



Research article

Vertical integration as a strategy to increase value absorption by primary producers: The Belgian sugar beet and the German rapeseed case

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Abstract: Vertical integration is a means of increasing market power. For some agricultural products, it is easier for farmers to exert control over their product beyond the farm gate, but for others it is more difficult. Cases in the latter category have two main characteristics. First, the farmer cannot sell the respective product to final consumers without processing. Second, processing is capital-intensive. Consequently, farmers have limited sales channels, and vertical integration of the supply chain is complex and challenging. It implies cooperation among farmers to process the raw material at a profitable scale and to finance the installation of processing facilities. Thus, for these product categories, farmers are prone to market power issues, since they depend on private businesses that have the financial means to install processing facilities and the logistical capacities to organize the collection of large amounts of raw material. This paper aims to identify and analyze the role of supply chain integration for farmers who are already cooperating horizontally. Two case studies serve as the basis for the analysis: sugar beet in Flanders, Belgium, and oilseed rape in Hessen, Germany. The analysis is based on a qualitative research approach combining interviews, focus groups, and workshops with farmers and processors. While for sugar beet, the effects of market power are emerging only now with the termination of the quota system, farmers growing oilseed rape have been experiencing these problems since the 1990s. Our analysis concludes that most strategies to maintain or improve farm income have been exhausted. Even various forms of vertical integration supported by European policies do not necessarily work as a successful strategy.

Keywords: supply chain; vertical integration; horizontal cooperation; qualitative research; sugar beet; rapeseed

1. Introduction

The European Commission has defined nine goals to guide the Common Agricultural Policy (CAP) for the 2021–2027 period. Among these goals are economic, environmental, and social goals. The diversity of CAP goals indicates that farmers are operating in a complex environment and have to respond to several challenges. A successful response to these challenges is relevant for our society at large [1], although it is not easy for farmers to successfully respond to all of these challenges. Environmental goals need to be considered, while farm operations need to remain competitive and financially viable. However, farmers have limited room to maneuver since they are operating in a space that can be described as the “agricultural squeeze” [2]. This squeeze refers to the concentration upstream and downstream of the value chain. Hence, market concentration can be found on the retail level [3–5], as well as on the farm input (e.g., fertilizers, seeds) level [6–8]. Supermarkets can act as gatekeepers [9], deciding what products enter the supermarket shelves [10]. On the farm input level, large suppliers represent one-stop shops, meaning that all necessary inputs are provided by one supplier [11]. This can create dependencies when farmers are forced to buy certain products to get access to a specific service or when farmers cannot switch to another seller [7].

The hourglass-shaped value chain [12], commonly found in the agri-food sector, does create power imbalances that can lead to unfair trading practices. This problem has been acknowledged by the European Union [13]. To counteract this instance, the European Parliament enacted a law to protect trading partners from unilaterally imposed unfair trading practices [14]. The legislative text explains that “within the agricultural and food supply chain, significant imbalances in bargaining power between suppliers and buyers of agricultural and food products are a common occurrence. Those imbalances in bargaining power are likely to lead to unfair trading practices when larger and more powerful trading partners seek to impose certain practices or contractual arrangements which are to their advantage in relation to a sales transaction” [14]. It is further stated that imbalances cannot only be explained by different company sizes but also by the commodity exchanged. The legislative text points out that farmers bear larger risks due to their dependence on environmental conditions (such as weather conditions). Furthermore, their produce is often seasonal and perishable. Hence, there are at least three factors that influence market power within the agri-food sector: 1) the horizontal and vertical market structure [12], 2) the relative size of companies within this structure [14], and 3) the product characteristics [14,15]. Though, these three factors can have a strengthening or weakening effect on each other.

Following the European Union’s acknowledgment of the problematic position of farmers within the value chain, it is reasonable to say that strengthening farmers’ position represents one of the nine CAP goals. One of the key messages within this goal is that “the future CAP aims at strengthening farmers’ position in value chains by strengthening cooperation among farmers, enhancing synergies within value chains, supporting the development of market-driven production models, fostering research and innovation, increasing market transparency and ensuring effective mechanisms against Unfair Trading Practices (UTPs)” [16]. This CAP goal addresses though two of the three above-mentioned factors influencing market power: the relative size of companies and the market structure.

By supporting collaboration among market players, the market structure and the size of market players can be changed *indirectly*. For example, through horizontal cooperation, farmers can act as one bigger actor within the value chain, indirectly increasing their relative size. Nevertheless, these measures do not impact product characteristics, which can influence market power as well.

Farm income cannot only be influenced through bargaining power but also by adding value to raw products through, e.g., further refinement. The ability of a company to fetch created value along the supply chain is related to its competitiveness [17]. Due to the homogeneity of agricultural products that must be processed before consumption, a farmer's ability to augment consumers' valuation of his or her raw product is limited. The product characteristic factor mentioned above is thus also relevant for added value creation. Refinement and processing of agricultural commodity crops can not only increase added value, it can also increase product differentiation, thus creating a higher value [18].

