used for several reasons. Firstly, it gives an indication of the farm's size and efficiency in addition to the vegetable area cultivated. Further, farmers do not always know how much they earn personally as a salary and thus might struggle to indicate a number, while we assume they generally know their total farm revenue. The concept of farm total revenue ("chiffre d'affaire") is additionally well known and understood by farmers in Wallonia (Dumont 2017). The share of vegetables on the farm total revenue was added to understand how important vegetable production is for the producer.

Marketing characteristics, as presented in Appendix 3, concern organic certification for vegetables and commercialisation channels used for vegetable sales (allowing for conventional channels such as supermarkets as well as for SFSCs like farmers' markets) in 2020. Moreover, two questions concerning the impact of the Covid-19 crisis on the share of the vegetable production sold through SFSCs compared to 2019 were asked.

4.4 Discrete Choice Experiment

To analyse farmers' preferences for SFSCs and their attributes, a DCE was conducted as part of the survey. Choice experiments are grounded on Lancaster's theory of consumer choice (Lancaster 1966), which states that consumer decisions are based on the utility generated from the specific attributes of the consumed good, and not from the good itself. In this case, it is assumed that farmers' decisions for or against a specific marketing channel depend on their different attributes. In the following, the design and implementation process of the DCE as well as the attributes and levels are described.

4.4.1 Design and Implementation

Choice experiments are designed to consist of several alternative options of a good (in this case a SFSC), each characterised by a number of attributes with different levels that describe the good. Under the assumption that respondents behave as utility maximisers, they would choose the combination of attributes that allows them to achieve the highest utility level (Schipmann and Qaim 2011).

To design the choice cards and blocks, the software Ngene was used. Overall, 12 choice cards were generated and distributed into two blocks (for an example of a choice card, see Appendix 4). Thus, each participant was offered six choice cards of one block to answer. The number of blocks was limited to two because a small sample size was expected due to an overall higher

difficulty to reach farmers compared to consumers, especially in high-income countries, to participate in surveys. Like this, it is more likely to achieve a reasonable number of respondents per block (Chèze et al. 2020). A D-efficient design was applied that requires prior information on the parameters which in turn allow to generate smaller standard errors compared to orthogonal designs. Those prior values were assigned to each attribute level based on the findings of the literature review, interviews and hypotheses (for the syntax, see Appendix 5).

In the econometric analysis, an alternative-specific constant (ASC) is included. The ASC shows the preferences for the opt-out option (Oyinbo et al. 2019). It "captures the average effect of all factors that influence opt-out choices that are not included in the utility specification" (Campbell and Erdem 2019, p. 4). Still, interpreting the utility of the ASC should be treated with caution as it includes several impacts, among them also those of unobserved attributes (Campbell and Erdem 2019). Here, the ASC is coded 1 for the SFSC scenarios and 0 for the opt-out option. Thus, a negative coefficient indicates a negative utility for adding another supply chain to the farmers' marketing channels compared to only maintaining the already existing channels. A positive ASC, in contrast, implies a preference for adding another SFSC to the existing marketing channels.

4.4.2 Attributes and Levels

For the DCE, participants were asked to imagine that they were offered the possibility to sell part of their vegetable production through a new SFSC as of tomorrow. This new SFSC would be characterised by five attributes: the vegetable volume sold under the new SFSC, the relative selling price of vegetables sold through this channel, the control mechanism and label required, the input of the producer into the direct marketing of the vegetables and the commitment of buyers. Each participant was offered six choice cards and had to choose between three options every time, two new SFSCs and a complete opt-out option. For the complete opt-out option (i.e., none of the two alternatives), all attributes of this alternative are set to zero (Campbell and Erdem 2019). After answering the choice cards, the respondents were asked to answer two more questions as a robustness check: (1) which was the attribute they focused on most and (2) whether they ignored one attribute while answering and if yes, which one.

Table 5 gives an overview over the DCE attributes and their levels which were chosen based on the results from the literature review and the face-to-face interviews with farmers. The number of attributes was restricted to five to avoid overloading the participants with different

possibilities and to consider their time constraint while answering. In the following, each attribute is described in detail.

Table 5: Attributes and attribute levels in the discrete choice experiment

Attribute	Attribute Levels
Vegetable volume sold under SFSC	20%
	50%
	80%
Relative selling price	Market price – 10%
	Market price (no premium)
	Market price + 10%
	Market price + 20%
Control and label	No control
	Internal control without label
	Internal control with label
	External control with label
Marketing of the vegetables	Production only without additional marketing activities
	Direct selling on-farm
	Direct selling off-farm
Commitment of buyers	No commitment of buyers
	Commitment of buyers

The vegetable volume sold describes the approximate part of the total vegetable production that the farmer could sell in the new SFSC. The remaining volume would be sold through their current channels. The attribute levels were set to 20, 50 and 80% to determine if farmers have a general preference for selling the majority of their production through one channel or rather prefer using diverse channels with lower volumes each. As mentioned by one of the interviewed farmers, some producers, especially large ones, might require a certain minimum volume to consider selling through SFSCs as interesting or profitable. Further, the volume was chosen as an attribute because in the literature the low volumes sold per each channel were mentioned as one of the challenges related to SFSCs.

The second attribute is the relative selling price, compared to the market price without certification premiums, which can be obtained when selling vegetables through the new SFSC. Four levels were chosen, a negative premium (-10%), no premium (market price) and two

positive premiums (+10% and +20%). Similar possible variations in the prices were also reported by the interviewed farmers.

The third attribute, control and label, concerns the control mechanism for the farmer's agricultural practices in the vegetable production without considering specific requirements (focus on the importance of the mechanism itself). The attribute consists of four levels. For no control, farmers are not obliged to respects specific production standards and are able to implement their preferred production practices (e.g., conventional, organic, agroecological, etc.). For internal control without label, the producers are required to comply with certain production standards which are determined in a participatory procedure by the producers, consumers and other actors in the chain. The compliance is controlled internally by some of these actors and no label is issued. On the other hand, internal control with label is the same but issues a label. The last level is external control with label. The producers are required to comply with certain production standards which are determined by an external organisation (e.g., the EU organic certification). The compliance is controlled by a third party and a label is issued. It is assumed that if the level of control is internal control with or without label, the price premium cannot be negative and if the level is external control, the premium cannot be negative or no premium.

Attribute number four, the marketing of the vegetables, is about the commercial activities carried out by the producer himself and the direct commercialisation to the consumer. The attribute has three levels. For production only without any additional marketing activities, the commercialisation is exercised by an external organisation (e.g., cooperative, purchasing group, etc.) and the farmer has no direct contact with the consumer. Direct selling on farm (e.g., pick-your-own schemes, farm shop) allows direct contact and the possibility of exchange between the producer and consumer. The last level, direct selling off-farm (e.g., farmers' market), also offers the possibility of exchange between the producer and consumer but the selling occurs at an off-farm location. This attribute aims to describe typical SFSCs based on the number of intermediaries involved, the possibility of direct contact to the consumer and the selling point.

The fifth attribute is the commitment of the buyers, including consumers and intermediaries. It has two levels, no commitment and commitment of the buyers concerning a volume, frequency and price for the vegetables that they agree on before harvest.

A few attributes were considered first but were not included in the final DCE to reduce its complexity and thus the difficulty for participants to choose between the alternatives. One initial attribute was the collaboration with other farmers, for example through membership in a farmer

cooperative. The relation to other farmers was mentioned in several of the interviews and studies highlighted its importance for knowledge exchange. This attribute was not included as this thesis aims to focus more on the relation between farmers and consumers. Further, farmers' valuation of their relation to other farmers might also be partly revealed within their choice of the control mechanism, as for example internal control is based on cooperation and interaction between farmers. Another attribute that was not included is additional time requirements. This is an important factor when researching SFSCs as they often impose additional activities on farmers which in turn require additional time investments. When designing the attribute, several difficulties were encountered. For example, mentioning specific times (e.g., hours per week/month) was challenging as farmers already struggled to indicate their time used outside of production, therefore it was considered unlikely that they could properly consider these in their decision process. Still, by referring to the selling location (on- or off-farm) and direct contact with consumers, the fourth attribute (marketing of the vegetables) already captures part of this time requirement constraint.

4.5 Econometric Analysis

The econometric analysis of choice experiments is grounded in Lancaster's theory of consumer choice and random utility theory. The theory of consumer choice states that the overall utility of a good is composed of all utilities derived from its characteristics which separately influence consumers' preferences (Lancaster 1966). Random utility theory implies that the utility from a good is divided into two parts. The first one is the deterministic (explainable) component, which depends on the attributes of the good and is composed by an individual-specific and a choice-specific part. The second one is the stochastic (random or unexplainable) component which captures unobservable factors determining the choice of an individual (McFadden 1974; Train 2009). This is illustrated by the following equation:

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \beta X_j + \alpha Z_i + \varepsilon_{ij} \quad (1)$$

with U_{ij} as the utility of farmer i from alternative j. V_{ij} represents the deterministic part while ε_{ij} stands for the stochastic part. The deterministic component V_{ij} can be split into X_j, a vector of the attributes of alternative j and Z_i, a vector of the characteristics of farmer i. β and α are the coefficients associated with these vectors (McFadden 1974; Train 2009).

The welfare estimates for the SFSC attribute levels, i.e., willingness to accept (WTA) values, are obtained from the estimated coefficients as:

$$marginal\ WTA = -\frac{\beta_{attribute}}{\beta_{price}} \quad (2)$$

Positive WTA values indicate the price increase needed for farmers to accept the specific attribute level. Negative values on the other hand represent how much the price could be reduced while the farmers would still accept the attribute level.

Dummy and effects coding were tested and both came to similar results, allowing the assumption that a dummy-trap is not present. Therefore, dummy-coding was implemented to allow for a simpler interpretation (Van den Broeck et al. 2017).

4.5.1 Conditional and Mixed Logit Model

As a starting point for the econometric analysis, a simple conditional logit (CL) model is used to analyse the preferences for the SFSC attributes expressed by the participants. In addition to the CL model, a mixed logit (MXL) model is used because heterogeneity in farmers' preferences for SFSC attributes is expected.

Compared to standard logit models like the CL model, the use of MXL models has several advantages. MXL models consider the existence of heterogeneity among the respondents by allowing the preferences to be randomly distributed around the coefficients' mean values. This means that MXL models estimate the mean of the coefficients as well as the standard deviation (SD) of their distribution around the mean value. A significant SD for a specific attribute indicates that preferences are heterogenous (Greene and Hensher 2003; Train 2009).

The following equation specifies the choice probability in a MXL model:

$$P_{ijt} = \frac{\exp(\beta_i X_{ijt})}{\sum_{j=1}^{J_i} \exp(\beta_i X_{ijt})}; \text{ and } \beta_i = \beta + \Delta z_i + \varepsilon_i \quad (3)$$

Alternative j (of J_i alternatives) on choice card t is chosen by individual i with the probability P. The individuals' preferences for the different attributes X_{jt} are expressed by a vector of the associated coefficients β_i. The equation further includes a vector of the standard deviations z_i and the error term ε_i (Greene and Hensher 2003; Train 2009).

All attributes, including the ASC and price, are defined as random parameters and as normally distributed in the sample. For the price attribute it is often assumed that there is a homogenous preference for higher prices. To test whether this is a reasonable assumption for this sample, the MXL model was ran both with price defined as random and non-random. As the SD of the price attribute turned out to be significant, the price was included as a random parameter (see

Appendix 6, Table A1). In all models, 5000 Halton draws were used and 100 initial draws were burned. Additionally, a MXL model on split-samples (organic/non-organic and small/large farms) was used as an approach to research the heterogeneity in preferences in the sample. Due to computational issues resulting from the low sample size in the subgroups of non-organic and large-scale farmers (MGM, MGL and VFC), these models were not included in the analysis.

To further research the origin of possible preference heterogeneity, interaction terms were added into the MXL model. The choice of the interactions (see Appendix 7) is based on the results of the simple MXL model and the hypotheses presented in section 4.2. To minimalise the risk of ordering effects, a maximum of three interactions was added in one model. Ordering effects describe the impact of the order in which variables enter the model on the estimated coefficients. In theory, this order should not influence the coefficients but the simulation noise in the procedure allows an influence in practice, especially when the number of draws is small (Palma et al. 2020). To check the robustness of the model against ordering effects, the order of the added terms was changed within the model. This robustness check revealed a strong impact of ordering effects on the MXL coefficients, therefore the MXL model with interaction terms was excluded from the analysis.

Another possible source of bias can result from attribute non-attendance (ANA) implying that the respondents do not consider all attributes while making their choices in the DCE (Coffie et al. 2016; Kragt 2013). It is possible that the farmers do not trade-off between all SFSC attributes in the experiment (Caputo et al. 2018). To check for ANA, the farmers were asked to state whether they ignored an attribute while making their choice (stated ANA), and in that case, which one was ignored. An ANA model is estimated by restricting the parameters of attributes stated as ignored to zero. This implies that ANA of a participant causes a marginal utility of zero for the ignored attribute (Kragt 2013). The results of the ANA model do not significantly differ from the MXL model (see Appendix 8), thus the MXL model appears to be robust against ANA.

4.5.2 Latent Class Model

A latent class (LC) model is estimated to explore the preference heterogeneity of the farmers in the sample due to the problems of bias and computational issues incurred with the MXL model on split-samples and the MXL with interaction terms. The LC model assumes that the farmer population is heterogenous in their preferences and can be separated into a discrete number of latent classes. For each class, the producers have a positive membership probability.

Preferences within a latent class are homogenous while preferences across classes are heterogenous. Therefore, the probability that farmer i chooses alternative j on choice card t is now conditional on their membership in a latent class c (Greene and Hensher 2003; Kragt and Llewellyn 2014; Oyinbo et al. 2019):

$$P_{ijt}|c = \frac{\exp\left(\beta_c X_{ijt}\right)}{\sum_{j=1}^{J_i} \exp\left(\beta_c X_{ijt}\right)} \quad (4)$$

In accordance with the Consistent Akaike Information Criteria (CAIC = 869) and the Bayesian Information Criteria (BIC = 848), two is the optimal number of classes for this model.

5 RESULTS

This section presents the results obtained from the survey. First, descriptive statistics are presented, including the farmer characteristics as well as their production and marketing strategies. Then, the results of the econometric analysis, as described in section 4.5, are illustrated.

5.1 Descriptive Statistics

With the questionnaire included in the survey (see section 4.3 and Appendix 1 – 3), an extensive overview over the characteristics of the participating farmers was obtained. The distribution of the characteristics is shown for the full sample (n=78), as well as the subgroups of organic (n=59) and non-organic farmers (n=19). While quantitative data on organic vegetable farmers selling on the fresh market in Wallonia is available, there is a lack of information about the population of non-organic farmers in this sector. Therefore, it is not clear how well the sample represents this subgroup. Nonetheless, a first insight into the characteristics of those farmers can be gained. Additional information about the characteristics of the subgroups of small-scale farms (MGS) (n=55) and large-scale farms (MGM, MGL and VFC) (n=23) are presented in Appendix 9, 10 and 11.

5.1.1 Farmer Characteristics

Table 6 presents the characteristics of the farmers in the sample. Most of the participants' farms are situated in Liège, followed by Brabant wallon, Hainaut and Namur while a significantly higher share of non-organic farmers is situated in Liège. With 71.8% the majority of the sample is male. Among non-organic farmers, the share of women is significantly higher with 42.1% compared to 22% for the organic farmers. Comparing MGS and large farms, the share of women is significantly higher among the MGS farms (34.5% compared to 8.7%). The producers are very well educated as around 80% have a Bachelor's degree or higher. The farmers in the sample are on average 44.82 years old and have an average farming experience of 10.68 years. For both age and farming experience, relatively large SDs of 10.85 years for age and 9.14 years for farming experience emphasise the heterogeneity of the population. 39.7% of the producers have a farming experience with vegetables of five years or less, indicating that the fresh vegetable sector appears to be attractive to new farmers.

Compared to organic farmers, non-organic farmers are significantly younger (mean of 38.05 years compared to 47 years for the organic farmers) and have less farming experience (mean of 6.58 years compared to 12 years for the organic farmers). The on average younger age likely causes the farmers to have less farming experience. Furthermore, it could indicate that many new farmers do not opt for an organic certification, which might be based on them rejecting the standards required for the certification, the certification mechanism in general or simply a lack of necessity for getting certified. A significant difference in the farming experience was also found when comparing the production systems, with an average of 8.02 years for MGS farms and 17.04 years for large farms.

Cooperative membership is quite common for vegetable farmers (41%), especially for organic (47.5% compared to 21.1% in the non-organic subgroup) and large-scale ones (60.9% compared to 32.7% in the subgroup of MGS farms). This indicates that a group of organic, but especially larger farmers in this sector, have a preference for cooperative memberships. GRASHUIS and SU (2019) conducted a literature review on farmer cooperatives and conclude that benefits are unevenly distributed between small and large farmers. Their review finds evidence both for more positive benefits gained by small farmers as well as more beneficial impacts on larger farmers, depending on the study. Thus, the higher share of large-scale farmers with a cooperative membership in the sample could indicate that in Wallonia, the benefits of cooperatives are higher for large farms. Additionally, as mentioned by one of the interviewed farmers, some cooperatives require organic certification for their members which could explain the higher share of organic farmers.

Lastly, about a third of the farmers have an off-farm job, which suggests that vegetable farming alone does not always allow farmers to sustain their livelihood. Interestingly, while 49.1% of the farmers in the MGS production system have an off-farm job, none of the large farmers indicated this. This shows that the size of the cultivated area of many MGS farmers might simply be too small to produce a volume that allows them to gain sufficient revenues. Therefore, other motives aside from profit are relevant for those farmers when deciding to produce vegetables, which is supported by statements from the interviewed farmers expressing a focus on social and environmental aspects of agriculture and their wish to contribute to respective improvements.

Table 6: Farmer characteristics

Variable	**Full sample (n=78)**		**Organic farmers (n=59)**		**Non-organic farmers (n=19)**		
	Mean	SD	Mean	SD	Mean	SD	
Age *(years)*	44.82	10.85	47.00	10.49	38.05	9.23	***
Farming experience with vegetables *(years)*	10.68	9.14	12.00	9.32	6.58	7.33	**
	Nb	%	Nb	%	Nb	%	
Region							
Liège	22	28.2%	13	22.0%	9	47.4%	**
Brabant wallon	18	23.1%	16	27.1%	2	10.5%	
Hainaut	16	20.5%	11	18.6%	5	26.3%	
Namur	13	16.7%	12	20.3%	1	5.3%	
Luxembourg	6	7.7%	5	8.5%	1	5.3%	
Region Brussels	3	3.8%	2	3.4%	1	5.3%	
Gender							
Male	56	71.8%	45	76.3%	11	57.9%	
Female	21	26.9%	13	22.0%	8	42.1%	*
Other	1	1.3%	1	1.7%	-	-	
Education							
Primary	1	1.3%	1	1.7%	-	-	
Secondary	15	19.2%	11	18.6%	4	21.1%	
Bachelor	27	34.6%	22	37.3%	5	26.3%	
Master or higher	35	44.9%	25	42.4%	10	52.6%	
Membership in farmer cooperative *(dummy)*	32	41.0%	28	47.5%	4	21.1%	**
Off-farm job *(dummy)*	27	34.6%	18	30.5%	9	47.4%	

Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

5.1.2 Production and Marketing Characteristics

Table 7 presents the production characteristics of the farmers for the year 2020. An average vegetable area of 12.78 ha is cultivated by the producers. It is important to notice the high SD of 39.64 resulting from the big differences in area farmed within the sample, especially due to a group of farmers with large farms (n=23 farmers with an average vegetable area of 41.41 ha) and opposing many very small farmers (n=55 with a vegetable area below 2.5 ha and an average area of 0.81 ha). Nearly half of the sample had a total revenue of less than €70,000, 20.5% earned between €70,000 and 150,000 and 11.5% between €150,000 to 300,000. Only 11.6% of the participants earned more than €300,000 of total revenue, while 9% were not willing to answer the question. All farmers in the non-organic sample had a total revenue below €150,000 in 2020, excluding two non-responses. A significantly higher share of non-organic farmers is in the total revenue category of less than €70,000 while in the organic subgroup the share of farmers in the revenue categories of €70,000 to 150,000 per year and €150,000 to 300,000 per year is higher. The average share of vegetables at the total revenue was 68.05%, again exhibiting a large SD of 28.68. This is similar in both subgroups. Over half of the producers grow more than 30 vegetable species and 28.2% grow between ten and 30 different species with a similar distribution in the two subgroups. In general, the producers in the sample employed rather few employees. In 2020, 75.6% only employed less than three FTEs and 14.1% employed between four and six. Significant differences between the subgroups can be found as all non-organic farmers fall in the category of employing less than three FTEs and among organic farmers significantly more belong in the category of employing four to six workers.