Raw product processing may require vertical integration, thus the integration of processing facilities. Gereffi, Humphrey and Sturgeon [17] discussed the relevance of value chain management. For the profitability of a company, it is pivotal to decide in which parts of the value chain to operate. Companies may only operate in one part, in a couple of parts, or they may integrate all parts of the value chain [17,19]. Companies can achieve higher profits by reducing costs [20], such as transaction costs along the value chain [17]. Reducing transaction costs may induce companies to vertically integrate other segments of the value chain [21].

In addition to vertical integration, horizontal cooperation is also related to the competitiveness of a company [19]. "While vertical integration [...] requires the acquisition of different types of capacities, horizontal integration requires capacities that are similar. The strategy of horizontal integration aims at increasing market share, diminishing competition and increasing cost competitiveness" [22]. The previous CAP (2014–2020) acknowledged this by supporting producer organizations and inter-branch organizations [23]. A producer organization fosters "joint production or marketing of agricultural products or the use of joint facilities, unless such joint action excludes competition [...]" [24]. An inter-branch organization is a self-organized, vertically integrated entity created by different players and branches of the agri-food chain, always including representatives linked to production and at least one partner from another part of the supply chain [24].

Despite increasing income, European farmers are struggling to operate cost-covering [25]. In part, this might be due to their limited bargaining power, which is related to the three factors mentioned above. To solve this problem, the European Union supports horizontal cooperation as well as vertical integration in the agricultural sector. Horizontal cooperation and vertical integration are potent means of improving the economic situation of primary producers [5,23,26,27]. However, while producer organizations establish horizontal coordination, in some cases, they may not be potent enough to maintain or improve the economic situation of farms [28]. More complex approaches may be needed to support farms [29]. Horizontal cooperation may have to be used in conjunction with vertical integration to support the economic profitability of primary production. In this paper, we investigate whether vertical integration is a potential option to increase farm income in cases in which farms are already cooperating horizontally. We do so by looking at two case studies in north-western Europe. To answer this question, we have conducted qualitative research with stakeholders such as farmers and processors. Interviews, focus groups, and workshops have been carried out in a stepwise manner and analyzed using grounded theory. Based on the gained insights, we have developed an analytical framework that helps to understand in which circumstances vertical integration may be a viable option to increase farm income.

The analysis of the case studies is structured as follows. We start by explaining the methodology used and then introduce the two case studies. Although favorable in the past, the limited success of horizontal cooperation for the German rapeseed and the Belgian sugar beet case is outlined. We then discuss alternative strategies, one of which is vertical integration. Finally, illustrating the farmers' situation and options allows us to draw conclusions on the effectiveness of vertical integration.

2. Materials and methods

This research has been part of a Horizon 2020 research project (SUFISA) that aimed, amongst other things, to identify the institutional arrangements (IA) that farmers use to support their operations [30,31]. An analytical framework was developed to analyze these IAs. For detailed information about the analytical framework and institutional arrangements¹, please consult Grando, Bonjean, Bartolini et al. [32] and Mathijs [33]. In brief, a sequence of research steps was conducted. First, the research teams performed desk-based research, followed up by interviews, focus groups, and multi-stakeholder workshops (see Table 1).

Results from each step served to refine subsequent research steps. Thus, the desk-based research aimed to become acquainted with the general situation, as well as preparing the next research step. Interviews were conducted with nine Belgian farmers and eight stakeholders of the German rapeseed industry. Interviews were analyzed, and main challenges were identified, which were further investigated in focus groups with farmers. Again, results were analyzed and further discussed in workshops with representatives of the value chain. Some documentation of the qualitative research can be found online [34]. Anonymized, raw data such as interview and focus group transcripts cannot be published as participants have not agreed to such data being published. However, questionnaires, notes, reports, and codes can be found online [34]. All qualitative data collection was performed between September 2016 and June 2017.

Table 1. Qualitative research steps for both case studies.

Research step	Sugar beet case	Rapeseed case
Interviews	Nine semi-structured face to face interviews	Eight telephone interviews with case study stakeholders and experts from the processing industry
Focus groups	Two with 14 farmers	One with 12 farmers
Workshops	One with 12 representatives from the value chain, including farmers	One with 10 representatives from the value chain, including farmers

Differences between the two case studies resulted from specific circumstances in the respective region and sectors. Although different research teams undertook the case studies, the teams exchanged regularly. Exchange was organized and took place during bi-annual project meetings. Further, exchange took place via e-mail before and after the project meetings. Thus, the alignment of processes was part of the SUFISA project design.