The biggest part of the sample (61.5%) participates in other farming activities besides vegetables, such as growing fruit (37.2%), cereal (19.2%) or livestock (16.7%). 12.8% mentioned other farming activities which mainly include growing potatoes, beets or sugar beets. The adoption of additional production activities likely results from farmers trying to diversify their production as a strategy to increase their revenue. Significantly more organic farmers additionally grew fruits while a higher share of non-organic farmers mentioned other farming activities, for example growing potatoes. This could on the one hand reflect positive consumer preferences for buying fruit or vegetables in organic quality (Saba and Messina 2003) and on the other hand result from the higher difficulty of farming plants like potatoes without chemicals as required by the organic standards (Finckh et al. 2006).

With respect to the production systems, the producers in the sample were classified according to DUMONT (2017) (see section 3.4). Due to overlapping definitions of this classification, the

following differentiation was made for our sample: MGS farmers are defined as producers farming on a vegetable area smaller than 2.5 ha, MGM on an area between 2.5 and 10 ha, MGL on more than 10 and up to 30 ha and VFC as farmers with a vegetable area above 30 ha. The distinction was mainly based on the size of the vegetable area but for the overlapping areas in the definition, the number of employees and number of vegetable species grown were additionally considered. One farmer was classified differently as they did not match with this grouping. With a vegetable area of 2 ha, they would have been part of the MGS farmers, but as they employed seven to ten FTEs and grew more than 30 vegetables, they were classified as MGM. Overall, the sector for fresh vegetables in Wallonia seems to be dominated by very small-scale farmers under the category of MGS (n=55) while a few middle scale MGM (n=9) and larger MGL (n=7) as well as VFC farms (n=7) exist.

The comparison between small and large farmers reveals that significantly more MGS farmers fall into the total revenue category of less than €70,000 per year (67.3% compared to none among large farmers) while more large farmers are in the categories of a total revenue of €300,000 and above (39.1% compared to none in the MGS subgroup). Further, a higher share of large farmers chose not to indicate their total revenue (26.1% compared to 1.8%, i.e., one farmer among MGS farmers). For the small farmers, vegetables make up a larger share of their total revenue, 74.05% compared to 53.7% for large farmers. While MGS farmers cultivate significantly more vegetable species (65.5% cultivate more than 30 species compared to 34.8% among large farms), the other production systems grow significantly more often only between one to ten species (43.5% compared to 3.6% for MGS). Significant differences between the subgroups are also found for the number of employees, as MGS farmers more often employ no to three FTEs (92.7%) and large farms employ significantly more employees (30.4% have four to six, 21.7% seven to ten and 13% have more than ten FTEs). Furthermore, only producing vegetables is significantly more common for MGS farmers (50.9%) than for large farms (8.7%), whereas the production of cereal, livestock and other products, mainly beets, sugar beets and potatoes, are more present among large farmers.

Table 7: Production characteristics

Variable	**Full sample (n=78)**		**Organic farmers (n=59)**		**Non-organic farmers (n=19)**		
	Nb/ **Mean**	%/ **SD**	Nb/ **Mean**	%/ **SD**	Nb/ **Mean**	%/ **SD**	
Vegetable area cultivated in 2020 *(ha)*	**12.78**	**39.64**	**15.94**	**45.00**	**2.96**	**7.91**	
Total revenue in 2020 *(€/year)*							
< 70,000	37	47.4%	21	35.6%	16	84.2%	***
70,000 – 150,000	16	20.5%	15	25.4%	1	5.3%	*
150,000 – 300,000	9	11.5%	9	15.3%	-	-	*
300,000 – 600,000	2	2.6%	2	3.4%	-	-	
> 600,000	7	9.0%	7	11.9%	-	-	
No answer	7	9.0%	5	8.5%	2	10.5%	
Vegetable share at total revenue *(%)*	**68.05**	**28.68**	**67.58**	**29.36**	**69.53**	**27.17**	
Number of vegetable species cultivated in 2020							
1 – 10	12	15.4%	9	15.3%	3	15.8%	
10 – 30	22	28.2%	16	27.1%	6	31.6%	
> 30	44	56.4%	34	57.6%	10	52.6%	
Number of employees in 2020 *(FTE)*[a]							
0 – 3	59	75.6%	40	67.8%	19	100%	***
4 – 6	11	14.1%	11	18.6%	-	-	**
7 – 10	5	6.4%	5	8.5%	-	-	
> 10	3	3.8%	3	5.1%	-	-	

[a]: Full-time equivalent (FTE)
Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

Table 7 ***Continued.***

Variable	**Full sample (n=78)**		**Organic farmers (n=59)**		**Non-organic farmers (n=19)**		
	Nb	%	Nb	%	Nb	%	
Produces only vegetables *(dummy)*	30	38.5%	20	33.9%	10	52.6%	
Produces fruit *(dummy)*	29	37.2%	25	42.4%	4	21.1%	*
Produces cereal *(dummy)*	15	19.2%	12	20.3%	3	15.8%	
Produces livestock *(dummy)*	13	16.7%	11	18.6%	2	10.5%	
Other production activities *(dummy)*	10	12.8%	5	8.5%	5	26.3%	**
Production system[b]							
Market gardening on small areas (MGS)	55	70.5%	39	66.1%	16	84.2%	
Market gardening on medium areas (MGM)	9	11.5%	8	13.6%	1	5.3%	
Market gardening on large areas (MGL)	7	9.0%	6	10.2%	1	5.3%	
Growing vegetables in combination with field crops (VFC)	7	9.0%	6	10.2%	1	5.3%	

[b]: see classification in section 3.4 .

Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

Table 8: Marketing characteristics

Variable	**Full sample (n=78)**		**Organic farmers (n=59)**		**Non-organic farmers (n=19)**		
	Nb	%	Nb	%	Nb	%	
Organic certification for vegetables *(dummy)*	59	75.6%	59	100%	-	-	
Organic certified vegetable area conditional on being certified *(%)*							
1 – 25	1	1.7%	1	1.7%	-	-	
26 – 50	5	8.5%	5	8.5%	-	-	
51 – 75	1	1.7%	1	1.7%	-	-	
76 – 100	52	88.1%	52	88.1%	-	-	
Previous organic certification conditional on not being certified *(dummy)*	2	10.5%	-	-	2	10.5%	
SFSC sales in March - June 2020[c]							
Sold less *(dummy)*	4	5.2%	2	3.4%	2	10.5%	
Sold the same amount *(dummy)*	37	47.4%	27	45.8%	10	52.6%	
Sold more *(dummy)*	37	47.4%	30	50.8%	7	36.8%	
SFSC sales after March - June 2020[c]							
Sold less *(dummy)*	5	6.4%	2	3.4%	3	15.8%	*
Sold the same amount *(dummy)*	50	64.1%	38	64.4%	12	63.2%	
Sold more *(dummy)*	23	29.5%	19	32.2%	4	21.0%	

Note: All numbers refer to the year 2020.
[c]: Refers to the impact of Covid-19 on the sales through SFSCs during the first lockdown from March to June 2020 and after the first lockdown.
Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

Table 8 ***Continued.***

Variable	**Full sample (n=78)**		**Organic farmers (n=59)**		**Non-organic farmers (n=19)**		
	Nb/ Mean	**%** / SD	**Nb**/ Mean	**%** / SD	**Nb**/ Mean	**%** / SD	
Number of commercialisation channels used	3.04	1.34	3.14	1.40	2.74	1.15	
Sells via on-farm channels *(dummy)*	**57**	**73.1%**	**40**	**67.8%**	**17**	**89.5%**	*****
Share sold on-farm *(%)*	47.74	29.68	43.40	29.04	57.94	29.51	*****
Sells via local shops *(dummy)*	**42**	**53.8%**	**34**	**57.6%**	**8**	**42.1%**	
Share sold via local shops *(%)*	25.07	22.78	23.64	20.62	31.00	31.16	
Sells via box schemes *(dummy)*	**35**	**44.9%**	**30**	**50.8%**	**5**	**26.3%**	*****
Share sold via box schemes *(%)*	39.94	26.54	42.41	27.39	25.60	16.10	
Sells to restaurants *(dummy)*	**30**	**38.5%**	**23**	**39%**	**7**	**36.8%**	
Share sold to restaurants *(%)*	18.00	13.26	15.96	11.49	24.71	17.23	
Sells via cooperatives *(dummy)*	**25**	**32.1%**	**20**	**33.9%**	**5**	**26.3%**	
Share sold via cooperatives *(%)*	25.44	22.45	28.70	23.84	12.40	7.67	
Sells on farmers' markets *(dummy)*	**18**	**23.1%**	**14**	**23.7%**	**4**	**21.1%**	
Share sold on farmers' markets *(%)*	32.78	26.90	35.07	28.10	24.75	23.82	
Sells via distribution companies *(dummy)*	**9**	**11.5%**	**8**	**13.6%**	**1**	**5.3%**	
Share sold via distribution companies *(%)*	42.50	43.42	37.29	44.12	79.00	0.00	
Sells via supermarkets *(dummy)*	**8**	**10.3%**	**5**	**8.5%**	**3**	**15.8%**	
Share sold via supermarkets *(%)*	37.88	32.87	52.00	33.65	14.33	13.65	
Sells via local institutions *(dummy)*	**8**	**10.3%**	**8**	**13.6%**	**-**	**-**	
Share sold via local institutions *(%)*	6.00	5.88	6	5.88	-	-	
Sells via public markets *(dummy)*	**4**	**5.1%**	**3**	**5.1%**	**1**	**5.3%**	
Share sold via public markets *(%)*	40.75	9.78	42.67	11.02	35.00	0.00	
Sells via auctions *(dummy)*	**1**	**1.3%**	**-**	**-**	**1**	**5.3%**	
Share sold via auctions *(%)*	50.00	0.00	-	-	50.00	0.00	

Note: All numbers refer to the year 2020. The share sold via a specific channel is conditional on participating in this channel.
Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

Table 8 summarises the farmers' marketing characteristics for the year 2020, including organic certification, the impact of Covid-19 and their marketing channels. About 75% of the producers were organic certified, of which 88.1% had between 76 and 100% of their vegetable area under certification. Of the non-organic farmers, only two were previously certified.

The majority of farmers used a variety of commercialisation channels to sell their vegetables, with an average of three channels used, indicating that a diversification of selling channels is important for the farmers. A minimum of one channel was used by 11.5% of farmers – mostly on-farm channels – while a maximum of seven channels were used by two producers. Non-organic farmers more frequently sold via only one channel while in comparison, organic farmers regularly sold through five or even up to seven channels (but no significant difference).

The most frequently used channels are on-farm channels (73.1%), local shops (53.8%) and box schemes (44.9%) followed by restaurants (38.5%), producer cooperatives (32.1%) and farmers' markets (23.1%). The farmers less frequently marketed their vegetables through distribution companies (11.5%), supermarkets (10.3%), local institutions (10.3%) and public markets (5.1%). This emphasises the importance of SFSCs over longer chains for selling fresh vegetables in Wallonia. With respect to the share[3] of the farmers' vegetable production sold through the different marketing channels, on average the largest volume is sold through on-farm channels (47.74%). Respectively, a mean of 42.5% of the vegetable production was sold via distribution companies, 39.94% via box schemes and 37.88% via supermarkets. Auctions were only used by one farmer to market 50% of their vegetables. This farmer said that auctions only take place in Flanders and require the farmers to pay a fee for participating. This explains why no other participants sold through auctions. Similarly, a low use of auctions was found by the Biowallonie sector study (Chavagne and Dombret 2021).

With respect to the marketing channels, significant differences between organic and non-organic farmers can be found. Firstly, a significantly higher share of organic farmers sells through box schemes. Further, a larger share of non-organic farmers (89.5% compared to 67.8% of organic farmers) markets via on-farm channels and, on average, also sells a larger volume through this type of channel (57.94% compared to 43.4% in the organic subgroup). Thus, it could be assumed that some of the non-organic farmers do not obtain a certification as they are able to credibly convey their production standards through direct contact to consumers.

[3] The share is conditional on using the channel.

Between small and large farms, significant differences were found as well. MGS farmers more frequently use on-farm channels (80% compared to 56.5% for large farms) and box schemes (52.7% compared to 26.1% for large farms), while large-scale farmers sell more often through distribution companies (30.4% compared to 3.6% for MGS) and supermarkets (30.4% compared to 1.8% for MGS). Additionally, a larger share in the subgroup of large farmers sells via local shops (73.9% compared to 45.5% for MGS) but MGS farmers sell a higher share of their production volume through this channel (29.8% compared to 17.69% for large farms).

With respect to the Covid-19 pandemic, farmers state that during the first lockdown from March to June 2020, they mostly sold the same amount (47.4%) or more (47.4%) compared to 2019. Similarly, BENEDEK et al. (2021) find that higher sales were achieved by 26% of the small-scale farmers in their sample (from overall 421 observations from four European countries) during the first Covid-19 wave from around March to June 2020. As indicated by interviewed farmers, consumers were more suspicious of buying through their normal channels such as supermarkets, as their concern for safety during the shopping process as well as regarding the safety of the food sold increased. Likewise, BUTU et al. 2020 mention that "consumers avoid shopping at grocery stores, farmers' markets and/or supermarkets which were often crowded during the pandemic" (Butu et al. 2020, p. 18). Nevertheless, after the first lockdown, the number of farmers experiencing an increase in their SFSC sales decreased to 29.5%, indicating that this boost in sales was only for the short term. Further studies will be needed to examine whether a significant number of consumers will change their buying channels for the long term due to this shock or whether the impact will be lost completely. Additionally, a significantly higher share of non-organic producers (15.8% compared to 3.4% in the organic subgroup) stated that they sold less through SFSCs after the first lockdown compared to 2019. This might be related to the higher share of non-organic farmers selling via on-farm channels and consumers returning to their previous longer channels after the lockdown.

5.1.3 Stated Attribute Preferences

With respect to the DCE, the participants were asked to indicate which attribute they focussed on the most while making their choice and whether they ignored any of the attributes.

Table 9: Farmers' attribute preferences

Variable	**Full sample (n=78)**		**Organic farmers (n=59)**		**Non-organic farmers (n=19)**		
	Nb	**%**	**Nb**	**%**	**Nb**	**%**	
Preferred Attribute							
Price	28	35.9%	23	39.0%	5	26.3%	
Commitment	17	21.8%	8	13.6%	9	47.4%	***
Volume	15	19.2%	12	20.3%	3	15.8%	
Control	10	12.8%	10	16.9%	-	-	*
Marketing	8	10.3%	6	10.2%	2	10.5%	
Ignored Attribute							
None	51	65.4%	36	61.0%	15	78.9%	
Volume	7	9.0%	7	11.8%	-	-	
Commitment	6	7.7%	5	8.5%	1	5.3%	
Marketing	6	7.7%	3	5.1%	3	15.8%	
Control	5	6.4%	5	8.5%	-	-	
Price	3	3.8%	3	5.1%	-	-	

Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables).

Table 9 shows the results for farmers' attribute preferences as stated by themselves. There is no common preference for one attribute. The attribute preferred by the largest group of producers (35.9%) is the price attribute, followed by commitment (21.8%) and volume (19.2%). Only 12.8% indicated that they preferred the control attribute and 10.3% the marketing attribute. A significantly higher share of non-organic farmers focussed most on commitment when making their choice while significantly more organic farmers focussed on the control attribute. Most farmers (65.4%) indicated that they did not ignore an attribute when choosing between the alternatives, while the others are relatively evenly distributed over the five attributes.

5.2 Estimation Results

As described in section 4.5, several regression models were used to estimate the results of the DCE. In Table 10, the results of the simple CL model and the MXL model are reported.

Table 10: Conditional logit and mixed logit model

	CL Model		MXL Model			
			Mean		SD	
	b		b		b	
	(se)		(se)		(se)	
ASC for adding a new SFSC	-2.140	**	-2.653		2.141	***
	(1.000)		(1.808)		(0.792)	
Selling Price (1€/kg)	0.823		0.728		1.803	**
	(0.904)		(1.570)		(0.757)	
50%	-0.407	**	-0.788	**	1.119	**
	(0.178)		(0.340)		(0.499)	
80%	-0.992	***	-2.156	***	1.482	**
	(0.204)		(0.650)		(0.712)	
Internal control without label	0.312		0.360		0.003	
	(0.208)		(0.307)		(0.829)	
Internal control with label	0.476	**	0.732	*	-1.207	*
	(0.229)		(0.423)		(0.653)	
External control	0.762	***	0.726		3.431	***
	(0.255)		(0.729)		(1.128)	
Direct selling on-farm	0.284		0.452		-0.991	**
	(0.186)		(0.312)		(0.464)	
Direct selling off-farm	0.107		-0.169		1.950	***
	(0.198)		(0.407)		(0.624)	
Commitment	0.723	***	1.084	***	-0.445	
	(0.149)		(0.298)		(0.720)	
Observations	1404		1404			
Log likelihood	-452		-379			

Significant effects are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

The CL model shows a significant and negative coefficient of the ASC indicating a preference for not adding another SFSC to the existing ones. The coefficient of the price attribute is not significant opposing to the general assumption of positive preferences for higher prices. To test for the robustness of the model, the CL was run again on the subgroup of farmers that indicated to prefer the price attribute while making their choice and for this subgroup the coefficient was significant and positive (see Appendix 6, Table A2). This strongly signals that a homogeneous preference for a higher price is not present in this sample. Both volume level coefficients are negative and significant with the 80% volume being more than double the size of the 50% volume, indicating a stronger negative preference the higher volumes that can be sold through one channel. The coefficients of all control mechanisms are positive but only significant for internal control with label and external control. Among their preference for the control mechanisms with label, external control is preferred over internal control. The marketing attribute's coefficients are both positive but not significant thus indicating no strong preferences

for either type of direct selling. Finally, the coefficient of commitment is positive and significant, showing that farmers prefer commitment in their marketing channels.

The results of the MXL model reveal strong preference heterogeneity in the sample for all attributes, except internal control without label and commitment. Mostly, the outcome is similar to the CL model, but a few important changes occurred. The coefficient of the ASC turns non-significant indicating that the negative preference for adding another SFSC channel is not generally one of all farmers in the sample. Further, the coefficient of external control becomes insignificant in the MXL model. Additionally, while still insignificant, the coefficient of direct selling off-farm has turned its sign to negative.

To further research the source of heterogeneity in farmers' preferences for different SFSC attributes, a LC model with two classes was implemented whose results are presented in Table 11.

Table 11: Latent class model with two classes

	Class 1 (n=35) Prob. 44.9%		**Class 2 (n=43) Prob. 55.1%**	
	b (se)		b (se)	
ASC for adding a new SFSC	-25.077 (12.225)	**	-0.196 (1.175)	
Selling Price (1€/kg)	18.064 (9.313)	*	0.151 (1.064)	
50%	-3.204 (1.131)	***	-0.159 (0.210)	
80%	-5.409 (1.861)	***	-0.718 (0.232)	***
Internal control without label	1.563 (0.904)	*	0.162 (0.243)	
Internal control with label	3.427 (1.422)	**	0.308 (0.275)	
External control	1.346 (1.544)		0.846 (0.303)	***
Direct selling on-farm	0.848 (0.868)		0.293 (0.214)	
Direct selling off-farm	0.327 (1.125)		0.197 (0.228)	
Commitment	2.291 (1.408)		0.658 (0.160)	***
Observations	1404			
Log likelihood	-378			

Significant effects are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

The two classes determined by the LC model almost split the sample in half, with a probability of belonging to class 1 of 44.9% and to class 2 of 55.1%. The classes strongly differ in their preferences except for the very negative preference for the 80% volume level. As already indicated by the MXL model, the preferences for the marketing attributes are not significant in both classes.

Farmers in class 1 have a strong negative preference for adding another SFSC to their marketing channels and a significantly positive preference for the price attribute. In addition to the strongly negative preference for a high volume (80%) sold, they also have negative preferences with respect to the 50% volume level. Finally, producers of class 1 have a positive and significant preference for internal control with and without label where the preference for a label is around double the preference for no label issued. All other attributes are not significantly preferred or detested in class 1. When it comes to class 2, the farmers only exhibit a strong negative preference for the possibility to sell a high volume (80%) through one channel, while their preference for the 50% volume level is not significant. Further, these farmers prefer external control and commitment for their marketing channels.

Table 12 presents the farmer, production and marketing characteristics that are significantly different between the two latent classes. Within class 1, a significantly higher share of farmers employs more than ten FTEs and they sell a significantly higher share of their vegetable produce through on-farm channels (60.42% compared to 37.1% in class2). Class 2 on the other hand, has on average a higher share of farmers with a Master's degree or higher. Further, a higher share of farmers belongs to the revenue group of €70,000 – 150,000 and produces more often other products, mainly beets, sugar beets or potatoes. Additionally, a higher percentage of class 2 belongs to the VFC production systems (14.0% compared to 2.9% in class 1) and a significantly higher share of the vegetable volume is sold through distribution companies (64.80% compared to 5.33% in class 1).