In the Belgian case study, the semi-structured face-to-face interviews and focus groups were

¹ Within the SUFISA project Institutional arrangements have been defined as “[...] combinations of horizontal cooperation, vertical coordination and public intervention in dealing with market issues [31].”

audio-recorded, transcribed, translated into English, and analyzed according to grounded theory [35] with the assistance of the NVIVO software. As mentioned, interviews followed a semi-structured format; the same applies to the focus groups and the workshop. Aiding material during the focus group were *strategy cards* that contained keywords, such as “upscaling,” “additional income,” or “innovation,” as well as an illustration that briefly described the identified strategy. These cards were reused during the workshop. The analysis of the workshop was based on notes taken by two note-keepers, as well as on flip charts and sticky notes created during the workshop. Direct statements of farmers that are used within this article were anonymized, so the names of farmers were changed. Moreover, company names were replaced to preserve their integrity. The notes taken during the workshop enriched the already analyzed data. Thus, notes were added to NVIVO, and grounded theory was applied as well. In the Belgian case, stakeholder recruiting followed two routes. Farmers could only be recruited with the help of the sugar beet farmers’ association (CBB). Thus, the research team only received a list of farmers via the CBB to choose from. For the workshop, other stakeholders were invited as well. Those were found by investigating all relevant supply chain members in Belgium. 48 supply chain members were contacted via e-mail.

In the German case study, notes were taken while conducting the eight explorative open-ended telephone interviews. The methodological foundation for the eight semi-structured telephone interviews emerged from the project’s analytical framework as referred to above [32,33]. The aim was to investigate the following guiding questions: What are the main challenges you are currently facing? Which strategies have you developed to address them? How ‘successful’ have the strategies been so far (success understood as manifestation of the sustainability performances of oilseed rape production)? In subsequent interviews, recurring issues were further investigated to gain additional information and insights. Key statements were cross-checked. Methodologically, the interview approach was based on the concept of grounded theory [35]. During the focus group, in which 12 farmers participated, a research team member took notes and prepared minutes after the event. A flow chart with drivers, (potential) strategies, and reached/aimed results served as a template. This chart was completed during the discussion. Currently lacking strategies crystalized through this focus group process. The resulting strategy-focused chart served as the starting point for the stakeholder workshop. The focus group discussion was audio-recorded. After the focus group, the minutes were circulated, allowing participants to comment and clarify. Participants’ statements were anonymized, and the minutes of the focus group were translated into English. Participants in the final workshop were representatives of the oilseed value chain. During the workshop, discussion cards showing relevant key issues were collected on pinboards. The farmers’ union of the Wetterau County recruited the rapeseed farmers for the study. Farmers could not be recruited directly owing to the protection of contact data. Relevant key stakeholders from processing or sales businesses, as well as advisors or market analysts, were identified and contacted directly. Their contact details are publicly available.

In both cases, grounded theory, more specifically open coding, was used to extract information from the qualitative data that is relevant for the analysis presented in this article. For example, in the sugar beet case, a parent code, “FU” (farmers union), was applied. This code had several sub-codes, such as “structure,” “communication,” or “FU’s impact.” Codes related to the farmers union capture aspects relevant to horizontal cooperation. Another code was “vertical integration,” which, as the name of the code indicates, captured statements related to vertical integration (e.g., buying or building a processing facility). Other codes, such as “sugar substitute,” “changing refinery,” “other end-product than sugar,” or “other crop,” indicate farmers’ bargaining power as they captured whether farmers

could easily switch to another crop or sell their crop to another processor (e.g., to produce biofuels or bioplastics instead of sugar). One parent code was “strategy,” which was the starting point to analyze different strategies farmers are already implementing. One of the sub-codes was “cooperation,” which captured farmers’ views on horizontal cooperation to support farm income via increased bargaining power.

2.1. Ethics approval of research

No formal ethical committee review was required by the two institutes conducting the research. However, it was made sure that the research process was in alignment with ethical considerations. For example, the anonymity of participants was guaranteed, and participants could opt out of the research process at any point without providing a reason. All participants of this study signed an informed consent form. An example of the informed consent form can be found online [34]. Prior to participating in the study, participants were informed about the purpose of the study and their participation. The informed consent form provided this information once more, including information about data handling (e.g., processing, access).

2.2. Analytical framework

Above, it has been indicated that at least three factors influence market power in the agri-food sector. The horizontal and vertical market structure, as well as the relative size of companies within this structure, is to some degree addressed by the support of vertical integration and horizontal cooperation. These strategies, however, do not influence product characteristics that can also impact market power.

According to the European Commission [16], whether or not farmers cooperate in Producer Organizations depends on product characteristics and production processes. Pertaining to product characteristics, the Commission emphasizes that the high perishability may increase the likelihood of the formation of producer organizations, as they make it possible to reduce transaction costs. Producer organizations are meant to increase bargaining power [23], but product characteristics may counterbalance this effort. Biely, Mathijs and Van Passel [36] argued that market structure, and accordingly farmers’ bargaining power, is influenced by crop and product characteristics. Accordingly, the product characteristics in the two case studies are relevant to understanding the market structure, bargaining power, and thus farm income.