Table 12: Significant differences between the latent classes

Variable	**Class 1 (n=35) Prob. 44.9%**		**Class 2 (n=43) Prob. 55.1%**		
	Nb	%	Nb	%	
Education					
Primary	-	-	1	2.3%	
Secondary	8	22.9%	7	16.3%	
Bachelor	15	42.9%	12	27.9%	
Master or higher	12	34.3%	23	53.5%	*
Total revenue in 2020 *(€/year)*					
< 70,000	18	51.4%	19	44.2%	
70,000 – 150,000	4	11.4%	12	27.9%	*
150,000 – 300,000	5	14.3%	4	9.3%	
300,000 – 600,000	1	2.9%	1	2.3%	
> 600,000	5	14.3%	2	4.7%	
No answer	2	5.7%	5	11.6%	
Number of employees in 2020 *(FTE)*[a]					
0 – 3	25	71.4%	34	79.1%	
4 – 6	5	14.3%	6	14.0%	
7 – 10	2	5.7%	3	7.0%	
> 10	3	8.6%	-	-	*
Produces only vegetables *(dummy)*	14	40.0%	16	37.2%	
Produces fruit *(dummy)*	15	42.9%	14	32.6%	
Produces cereal *(dummy)*	5	14.3%	10	23.3%	
Produces livestock *(dummy)*	5	14.3%	8	18.6%	
Other production activities *(dummy)*	2	5.7%	8	18.6%	*
Production system[b]					
Market gardening on small areas (MGS)	25	71.4%	30	69.8%	
Market gardening on medium areas (MGM)	6	17.1%	3	7.0%	
Market gardening on large areas (MGL)	3	8.6%	4	9.3%	
Growing vegetables in combination with field crops (VFC)	1	2.9%	6	14.0%	*
	Mean	SD	Mean	SD	
Share sold on-farm (%)	60.42	27.24	37.10	27.75	***
Share sold via distribution companies (%)	5.33	4.51	64.80	40.40	**

[a]: Full-time equivalent (FTE); [b]: see classification in section 3.4 .
Significant differences between groups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

Welfare estimates for the SFSC attributes for class 1 are presented in Table 13. Since class 2 had no significant preferences for the price attribute, the welfare estimates could only be derived for class 1.

Table 13: Welfare estimates (in euro) for SFSC attributes

Attributes		**Class 1**
Vegetable volume sold under SFSC	20%	Reference
	50%	+0.18
	80%	+0.30
Control and label	No control	Reference
	Internal control without label	-0.09
	Internal control with label	-0.19
	External control	-0.07
Marketing of the vegetables	Production only without additional marketing activities	Reference
	Direct selling on-farm	-0.05
	Direct selling off-farm	-0.02
Commitment of buyers	No commitment	Reference
	Commitment	-0.13

The welfare estimates show that a high vegetable volume sold under one SFSC requires high compensations to make farmers use them (€0.30 for 80% and €0.18 for 50%). On the other hand, a similarly high willingness to pay of €0.19 is found for internal control with label. While class 1 exhibits significant preferences for both internal control mechanisms, the willingness to pay is more than double as high if a label is issued.

6 DISCUSSION

The results of the questionnaire offer a good overview over the production and marketing strategies as well as the characteristics of farmers in the sector for fresh vegetables in Wallonia, especially for MGS and organic farmers who make up the largest subgroups in the sample. Due to a lack of research and statistics on the subgroup of non-organic fresh vegetable farmers, it is not clear how representative the sample is for them. Nonetheless, the results serve as a first valuable insight into their characteristics and preferences.

6.1 General Preferences for Short Food Supply Chain Attributes

The results of the MXL model suggest that, while for most attributes preference heterogeneity is found, some general preferences for SFSC attributes exist. In section 4.2, the hypotheses for these general references were presented and are now discussed in the context of the results of the econometric analysis.

"**Hypothesis 1a.** Farmers prefer to be able to sell larger volumes via SFSCs."

Hypothesis 1a can be rejected based on the results of the analysis. Throughout all implemented models, the farmers exhibited a generally negative preference towards selling a higher percentage of their produce through a new SFSC channel. As revealed by the MXL model, the higher the volume sold through one channel, the higher the aversion of farmers to choose this channel (negative preference for a volume of 80% is around 2.7 times higher than for the 50% volume). This outcome strongly opposes the statement of the interviewed farmers who highlighted the importance of the volume. Nevertheless, there are several possible explanations for this.

First of all, the importance of selling a higher volume via one SFSC as stated by the interviewed farmers, who for example mentioned a minimum quantity of 30% per channel, might have an upper limit caused by other interests of the farmer. They might for instance prefer to diversify their marketing channels, instead of selling the majority of their produce through one channel, as a risk reduction strategy. This is supported by an average of three channels used by the farmers in the sample to sell their vegetables. In addition, it is possible that the producers are already satisfied with their choice of commercialisation channels causing them to not want to add new ones. Adding a new SFSC which accounts for 50% or 80% of the production volume to farmers' marketing channels would require them to reduce the volume sold through

established channels or even stop selling through them. If farmers have established good relationships to their customers, for example through direct selling channels, they might fear that they would have to give those up to sell through the new chain or that they could not increase their production volume enough to both cover the demand of their established customers and sell 50% or 80% via a new SFSC. The latter is supported by comments of respondents at the end of the questionnaire, stating that they already struggle to fulfill their current demand and can simply not increase their production volume due to limits in area and extensive production techniques.

Additionally, one interviewee stated that they would consider selling through SFSCs if they could sell a larger volume under the condition that only a limited number of buyers is involved in order to avoid higher time requirements related to contact to many consumers. Thus, the preference for higher volumes could be bound to the condition that only few buyers are involved (for example chains with intermediaries). Therefore, the negative preference for volume might be partly connected to a negative preference to sell a large volume to many individual buyers, like it would be the case for direct selling channels, and not indicate a general aversion for selling a higher volume through one channel.

"**Hypothesis 1b.** Farmers prefer direct selling to consumers over no direct selling."

Hypothesis 1b cannot be supported based on the findings of the MXL model. No significant preferences for direct selling to the consumer, both on- and off-farm, were found. Nevertheless, the results indicate a positive coefficient for direct selling on-farm while for direct selling off-farm the coefficient is negative. This is supported by the comment of one producer who stated that they consider the selling point a very important criterium, as selling off-farm has higher requirements for time, management and investments. Still, preference heterogeneity, especially for direct selling off-farm is present.

"**Hypothesis 1c.** Farmers prefer internal control mechanisms over external control."

Hypothesis 1c is not entirely supported by the sample results. While the MXL model indicates a significant preference for internal control with label, no significant preferences can be found for internal control without label and external control with label. Nevertheless, this suggests a general preference for internal control over the other mechanisms, as long as a label is issued. Farmers could possibly fear that, without a label, they would not be able to sell their products at a higher price or that consumers would not be able to identify the products as produced according to certain standards. In addition, if no label is issued, farmers might prefer to just

directly communicate their production mechanisms to the consumers without being bound to any specific restrictions related to an internal guarantee scheme.

"**Hypothesis 1d.** Farmers prefer commitment of the buyers over no commitment."

Farmers were found to generally strongly prefer commitment over no commitment without significant variations for this attribute. Thus, Hypothesis 1d is supported by the MXL model results. In line with this, commitment was also the second most preferred attribute as indicated by the participants. BELLEMARE and BLOEM (2018) state "that households expect their welfare to improve due to engaging in contract farming" (Bellemare and Bloem 2018, p. 261). Several studies, mainly in developing countries, demonstrate a positive impact of contract farming on revenues, income or productivity (Mishra et al. 2016; Miyata et al. 2009). VAMULOH et al. (2019) mention that in a sector dominated by small farmers, like it is the case for fresh vegetables in Wallonia, small-scale farmers are also able to enter contract relations, whereas they might be excluded when many large farms are present. However, these observations should be treated with caution as they are often not generalisable due to a lack of internal and external validity (Bellemare and Bloem 2018; Ton et al. 2018).

6.2 Heterogeneity in Preferences for Short Food Supply Chain Attributes

The MXL model revealed strong preference heterogeneity for SFSC attributes in the sample as the SDs of all attributes and of the ASC were significant, with the exception of internal control without label and commitment (see section 5.2). To research the sources of preference heterogeneity, several models were computed. First, the MXL model with interaction terms (e.g., organic certification and different levels of the control attribute) led to inconclusive results due to strong ordering effects. Second, a MXL model was run for split-samples (for organic/ non-organic and small/large farmers). Due to the further reduction in sample size for the split-samples, computational issues occurred for the smaller subgroup. Finally, a LC model was used, which divided the sample into two latent classes revealing different preferences. Only few significant differences between the two classes could be found, likely due to the small sample size. Moreover, welfare estimates for the SFSC attributes could only be credibly derived for class 1 as, similar to the MXL model results, class 2 did not reveal significant preferences for the price attribute making the monetary valuation of their preferences impossible. Hence, qualitative insights from the farmer interviews will be used in addition to the LC model to analyse the results.

As presented in section 5.2, the most significant differences between the two latent classes are the marketing channels through which the farmers sell the largest share of their production volume. Based on this defining characteristic, class 1 is mainly composed of on-farm marketing farmers while class 2 mostly represents farmers selling through distribution companies. First of all, on-farm marketing farmers have a significant negative preference for adding another supply chain. On-farm channels are generally characterised by direct contact to the consumers which over time allows to form relations between producer and consumers. This might reduce farmers' willingness to decrease selling through channels with established relationships in exchange for a new channel with new customers and the need to invest time into building new relationships with them. Further, on-farm marketing farmers might already be satisfied with their selling strategy due to, for example, trust relationships or long-term commitments of the consumers (e.g., for CSA) (Kirwan 2004; Malak-Rawlikowska et al. 2019; Samoggia et al. 2019). In the farmer interviews, one farmer who exclusively sold through CSA, highlighted that this type of on-farm channel is the optimal strategy for them to balance work and social life. Such cases explain a negative attitude towards new supply chains and are likely to apply to several farmers who mainly use on-farm channels to market their vegetable production.

On-farm marketing farmers further have significant positive preferences for higher prices. On average, these farmers have more employees than farmers selling through distribution companies (significant difference for the category of more than 10 FTEs). A higher number of employees leads to higher costs and a responsibility to be able to pay their wage. Furthermore, MALAK-RAWLIKOWSKA et al. (2019) demonstrate that on-farm channels allow farmers to gain a price premium. Average price premiums of 70.5% for on-farm sales and 96.7% for pick-your-own schemes were identified by the authors, which, together with sales on farmers' markets, are the highest premiums achieved among the researched channels. Thus, experience with a channel that allows for price premiums might in turn increase the preference for the price attribute. The interviewed farmers further highlight the importance of providing quality food at affordable prices and of complying with their internal and ethical motivations for production techniques rather than mainly focusing on high prices and profit. Since only four interviews were conducted, these results cannot be generalised and further questions on farmers' motivations and attitudes in the questionnaire would have been necessary to determine if this is also the case for this sample or the population of fresh vegetable farmers in general.

Concerning commitment, non-organic farmers significantly more often indicated a preference for the commitment attribute while making their choice compared to organic farmers. This

could be related to the on average lower total revenue of non-organic farmers which increases the perceived value of commitment of the customers. In addition, the LC model suggests that farmers selling via distribution companies have strong positive preferences for commitment while on-farm marketing farmers' preferences are not significantly different from zero. The strong preference for commitment among farmers selling through distribution companies could be related to their lower aversion towards selling a higher volume, which in turn raises the importance of commitment of the buyer to reduce the risk of large losses.

With respect to the control attribute, farmers' preference is influenced by previous experiences with control mechanisms, since organic farmers indicated significantly more often that they preferred control while making their choices compared to non-organic farmers.

"**Hypothesis 2a.** For larger farms (MGM, MGL, VFC) the assured volume sold under SFSCs is more important than for smaller farmers (MGS)."

First of all, as stated before, there is generally a significant and negative preference for selling a large part (50% or 80%) of the produce through a new SFSC. The LC model reinforces that farmers generally do not prefer selling high volumes through one channel, but some have a higher negative preference than others. The results of the LC model suggest that on-farm marketing farmers have a stronger negative preference than farmers selling through distribution companies as they already significantly detest the 50% volume. This could be related to similar reasons as described in section 6.1.

In addition, the less negative preferences for volumes below 80% among farmers selling via distribution companies can be related to the higher share of large farmers (VFC) and their chosen marketing channels. Both the descriptive statistics as well as the LC model indicate that larger farms more frequently use longer channels (i.e., distribution companies or supermarkets) and SFSCs with one intermediary (i.e., local shops) which allow them to sell a larger volume while only involving one buyer. This reduces the time requirements in the interaction compared to selling a similar volume to a high number of customers, like it would be the case for direct selling. Overall, this hints towards a preference (or at least no negative preference) of larger farmers to sell volumes of up to 50% and below 80% through one channel if the condition of only few buyers is fulfilled.

"**Hypothesis 2b.** Larger farmers (MGM, MGL, and VFC) have a higher preference for external control than small farmers (MGS)."

Farmers marketing via distribution companies have a high and positive preference for external control. While no significant differences in the size of the vegetable area cultivated are found between the latent classes, significantly more farmers that sell via distribution companies are categorised into the VFC production system (vegetable area of more than 30 ha). The standardised guarantee mechanism of external control is more compatible and might even be advantageous for larger selling volumes and large-scale farms (Farrell 2005; Zanasi et al. 2009). Further, distribution companies might also be more in favour of accepting products certified by external control mechanisms compared to internal control, due to requirements of supermarkets or trade partners which might prefer a more standardised guarantee. Thus, Hypothesis 2b is supported by the results.

Besides differences in the preference for external control, different preferences for internal control mechanisms are found between the two latent classes. On-farm marketing farmers have a significant positive preference for both internal control with and without label, while no significant preferences are indicated for farmers selling through distribution companies. Through more direct contact to the consumers, due to direct selling via on-farm channels, producers can build a trust relationship with their customers, which in turn makes it possible to directly convey their production techniques and standards to the customers. Therefore, on-farm marketing farmers might prefer internal control mechanisms as they allow them to get a guarantee for their compliance with production standards without the standardised procedure of control by a third-party and at the same time are still likely accepted by the customers due to the closer relation and trust. Additionally, their production standards are also conveyed to new consumers with whom no relationship is established.

Due to the possibility to reduce certification costs with internal control, higher prices could be gained by farmers. This is in line with the higher preferences of on-farm marketing farmers for both the price attribute and the internal control mechanisms. The results further suggest a higher positive preference among on-farm marketing farmers for internal control if a label is issued compared to no label. On the one hand, there is a group of farmers among them that might prefer not to use a label because their customers do not consider it as necessary or because they fear that consumers are more confused by a new label (as mentioned by one of the interviewed farmers). On the other hand, another group of producers in this class might prefer to not solely rely on direct contact to the consumer as guarantee mechanism, but still put importance on a label which symbolises their compliance with standards, either because they assume it is

important for their customers or maybe related to the possibility of selling through other off-farm channels which require a label.

"**Hypothesis 2c.** Younger and more educated farmers prefer direct selling to the consumer more than older and less educated farmers."

No significant differences between the two latent classes are found concerning age. With respect to the farmers' education, a significantly higher share of farmers selling via distribution companies has a Master's degree or higher (53.5% compared to 34.3% of the on-farm marketing farmers). Nevertheless, no significant preferences for direct selling on- or off-farm are found for both classes. Therefore, Hypothesis 2c can neither be rejected nor confirmed.

"**Hypothesis 2d.** Small farmers (MGS) prefer direct selling more compared to larger (MGM, MGL and VFC) farmers."

No significant preferences for direct selling on- or off-farm are found in either model, likely due to the small sample size. Nevertheless, the results of the farmer interviews and the survey offer first indications for farmers' preferences for marketing. The comparison of marketing strategies between small and large farms shows that smaller farmers more often use direct selling through on-farm channels (80.0% compared to 56.5% for larger farms) or box schemes (52.7% compared to 26.1% for larger farms). Larger farms on the other hand more frequently use channels without direct contact to the consumer, for example with one or more intermediaries (i.e., local shops, distribution companies or supermarkets). This is a first indication that Hypothesis 2d can be supported for direct selling on-farm, even though the results of the LC model are inconclusive.

With respect to direct selling off-farm, the farmer interviews and participants' comments indicate that the higher time requirements, for example for driving to the point of sale, are perceived as more demanding and might possibly outweigh the advantages offered from direct contact to the consumer. This hint towards a possible negative preference for direct selling at an off-farm location is further supported by the negative sign of the coefficient of this level in the MXL model.

7 CONCLUSION

In the current agri-food sector in high-income countries, food is most commonly provided through long, globalised supply chains and mass-marketing channels like supermarkets (Malak-Rawlikowska et al. 2019). A variety of economic, social and environmental challenges arise from this current standard of production and distribution of food, including pressure on farmers' economic margins, increasing social distance between producers and consumers as well as contribution to pollution of the environment and climate change (Crippa et al. 2021; Kneafsey et al. 2013; Renting et al. 2003; Van der Ploeg et al. 2000). As a result, farmers, especially small-scale ones, look for alternative and more sustainable ways of producing (Renting et al. 2003). In this context, an increase in the development and adoption of SFSCs and AGS in Europe could be observed in the past years (IFOAM n.d.; Malak-Rawlikowska et al. 2019; Renting et al. 2003).

The sector for fresh vegetables in Wallonia, Belgium, was chosen as case study for this thesis as, partly due to the ongoing Covid pandemic, SFSCs have gained more attention but are not well researched in this specific sector and region – except for DUMONT (2017). To support the development of SFSCs and AGS, it is necessary to consider farmers' preferences for their different attributes, thus this study aims to determine which attributes of SFSCs are preferred by farmers and which farm characteristics influence their preferences. Therefore, explorative interviews with Belgian farmers were conducted and a survey, including a questionnaire and a DCE, was implemented. To analyse the results of the DCE, a MXL and a LC model were computed to account for preference heterogeneity in the sample.

The descriptive results of the questionnaire reveal that the sample is dominated by organic and MGS farmers but is nevertheless very heterogenous regarding the farmers' characteristics. Further, the majority of the farmers in the sample use SFSCs, most commonly direct selling on-farm, selling via local shops or box schemes, to market their vegetables. Answers to the research questions are derived from quantitative results from the MXL and LC model, and additional qualitative insights from the farmer interviews and the comments of the survey participants.

a) "Which attributes of SFSCs are preferred by vegetable farmers for the fresh market in Wallonia?"

Overall, the results suggest that farmers generally prefer internal control with a label and commitment in SFSCs while they are averse to selling a large share of their production volume through one channel.

b) "Which characteristics of vegetable farmers for the fresh market in Wallonia influence their preferences for SFSC attributes?"

The econometric analysis revealed strong preference heterogeneity in the sample, which is attributed to the heterogeneity in the farmers' characteristics and might additionally result from heterogeneous motivations and attitudes towards production and marketing. Surprisingly, while a positive preference for higher prices could be found, it was only significant for on-farm marketing farmers, indicating that for farmers selling through distribution channels the price plays a less important role. Moreover, on-farm marketing farmers had a negative preference for adding a new SFSC but preferred internal control mechanisms, especially with label, which is likely connected to their closer relation to consumers. Farmers selling through distribution companies had less negative preferences for higher volumes sold through one channel as well as positive preferences for external control, which can be related to advantages of standardised control for larger farms and higher quantities sold (Farrell 2005; Zanasi et al. 2009).

The results of this study need to be seen in the context of several limitations. The biggest limitation results from the rather small sample size which can be traced back to a higher difficulty to reach farmers in high-income countries to participate in such surveys (Chèze et al. 2020). Thus, a detailed quantitative analysis of the preference heterogeneity among farmers was not possible, since computational issues occurred for MXL models on split-samples and the LC model did not reveal many significant differences between the two latent classes. Additionally, strong ordering effects influenced the MXL model with interaction terms.

Further research is needed, especially for the heterogeneity in farmers' preferences for the price and the marketing attribute. Price preferences could be researched by asking farmers to state their opinions on certain topics or motivations for their actions to help verify whether and which motivations for social or environmental issues are important enough for farmers to reduce the importance of the price. With respect to the marketing attribute, further research could try to disentangle more specific characteristics of SFSCs separately, for example time requirements, point of sale, contact to the consumer or presence of an intermediary, to derive more detailed results. It would additionally be interesting to look further into the population of non-organic farmers as this might offer some insights into direct selling as a quality guarantee mechanism because many of the non-organic farmers use direct selling channels. Moreover, focus group discussions could be conducted with different subgroups of farmers (e.g., non-organic, large scale, etc.) to validate the results of the survey. In addition to research focussing on the producer

side, further research exploring the opinions and preferences of other actors along the supply chain in Wallonia, including consumers, intermediaries or local institutions, would be important.

Finally, some recommendations for policymakers can be made. For the group of on-farm marketing farmers, it is recommended to focus on strengthening already existent on-farm channels and additionally support and enhance the development of internal control mechanisms such as PGS. Therefore, it would be important to work on offering the possibility of legal recognition for AGS, which could already start at the local or regional scale of Wallonia. For the group of farmers selling via distribution companies, further support of the external EU-organic certification should be offered, for instance through higher premiums or a reduction of the certification costs. Additionally, institutional procurement policies, for example with local canteens, could be supported for this group that has strong preferences for commitment and does not mind selling higher volumes through one chain.