In the course of analyzing the qualitative data, it became clear that product characteristics play a vital role in counterbalancing the effectiveness of horizontal cooperation and/or making vertical integration more difficult to implement. To capture the relevant product characteristics, we developed an analytical framework (Table 2) to better understand the different factors affecting the availability and effectiveness of vertical integration for each case study. The base of the analytical framework was developed by identifying common characteristics within both case studies, which are described in the following section. Further, we consulted agricultural value chain literature to find indications of what may affect the effectiveness of vertical integration for farm income generation.

Carillo [37] indicated that vertical integration depends on farm size. Thus, the market structure and bargaining power seem to be relevant factors for vertical integration. Vertical integration is one of many strategies to increase farm income [37,38]. Thus, the effectiveness of this strategy can be evaluated by its ability to increase farmers’ income. Vertical integration could improve a farmer’s

income through differentiation, lower transaction costs, or harvesting added value [39,40]. Whether or not a farmer will be able to engage in vertical integration depends on certain factors, such as processing costs, demand, or risks.

Pomarici and Sardone [41] analyzed the European wine sector, noting that the EU's wine policy is the only true vertical policy within the CAP; not only farmers are supported, but also other players along the value chain. The need for such support is argued to be found in the high dependency of grape farmers on processing facilities, as well as in the high perishability of the crop. Other studies have also indicated the relevance of vertical integration to counterbalancing product perishability [42,43]. Product differentiation that might be acquired through certification is another factor affecting vertical integration [39]. Rehber [44] indicated that the product type affects the contract type and noted that, for example, sugar beet farming necessitates contract farming. Kvaløy and Tvetervås [45] presented the processor perspective and highlighted that the higher the processing costs, the more processors are inclined to vertically integrate in order to operate their processing facility efficiently.

Based on the above-outlined literature and the common characteristics of our two case studies, we suggest a conceptual framework, as provided in Table 2. This framework is applied to this comparative case study to understand the availability and effectiveness of horizontal cooperation and vertical integration for sugar beet farmers in Belgium and rapeseed farmers in the Wetterau region. The analysis of these two cases is based on two stages as they have been shown to be sufficient to illustrate the effect of crop and product characteristics on market structure, dependencies, demand, competition, and value-added creation. The crop characteristics have an effect on each other as well. For example, high transportability may affect substitutability. Substitutability will be higher if a crop is homogenous, easy to transport, and easy to store. Substitutability has an impact on market competition. If a crop is easy to substitute and homogeneous local demand for the crop may not exist and be difficult to create. If further processing is then required, the creation of local demand may not even be up to farmers but to processors. Thus, value-added may be harvested by processors rather than by farmers.

It is important to note that we do not include factors that increase the likelihood of farmers to vertically integrate based on the farmers' characteristics, as other authors have done [37,46]. Rather, we are interested in whether vertical integration is a viable option at all and if this option increases farm income.

2.3. Case study description

As mentioned above, this research is part of the SUFISA project, which undertook 22 case studies [47]. One aim was to identify cross-cutting issues among all case studies. This applies to the problems farmers were facing, as well as to farmers' coping strategies. One of these strategies are the specific IAs. The analysis of the various case studies highlighted that the sugar beet and the rapeseed case were found to exhibit commonalities pertaining to crop type (see Table 2), as well as the role of the farmers' organization (IA). Furthermore, both case study regions are located in neighboring European countries with relatively similar production systems and natural conditions. Both are commodity crops that need processing and refinement before final consumption. Processing is an expensive activity that needs to make use of scale effects in order to be profitable [48]. Therefore, primary producers cannot take over refinement individually. They must either sell their harvest to a refinery or cooperate and invest in their own common processing facilities. In both cases, farmers are organized horizontally to improve bargaining power and conclude favorable contracts with the

processing enterprise. Additionally, regarding farmers' dependency on the processors, the raw product is relatively homogenous. A main distinction is organic versus conventional products. However, if refineries do not demand and pay for product differences, farmers cannot cultivate them. Thus, value creation may occur through further processing in food and beverage manufacturing rather than by the quality properties of the commodity crop. Since sugar, as well as oil, make up only one part of complex final products, the value of primary producers' input is low. Moreover, through the globalization of sugar and vegetable oil markets, primary producers must compete with world market prices.

2.3.1. Sugar beet case study

Sugar beet represents a particularly interesting case due to the termination of the quota system in September 2017. Since 2006, the quota system has undergone a major overhaul, aiming at a stepwise adaption to free-market conditions. This meant not only a reduction of distributed quota, but also a considerable reduction of the minimum price for sugar beet. Since the sugar beet campaign of 2016/17, sugar beet farmers have been vulnerable to market price fluctuations, putting an end to the secured profitability of sugar beet cultivation. Apart from this, sugar beet is an interesting case study due to the high concentration at the manufacturing level. The number of sugar beet refineries has reduced dramatically since 1970. Today, only two sugar beet refining companies and three refineries remain in Belgium. While this instance did not pose major problems in the past, concerns regarding market power are now being raised [49]. During the quota period, sugar beet farmers in Belgium negotiated interprofessional agreements collectively through the sugar beet farmers' association (CBB) with the refineries. Thus, all aspects apart from the price (which was predetermined by the EU) were negotiated commonly. This approach aimed to create a level playing field among farmers by increasing transparency and setting common conditions for all farmers, as well as between farmers and refineries by counterbalancing the concentration on refinery level. Until the campaign of 2016/17, this approach seemed to have worked well.