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APPENDIX 1: FARMER CHARACTERISTICS MODULE

Question	Answer options
Region	Liège Brabant wallon Region Brussels Hainaut Luxembourg Namur
Gender	Male Female Other
Age	Year of birth
Education	Primary Secondary Bachelor (or similar) Master (or similar) and higher
Farming experience with vegetables	In which year did you start producing vegetables on your farm?
Membership in farmer cooperative	No Yes
Additional professional activity (off-farm job)	No Yes

APPENDIX 2: PRODUCTION CHARACTERISTICS MODULE

Question	Answer options
Vegetable area cultivated in 2020 (in ha)	# ha
Number of vegetable species cultivated in 2020	1-10 10-30 >30
Farming activities in 2020	Only vegetables Fruit Livestock (cows for milk or meat, sheep, poultry for eggs or meat, other) Cereals Other (please elaborate)
Number of employees in 2020 **(Full-time Equivalent (FTE))**	0-3 4-6 7-10 >10
Total revenue in 2020 (in €/year)	< 70,000 70,000 – 150,000 150,000 – 300,000 300,000 – 600,000 >600,000 Prefer not to answer/ not known
Approximate share of vegetables over the farm total revenue in 2020 (in %)	# approximate %

APPENDIX 3: MARKETING CHARACTERISTICS MODULE

Question	Answer options
Organic certification for vegetables in 2020	No (if no, previous organic certification for vegetables: No, Yes) Yes (if yes, percentage of vegetable area certified: 1-25, 26-50, 51-75, 76-100%)
Commercialisation channels used for vegetable sales in 2020 + **approximate % of vegetable volume sold through the chosen channels**	Auctions Distribution companies Supermarkets Local shop Local institutions (e.g., schools) Farmer cooperative Restaurants On-farm sales (farm shop or pick-yourself) Food boxes (home delivery or pick-up point) Farmers' market Other (please elaborate)
Compared to 2019, did you sell a larger share of vegetables through SFSCs during the Covid-19 quarantine in March – June 2020?	Decrease Same Increase
Compared to 2019, did you sell a larger share of vegetables through SFSCs after the Covid-19 quarantine in March – June 2020?	Decrease Same Increase

APPENDIX 4: EXAMPLE OF A CHOICE CARD

	Volume de vente	Prix de vente	Contrôle de la production et label	Activité commerciale exercée par le producteur	Engagement des acheteurs
A	 80%	Prix du marché **+ 10%**	 Pas de contrôle	 Vente directe au consommateur hors ferme	 Pas d'engagement
B	 20%	Prix du marché	 Contrôle en interne avec un label	 Vente directe au consommateur à la ferme	 Engagement assuré
C	Pas de filière de vente supplémentaire				