Belgium is the fifth-largest sugar beet producer in the EU, with a total harvested sugar beet area of approximately 56,000 hectares in 2016 and 65,000 hectares in 2017. This represents approximately 4,5 percent of the agricultural area in Belgium. The total sugar production from sugar beet in Belgium was approximately 644,000 tons in 2017, produced by around 7,190 farmers [50]. Between 1968 and 2017, the number of sugar beet farmers reduced from 36,114 to 7,190. Since 2006 alone, 6,184 farmers have terminated sugar beet cultivation. The number of sugar beet growers has been declining steadily over the last decade, with a sharp decline occurring between 2007 and 2008. The concentration at the refinery level is even more pronounced. In 1872, 174 sugar beet factories could be found in Belgium, but there are now only two [50,51].

The role of horizontal cooperation in the Belgian Sugar beet case

The Belgian sugar beet farmers' association (CBB) was founded in 1965 and is officially recognized by the European Union as a producer organization. The CBB supports farmers' interests on regional, national, and international levels. To allow proper representation, they have four regional subgroups and are a member of the international confederation of European beet growers (CIBE). The association provides statistics and has a newsletter and a journal discussing relevant issues.

Table 2. Analytical framework to analyze the availability and effectiveness of horizontal cooperation and vertical integration. The categories within each row are the extreme endpoints of a scale. Thus, qualitative values can be identified along the respective scale.

	Perishability	Transportability	Homogeneity	Substitutability	Direct marketing	Processing	Processing costs	Value of end product	Emerging local or global market dynamics
Crop characteristic	High/Low	High/Low	High/Low	High/Low	Possible/Impossible	Needed/not needed	High/Low	High/Low	→Market structure, dependencies, competition, demand, added value
Product characteristic	High/Low	High/Low	High/Low	High/Low	Possible/Impossible	Needed/not needed	High/Low	High/Low	→Market structure, dependencies, competition, demand, added value

Up until September 2017, the sugar beet markets in Europe were protected by a quota system. Hence, prices were set by the European Union [52] rather than by the market. Thus, while the CBB was relevant before this date, its relevance increased thereafter. We have already outlined that the sugar beet market is highly concentrated at the refinery level. Thus, with the end of the quota regulation, the CBB had the task of negotiating prices with the refineries. All Belgian sugar beet farmers are part of the CBB, which would lead to the assumption that the CBB is sufficiently powerful to counterbalance market power at the refinery level.

The CBB was successful at keeping its members and its strategy to only negotiate as a group. That is quite an achievement, as particularly farmers with larger farms have fewer incentives to remain with the association. If these members were lost, the bargaining power of the association would be reduced as well. However, this solidarity did not help sugar beet farmers to maintain a high price, although prices received for the crop did differ depending on the refinery farmers delivered to. While one refinery maintained the prices of the previous campaign, the other refinery changed its pricing strategy. Farmers delivering to the former refinery were satisfied with their contract, but the opposite applied to farmers delivering to the latter refinery. The results were negotiations that lasted for months, which could only conclude due to the involvement of political actors [53]. For the following campaign (2017/18) a similar scenario took place. While the negotiations with one refinery were concluded quickly, the opposite was the case for the other refinery.

Despite the CBB being exemplary for horizontal cooperation among farmers, it was not enough to secure their income. Nevertheless, well-structured cooperation among farmers allowed them to explore an alternative strategy: vertical integration. This strategy will be explored below.

2.3.2. Rapeseed case study

Rapeseed is an oilseed cash crop that competes on international markets for vegetable oil and meals. In 2014, the rapeseed harvest accounted for 6.2 million tons, but approximately 9.6 million tons were processed in Germany. A volume of 3.8 million tons was imported, mainly from France and Poland [54]. Consequently, the development of the rapeseed price in Germany depends on international markets and on changes in the prices of crude oil, soy, and soybeans. Rapeseed oil prices are coupled with crude oil prices, as rapeseed oil can be used as a food or energy provider. Regional fluctuations in yields have no impact on rapeseed prices.

In Germany, the oil mills usually set prices following the given market conditions and key quality criteria, which are the oil content, the humidity, and the contamination of seeds. This system is well established and widely accepted. Rapeseed supply chains have bottleneck structures because the seeds have to be cleaned, dried, and pressed for vegetable oil production. Due to the concentration process within the sector, Germany has only 10 oil mill companies.

Since Germany is a large country with a large variety of regions driven by heterogeneous conditions for farming, we selected one area (Wetterau district) to exemplify farmers' cooperation and the challenges for an integration of the value chain. The Wetterau district is located in the middle of the German Federal State of Hessen. Both rural and urban structures characterize the area due to its rural towns and villages and proximity to the Rhine-Main conurbation. The region is one of the most productive agrarian regions in Germany: the climate is moderate, and the soil is very fertile. Intensive agriculture is widespread. Arable crop rotation with wheat, oilseed rape, or sugar beet is characteristic. Pork production or dairy is sometimes linked to arable farming. Over the decades, a steady decrease in livestock farming has taken place; only the number of horses increased over time. Approximately 1,300 farms are located in the area, about 55 percent of which are full-time farms. Due to a prosperous regional economy with various industry and service enterprises, unemployment rates are low. Historically, the Wetterau was the fertile backyard of the growing cities of the Rhine-Main area. Farmers' entrepreneurial orientation and close cooperation have a long tradition because they always aimed to address the requirements of these complex marketplaces.

The role of horizontal cooperation in the German rapeseed case

Farmers' close cooperation has a long tradition in the Wetterau district, with a machinery ring (MR Wetterau) established in the 1980s. The MR Wetterau has two daughter enterprises, one of which is HERA (Hessische Erzeugerorganisation für Raps w. V.), an economic association, particularly for oil rape. HERA was founded in 1994; back then, it was called NAWARO – Renewable Materials Organization. NAWARO supported farmers in aligning with and profiting from legislative changes that have taken place since the 1990s. The legal changes aimed to reduce the overproduction of food based on the MacSharry reform in 1992 [55]. Moreover, the production of biofuels was expected to grow due to the 'Electricity Feed-in Law' (Stromeinspeisungsgesetz or StromEinspG [56]) and the Renewable Energy Law in 2000 Erneuerbare-Energien-Gesetz or EEG [57]. Both regulations define the framework for financial support to ensure the profitability of the cropping for biofuel production.

In the 1990s, NAWARO's activities focused on negotiations among a biofuel processor in Nordrhein-Westfalen and farmers' representatives. This initiative started with 150 members and 500 ha of rape from set-aside areas. The aim was to realize the highest possible price for the member farmers and to manage the registration and subsidy payment for their set-aside-land for its members [58]. NAWARO offered biodiesel, biodiesel-service stations, and biodegradable lubricants and provided farm advice. The initiative managed to set up a regional market for biofuels in cooperation with other distributors and machinery rings in the wider region. The consortium of steadily expanding farmers' organizations was a successful model that realized higher added value for rapeseed.

Although nationally produced biofuel volumes and the proportion of biofuel in fuel mixtures for vehicles have remained relatively stable in Germany, even after the economic crisis of 2007/08, the area for rape cultivation for biofuel shrank [59,60]. However, the production of renewable energy from Wetterau farming was less cost-effective than in other areas, and NAWARO adjusted its strategy and switched to sales with the food industry. This restructuring led to a reorientation of NAWARO, which became HERA.

For several years, HERA was very successful, with a contract-based cooperation with a large-scale food processor. This contract included environmental standards and payments for participating farmers [58]. Farmers received a slightly higher price (1–2 €/ton) for their environmentally friendly production. During these years, HERA was the role model for this international processing enterprise, but the involved oil mill closed down, and the food corporation shifted its vegetable oil production to northern Germany. Moreover, the CEOs of the corporation lost interest in the oil processing branch and decided it should be outsourced. As a result, the oil mill in the area was closed, and this private agri-environmental scheme for oil seed rape farmers in the Wetterau ended [61]. Due to these changes in the food corporation, Wetterau farmers experienced reduced profits from arable farming and higher economic risks with oilseed rape cultivation.

3. Results

3.1. *The role of horizontal cooperation in the supply chain*

3.1.1. Comparison of past strategies aiming to tackle current challenges

As noted above, farmers need to develop strategies to maintain or improve their financial situation.

The interviews allowed us to identify several potential strategies (see Table 3). Most of these strategies were either fully exploited or only of theoretical nature. One of these strategies is vertical integration. Given the importance of vertical and horizontal integration to improve the economic stability of the farm, we are interested in further investigating these strategies. Before doing so, we briefly outline other potential strategies and explain why they are not viable.

Table 3. Comparison of past strategies between both case studies.