APPENDIX 5: NGENE SYNTAX

```
if (alt2.Control = [1,2], alt2.Price = [1,2,0]),
? If the control mechanisms is internal control, I assume that the price will not have a negative premium.

if (alt1.Control = [3], alt1.Price = [1,2]),
if (alt2.Control = [3], alt2.Price = [1,2])
? If the control mechanism is external control, I assume that there will always be a positive price premium.

? Volume: 1 (50%), 2 (80%), 0 (20%)
? Price: -1 (-10%), 1 (+10%), 2 (+20%), 0 (Market price)
? Control and label: 1 (Internal without label), 2 (Internal with lable), 3 (External), 0 (No control)
? Marketing: 1 (Direct on-farm), 2 (Direct off-farm), 0 (Production only)
? Commitment: 1 (Commitment), 0 (No commitment)

;model:
U(alt1) = b1.dummy[0.01|0.01] * Volume[1,2,0]
+ b2.dummy[-0.02|0.01|0.02] * Price[-1,1,2,0]
+ b3.dummy[-0.01|-0.01|-0.02] * Control[1,2,3,0]
+ b4.dummy[0.02|0.01] * Marketing[1,2,0]
+ b5.dummy[0.01] * Commitment[1,0]/

U(alt2) =  b1 * Volume
+ b2 * Price
+ b3 * Control
+ b4 * Marketing
+ b5 * Commitment /

U(OO) = b0.dummy[0.1]
+ b1 * Volume_OO[1,2,0](0,0,12)
+ b2 * Price_OO[-1,1,2,0](0,0,0,12)
+ b3 * Control_OO[1,2,3,0](0,0,0,12)
+ b4 * Marketing_OO[1,2,0](0,0,12)
+ b5 * Commitment_OO[1,0](0,12)

? The utility of the opt-out option is determined by the base levels of the attributes (0), plus a positive ASC
? (i.e. all things equal, farmers prefer to have a new SFSC than none).


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APPENDIX 6: PREFERENCES FOR THE PRICE ATTRIBUTE

Table A1: Mixed logit model with price as random and non-random parameter

	Non-random				**Random**			
	Mean b (se)		SD b (se)		Mean b (se)		SD b (se)	
ASC for adding a new SFSC	-4.870 (2.742)	*	3.787 (1.108)	***	-2.653 (1.808)		2.141 (0.792)	***
Selling Price (1€/kg)	2.007 (2.060)				0.728 (1.570)		1.803 (0.757)	**
50%	-1.105 (0.464)	**	1.832 (0.717)	**	-0.788 (0.340)	**	1.119 (0.499)	**
80%	-3.410 (1.306)	***	2.633 (1.034)	**	-2.156 (0.650)	***	1.482 (0.712)	**
Internal control without label	0.433 (0.412)		-1.052 (0.758)		0.360 (0.307)		0.003 (0.829)	
Internal control with label	1.165 (0.638)	*	1.676 (0.771)	**	0.732 (0.423)	*	-1.207 (0.653)	*
External control	1.030 (0.820)		5.002 (1.926)	***	0.726 (0.729)		3.431 (1.128)	***
Direct selling on-farm	0.698 (0.462)		1.637 (0.715)	**	0.452 (0.312)		-0.991 (0.464)	**
Direct selling off-farm	-0.019 (0.500)		2.622 (1.009)	***	-0.169 (0.407)		1.950 (0.624)	***
Commitment	1.630 (0.593)	***	-1.281 (0.712)	*	1.084 (0.298)	***	-0.445 (0.720)	
Observations	1404				1404			
Log likelihood	-378				-379			

Significant effects are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

Table A2: Conditional logit model for price preference

	b (se)	
ASC for adding a new SFSC	-3.475 (1.547)	**
Selling Price (1€/kg)	3.195 (1.413)	**
50%	-0.422 (0.269)	
80%	-1.126 (0.316)	***
Internal control without label	0.288 (0.313)	
Internal control with label	0.356 (0.342)	
External control	0.674 (0.384)	*
Direct selling on-farm	-0.305 (0.274)	
Direct selling off-farm	-0.221 (0.285)	
Commitment	0.491 (0.213)	**
Observations	504	
Log likelihood	-167	

Significant effects are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

APPENDIX 7: ORDERING EFFECTS

Within three separate MXL models, the following interaction terms were added:

- Interactions between organic certification and the control mechanism (one interaction with each level of the control attribute) based on the hypothesis that farmers who already obtain a certification have stronger preferences for maintaining one;
- Interactions between the vegetable area farmed and the volume attribute (two interaction terms, one with each volume level) to test for the hypothesis that farmers with a larger area would prefer to sell a higher volume through one channel;
- Interactions of the vegetable area farmed and the marketing attribute (two interaction terms, one with each marketing level) to test the hypothesis that smaller farmers (MGS) have a stronger preference for direct selling to the consumers compared to larger farmers (MGM, MGL, and VFC).

For the interaction of vegetable area with volume, the interaction terms were insignificant independent of the ordering but with respect to the other two models, the ordering strongly changed the significance of the interactions, thus revealing a strong impact of ordering effects on the model. For example, the interaction of the vegetable area and direct selling on-farm is significant at a 1% significance level while with different ordering, the interaction is not significant at all. Similar results are obtained for the interactions of organic certification and the control attribute, where the interaction with external control is significant at the 1% significance level with one ordering and not significant at all when the ordering is changed.

APPENDIX 8: ATTRIBUTE NON-ATTENDANCE

Attribute non-attendance (ANA) describes that the respondents do not consider all attributes while making their choices in the DCE (Coffie et al. 2016; Kragt 2013). ANA is present in the sample as 35% of the participants stated that they ignored an attribute while choosing between the different alternatives on the choice cards (see Table 9). Nevertheless, ANA is relatively similarly distributed over the five attributes and no significant differences between the subgroups of organic and non-organic farmers were found.

The results of the stated ANA model suggest robustness of the MXL model against ANA as the results do not change much between the models (see Table A3).

Table A3: Mixed logit model and stated attribute non-attendance model

	MXL				Stated ANA Model			
	Mean b (se)		SD b (se)		Mean b (se)		SD b (se)	
ASC for adding a new SFSC	-3.416		3.025	***	-3.749	**	2.451	***
	(2.112)		(0.883)		(1.498)		(0.844)	
Selling Price (1€/kg)	1.330		1.413	**	1.635		1.657	
	(1.781)		(0.702)		(1.280)		(1.210)	
50%	-0.988	**	1.505	**	-0.606	*	1.178	**
	(0.460)		(0.689)		(0.350)		(0.529)	
80%	-2.605	***	2.087	***	-2.062	***	1.852	**
	(0.865)		(0.802)		(0.671)		(0.814)	
Internal control without label	0.447		-0.435		0.281		-0.317	
	(0.374)		(0.791)		(0.319)		(1.144)	
Internal control with label	0.963	*	-1.327	*	0.555		-1.317	**
	(0.524)		(0.745)		(0.434)		(0.600)	
External control	1.059		3.809	***	0.597		2.911	***
	(0.852)		(1.326)		(0.686)		(1.050)	
Direct selling on-farm	0.488		-1.410	*	0.582	*	-0.922	*
	(0.365)		(0.744)		(0.316)		(0.547)	
Direct selling off-farm	-0.289		2.307	***	-0.223		1.875	***
	(0.484)		(0.855)		(0.428)		(0.620)	
Commitment	1.321	***	1.140	*	1.271	***	0.700	
	(0.439)		(0.650)		(0.321)		(0.576)	
Observations	1404				1404			
Log likelihood	-378				-380			

Significant effects are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

APPENDIX 9: FARMER CHARACTERISTICS OF SUBSAMPLES OF SMALL AND LARGE FARMS

Variable	**Full sample (n=78)**		**Small farms (MGS) (n=55)**		**Large farms (MGM, MGL, VFC) (n=23)**		
	Mean	SD	Mean	SD	Mean	SD	
Age *(years)*	44.82	10.85	43.80	10.84	47.26	10.72	
Farming experience with vegetables *(years)*	10.68	9.14	8.02	7.44	17.04	9.81	***
	Nb	%	Nb	%	Nb	%	
Region							
Liège	22	28.2%	17	30.9%	5	21.7%	
Brabant wallon	18	23.1%	10	18.2%	8	34.8%	
Hainaut	16	20.5%	12	21.8%	4	17.4%	
Namur	13	16.7%	9	16.4%	4	17.4%	
Luxembourg	6	7.7%	5	9.1%	1	4.3%	
Region Brussels	3	3.8%	2	3.6%	1	4.3%	
Gender							
Male	56	71.8%	35	63.6%	21	91.3%	**
Female	21	26.9%	19	34.5%	2	8.7%	**
Other	1	1.3%	1	1.8%	-	-	
Education							
Primary	1	1.3%	-	-	1	4.3%	
Secondary	15	19.2%	9	16.4%	6	26.1%	
Bachelor	27	34.6%	22	40.0%	5	21.7%	
Master or higher	35	44.9%	24	43.6%	11	47.8%	
Membership in farmer cooperative *(dummy)*	32	41.0%	18	32.7%	14	60.9%	**
Off-farm job *(dummy)*	27	34.6%	27	49.1%	-	-	***

Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

APPENDIX 10: PRODUCTION CHARACTERISTICS OF SUBSAMPLES OF SMALL AND LARGE FARMS

Variable	**Full sample (n=78)**		**Small farmers (MGS) (n=55)**		**Large farmers (MGM, MGL, VFC) (n=23)**		
	Nb/ **Mean**	%/ **SD**	Nb/ **Mean**	%/ **SD**	Nb / **Mean**	% / **SD**	
Vegetable area cultivated in 2020 *(ha)*	**12.78**	**39.64**	**0.81**	**0.52**	**41.41**	**65.46**	*******
Total revenue in 2020 *(€/year)*							
< 70,000	37	47.4%	37	67.3%	-	-	***
70,000 – 150,000	16	20.5%	12	21.8%	4	17.4%	
150,000 – 300,000	9	11.5%	5	9.1%	4	17.4%	
300,000 – 600,000	2	2.6%	-	-	2	8.7%	**
> 600,000	7	9.0%	-	-	7	30.4%	***
No answer	7	9.0%	1	1.8%	6	26.1%	***
Vegetable share at total revenue *(%)*	**68.05**	**28.68**	**74.05**	**27.85**	**53.70**	**25.87**	*******
Number of vegetable species cultivated in 2020							
1 – 10	12	15.4%	2	3.6%	10	43.5%	***
10 – 30	22	28.2%	17	30.9%	5	21.7%	
> 30	44	56.4%	36	65.5%	8	34.8%	**
Number of employees in 2020 *(FTE)*[a]							
0 – 3	59	75.6%	51	92.7%	8	34.8%	***
4 – 6	11	14.1%	4	7.3%	7	30.4%	***
7 – 10	5	6.4%	-	-	5	21.7%	***
> 10	3	3.8%	-	-	3	13.0%	***
Produces only vegetables *(dummy)*	30	38.5%	28	50.9%	2	8.7%	***
Produces fruit *(dummy)*	29	37.2%	20	36.4%	9	39.1%	
Produces cereal *(dummy)*	15	19.2%	3	5.5%	12	52.2%	***
Produces livestock *(dummy)*	13	16.7%	6	10.9%	7	30.4%	**
Other production activities *(dummy)*	10	12.8%	2	3.6%	8	34.8%	***

[a]: Full-time equivalent (FTE)

Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

Continued.

Variable	**Full sample (n=78)**		**Small farmers (MGS) (n=55)**		**Large farmers (MGM, MGL, VFC) (n=23)**		
	Nb	%	Nb	%	Nb	%	
Production system[b]							
Market gardening on small areas (MGS)	55	70.5%	55	100%	-	-	***
Market gardening on medium areas (MGM)	9	11.5%	-	-	9	39.1%	***
Market gardening on large areas (MGL)	7	9.0%	-	-	7	30.4%	***
Growing vegetables in combination with field crops (VFC)	7	9.0%	-	-	7	30.4%	***

[b]: see classification in section 3.4 .

Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

APPENDIX 11: MARKETING CHARACTERISTICS OF SUBSAMPLES OF SMALL AND LARGE FARMS

Variable	Full sample (n=78)		Small farmers (MGS) (n=55)		Large farmers (MGM, MGL, VFC) (n=23)		
	Nb	%	Nb	%	Nb	%	
Organic certification for vegetables *(dummy)*	59	75.6%	39	70.9%	20	87.0%	
Organic certified vegetable area conditional on being certified *(%)*							
1 – 25	1	1.7%	-	-	1	5.0%	
26 – 50	5	8.5%	-	-	5	25.0%	***
51 – 75	1	1.7%	-	-	1	5.0%	
76 – 100	52	88.1%	39	100%	13	65.0%	
Previous organic certification conditional on not being certified *(dummy)*	2	10.5%	1	6.3%	1	33.3%	
SFSC sales in March - June 2020[c]							
Sold less *(dummy)*	4	5.2%	3	5.5%	1	4.3%	
Sold the same amount *(dummy)*	37	47.4%	27	49.1%	10	43.5%	
Sold more *(dummy)*	37	47.4%	25	45.5%	12	52.2%	
SFSC sales after March - June 2020[c]							
Sold less *(dummy)*	5	6.4%	4	7.3%	1	4.3%	
Sold the same amount *(dummy)*	50	64.1%	34	61.8%	16	69.6%	
Sold more *(dummy)*	23	29.5%	17	30.9%	6	26.1%	

Note: All numbers refer to the year 2020.

[c]: Refers to the impact of Covid-19 on the sales through SFSCs during the first lockdown in March to June 2020 and after the first lockdown.

Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

Continued.

Variable	**Full sample (n=78)**		**Small farmers (MGS) (n=55)**		**Large farmers (MGM, MGL, VFC) (n=23)**		
	Nb/ Mean	**%** / SD	**Nb**/ Mean	**%** / SD	**Nb**/ Mean	**%** / SD	
Number of commercialisation channels used	3.04	1.34	2.95	1.22	3.26	1.60	
Sells via on-farm channels *(dummy)*	**57**	**73.1%**	**44**	**80.0%**	**13**	**56.5%**	**
Share sold on-farm *(%)*	47.74	29.68	48.16	26.16	46.31	40.69	
Sells via local shops *(dummy)*	**42**	**53.8%**	**25**	**45.5%**	**17**	**73.9%**	**
Share sold via local shops *(%)*	25.07	22.78	29.80	23.88	17.69	19.38	*
Sells via box schemes *(dummy)*	**35**	**44.9%**	**29**	**52.7%**	**6**	**26.1%**	**
Share sold via box schemes *(%)*	39.94	26.54	40.79	24.52	36.00	37.15	
Sells to restaurants *(dummy)*	**30**	**38.5%**	**22**	**40.0%**	**8**	**34.9%**	
Share sold to restaurants *(%)*	18.00	13.26	19.91	12.65	12.75	14.33	
Sells via cooperatives *(dummy)*	**25**	**32.1%**	**16**	**29.1%**	**9**	**39.1%**	
Share sold via cooperatives *(%)*	25.44	22.45	22.25	16.54	31.11	30.70	
Sells on farmers' markets *(dummy)*	**18**	**23.1%**	**15**	**27.3%**	**3**	**13.0%**	
Share sold on farmers' markets *(%)*	32.78	26.90	32.53	25.30	34.00	40.84	
Sells via distribution companies *(dummy)*	**9**	**11.5%**	**2**	**3.6%**	**7**	**30.4%**	***
Share sold via distribution companies *(%)*	42.50	43.42	3.00	2.83	55.67	42.50	
Sells via supermarkets *(dummy)*	**8**	**10.3%**	**1**	**1.8%**	**7**	**30.4%**	***
Share sold via supermarkets *(%)*	37.88	32.87	8.00	0.00	42.14	33.02	
Sells via local institutions *(dummy)*	**8**	**10.3%**	**4**	**7.3%**	**4**	**17.4%**	
Share sold via local institutions *(%)*	6.00	5.88	8.75	7.5	3.25	2.06	
Sells via public markets *(dummy)*	**4**	**5.1%**	**4**	**7.3%**	**-**	**-**	
Share sold via public markets *(%)*	40.75	9.78	40.75	9.78	-	-	
Sells via auctions *(dummy)*	**1**	**1.3%**	**-**	**-**	**1**	**4.3%**	
Share sold via auctions *(%)*	50.00	0.00	-	-	50.00	0.00	

Note: All numbers refer to the year 2020. The share sold via a specific channel is conditional on participating in this channel.
Significant differences between subgroups are indicated with *p<0.1, **p<0.05, ***p<0.01 (based on a pr-test for dummy variables and a two-sample t-test for continuous variables).

PERSONAL DECLARATION

I hereby affirm that I have prepared the present thesis self-dependently, and without the use of any other tools, than the ones indicated. All parts of the text, having been taken over verbatim or analogously from published or not published scripts, are indicated as such. The thesis has not yet been submitted in the same or similar form, or in extracts within the context of another examination.

Gummersbach, 05.08.2021

Student's signature

Farmers' preferences for short food supply chain attributes

- A discrete choice experiment on the sector of fresh vegetables in Wallonia, Belgium

Submitted by: Miriam Skambracks

In the past decades, a variety of economic, social and environmental challenges arose from the current common supply of food through long, globalised chains. As a solution to these challenges, short food supply chains (SFSCs) and alternative guarantee systems (AGS) increasingly developed in Europe during the past years. The sector for fresh vegetables in Wallonia, Belgium, was chosen as case study for this thesis as SFSCs and AGS have gained attention but are not well researched in this specific sector and region. To support the development of SFSCs, farmers' preferences for their different attributes have to be considered, thus this study aims to determine which attributes are preferred by farmers and which farm characteristics influence their preferences. Explorative interviews with Belgian farmers and a survey, including a questionnaire and a DCE, were conducted.

Overall, the results suggest that farmers generally prefer internal control with a label and commitment in SFSCs while they are averse to selling a large share of their production volume through one channel. Further, strong preference heterogeneity was found in the sample, indicating a positive preference of on-farm marketing farmers for the price attribute and internal control mechanisms and negative preferences for adding a new SFSC. The subgroup of farmers selling through distribution companies, on the other hand, had less negative preferences for higher volumes sold through one channel as well as positive preferences for external control.

Overall, the results of this study need to be seen in the context of several limitations, mainly resulting from the rather small sample size. Nevertheless, first recommendations for policymakers can be made. For on-farm marketing farmers, it is recommended to focus on strengthening already existent on-farm channels and supporting the development of internal control mechanisms. For farmers selling via distribution companies, the external EU-organic certification should be supported and institutional procurement policies should be facilitated.

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