Strategy	Sugar beet case study	Rapeseed case study
Choosing another manufacturer	It is impossible to choose another refinery due to high transportation costs and no alternative choice in proximity.	Farmers have alternative options to sell rapeseed: to mills, distributors, at commodity exchanges, futures exchanges (different types of contracts). However, these sales channels do not ensure profitability in low price years and do not cover additional environmental standards.
Innovation	This strategy refers to innovation regarding cultivation technique, inputs and seeds. Innovation is seen as the most important strategy of the past, but farmers indicated that a limit has been reached.	Innovation has been an important strategy to maintain or even increase income. However, this strategy is now not sufficient to maintain income.
Intensification–upscaling	Intensification in terms of more output per hectare is covered by innovation. As stated, this strategy might be exhausted. Upscaling refers to increased farm size to take advantage of scale effects. However, farmland is limited and most farmers cannot expand their operations.	The same is true for the German rapeseed case for both the exhaustion of innovation as a strategy and regarding the availability of land for agricultural purposes.
Alternative crops	For some farmers, this will be an option. Still, several factors must be taken into account when this strategy is considered. If a larger proportion of sugar beet farmers switches to another crop, the market for the alternative crop may crash. Generally, the market situation for alternative crops needs to be considered. Other factors that limit the viability of this strategy are, crop rotation, soil and climatic conditions, or a lack of buyers.	Rape has a positive effect on crop rotation with wheat and other cereal crops. Without rape, rotational benefits would vanish. Risks will be higher, and the system’s resilience will be lower. Rape is expected to realize a higher profit. Without this crop, the economic sustainability of the arable system as a whole might be at risk.

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Strategy	Sugar beet case study	Rapeseed case study
Risk management	Other insurance mechanisms have been suggested that are more synchronized with climatic and market conditions. Although there might be some scope, it was not mentioned as a main strategy.	On the EU level, some stakeholders promote policy support for insurance mechanisms, although German policy does not support this initiative. The traditional insurance system works well, with farmers deciding which yield insurance type they want to choose.
Branding	One sugar refinery is already using a brand that has high customer recognition within Belgium. However, this does not affect the farmers' revenue positively.	The food industry has sustainability standards for its B2B marketing. These standards do not cover production systems on the farm. There is not enough demand from retailers (consumers), such as higher agri-environmental standards in rapeseed cultivation.
Alternative end-products	With sustainability becoming increasingly important, other end-products may increase demand and thus prices. However, alternative end-products such as biofuels or bioplastics, both of which compete with products based on cheap petroleum, are not yet generating enough demand.	There are several alternative end-products from oilseed rape. However, none of these ensures higher prices for higher sustainability standards because they are anonymous commodity inputs in various types of products such as animal feed, pharmaceutical crèmes, lubricants, etc.
Additional income	Within the farm household often already at least one member has employment outside the farm. Thus, this strategy is exhausted.	If farming was no longer profitable, farmers would find an alternative employment in the area. Due to low unemployment rates and high income in non-agricultural sectors, farmers would stop farming.
Striking for better prices	Farmers pointed out that if they would not deliver their crop within a campaign, the refinery would need to close down permanently. Hence, this strategy is counterproductive and not picked up.	Rapeseed farmers would not be able to improve their situation by striking since their commodity is substitutable by global supply.
Strengthening the farmers' union	The CBB is already a role model for a farmers' association. It was not stated that the organization could be improved considerably or that such a change would improve the farmers' position.	Farmers mostly intend to stay with HERA since they believe in the association's potential to develop new strategies ensuring profitability of rape production.

Continued on the next page

Strategy	Sugar beet case study	Rapeseed case study
Freedom of choice	This strategy referred to farmers being able to decide themselves, when to sow and when to harvest their crop. While this was mentioned during interviews, farmers did not expand on it. Mainly, restrictions are caused due to logistical reasons, as refineries cannot process all sugar beets at the same time. While certain improvements may be possible in this regard, this strategy will not be a solution to the farmer's problem.	Since most oil mills often have insufficient storage capacities for oilseeds during the harvesting season (farmers have no storage), farmers cannot expand or change the harvesting time due to quality reasons and weather conditions.
Leaving the farmers' union	Sugar beet farmers in Belgium are obliged to be part of the CBB. Only some farmers would prefer abandoning the farmers union. Probably only large farms would profit from individual contracting.	Since prices realized by the PO were lower than expected recently, more farmers seek individual sales. This strategy only works for larger farm businesses with higher volumes. Small farms with reduced negotiation power do not realize higher prices.
Sustainability	On one hand, sugar beet is perceived as being superior to sugar cane regarding the sustainability of the production process (including environmental as well as social variables). On the other hand, sugary products are products that are potentially less consumed by environmentally conscious consumers. Thus, the willingness of consumers to pay for a sustainable product is low.	Contract farming with the food corporation generated additional income and farmers implemented higher agricultural environmental standards. This model solution of vertical integration ended. Since then, farmers tried out different approaches in recent years, again aiming to realize financial compensation for sustainability standards. An agreement with a local water supplier that compensated for reduced N-levels has a risk of non-compliance under unfavorable weather conditions.

The information provided in Table 3 does not only show that many strategies have already been implemented and that these are exhausted. It provides insights into market power-related issues. For example, it is difficult to impossible to choose another processor. That is, even if alternative end-uses for the raw material are considered. Farmers can neither easily switch to another crop where sales conditions are better. Due to the product characteristics, direct marketing or added-value activities are either impossible or difficult. These factors place farmers in a vulnerable position with limited bargaining power. To summarize the complex situation that leads to reduced bargaining power of sugar beet farmers in Belgium and of rape seed farmers in the Wetterau, the analytical framework introduced above (Table 2) is applied. The application of the analytical framework to the two case studies is presented in Tables 4 and 5.

The most important aspects of the sugar beet case are farmers being faced with monopoly, having

no option to sell their crop to another buyer (dependency). All strategies seem to be exhausted or close to exhaustion. Additionally, the characteristic of the crop (high perishability and low transportability) increases the inflexibility of farmers. Due to the perishability of sugar beet, the crop needs to be processed shortly after harvest. Thus, farmers cannot store the crop and wait for better prices. Farmers cannot sell their product directly to a final consumer (direct marketing) since the crop needs refinement (processing). The traditional refinement process is cost-intensive (processing costs), making it impossible for individual farmers to further process their crop themselves.

The situation for the Wetterau rapeseed farmers is similar. Global competition reduces their space for maneuver to negotiate better prices. According to the consulted farmers, on-farm strategies to maintain or increase their income are exhausted. As Table 5 shows, the invisibility (homogeneity) of rapeseed oil within final food products reduces transparency and hence the ability to raise awareness about a high-value ingredient (value of end product). Direct marketing is again difficult, since the seeds need processing, which is expensive and less efficient on a small scale.

This ostensibly hopeless situation calls for new pathways. The remaining strategy that has not been discussed yet is vertical integration. The potential of this last strategy will be outlined in the next section.

3.2. Vertical integration as a major future strategy

3.2.1. The Belgian sugar beet case

As described above, horizontal integration in the Belgian sugar beet sector can be regarded as exemplary. Therefore, (1) it can be stated that this is a strategy that has already been implemented successfully, but that this strategy is (2) not sufficient to balance off market concentration on the refinery level. From this, it can be concluded that further cooperation may be needed. Vertical integration was a topic often mentioned by farmers, mostly in relation to farmers being engaged in sugar production.

Another option mentioned by farmers was *selling the land to the refinery*. This was a cynical statement by a farmer during the interviews. Despite the cynical character of the statement, it was taken as a potential strategy to be further discussed during the focus groups. As soon as the strategy card *selling land to refinery* was discovered, a controversial discussion started. Initially, there was no understanding of why such a strategy card was even put on the table, but during the course of the discussion, it became clear that for some farmers, this is the last resort. Selling the land to the refinery would allow farmers to stay in business and retain them from the shame of losing their property. While selling land to other farmers would make such a step public, selling land to the buyer remains undisclosed. However, the focus group discussion revealed that such a step is related to a hopeless future perspective and is therefore not a strategy that aims to maintain the farm business in the long run.

The other strategy regarding vertical integration is getting involved in sugar production. Although farmers do hold shares within the sugar refineries, it was bitterly stated that not taking over the refinery as it was offered for sale was a missed opportunity. The shares do not allow Belgian sugar beet farmers to compensate for lower sugar beet prices, nor do they equip them with an increased right to say within the refinery. This situation is compared to Germany, where farmers commonly hold more than 50 percent of the refinery they are delivering to. In contrast, according to the interviews, farmers hold only about six percent of each of the Belgian refineries.

The ability to harvest dividends is perceived as an advantage of German farmers. Moreover, one interviewee indicated that the German farmers do not understand the Belgian farmers and thus do not understand why the Belgian farmers need different conditions than the German farmers. In any case, it is also understood that farmers in Germany can neither dictate the price since they are also obliged to increase profits to satisfy the other shareholders.

Therefore, it may not come as a surprise that a model that gives farmers more control over production is palatable. The Dutch sugar refinery serves farmers as an example in this regard. For some farmers, getting involved in sugar processing to a larger extent is a promising strategy for reducing the risks caused by price volatility.

In the course of the case study investigations, Belgian sugar beet farmers started planning a cooperative sugar refinery that should have been operating in September 2021. Belgian sugar beet farmers had two options. The first option was to buy more shares, but this was not the option that the farmers took up, perhaps due to the fact that buying shares of a foreign company may only increase their income in terms of dividends, but does not improve the communication flow or the right to say within the company. Another option, which is indeed much more venturous, is building their own cooperative refinery.

The possibility of building a cooperative refinery was first mentioned in one of the focus groups (February, 2017). At this time, the idea was not well developed. However, a couple of months later, the idea became more concrete, and a feasibility study was commissioned [62,63,64]. After a positive estimation regarding the feasibility, at the beginning of 2018 farmers decided to build the refinery. Not much has been made public at that point, but the short report in the *De Bietplanter* [65] indicated that the amount of sugar beet refined within one campaign would be more than for the international Belgian sugar refinery. As we know from the focus groups, the new refinery is the result of the internationally connected Belgian sugar refinery not accommodating the needs of the sugar beet farmers. During the focus group, it became apparent that instead of additionally planting sugar beet for the new cooperative refinery, farmers would switch to the new cooperative refinery. Subsequently, this would mean the end of refining sugar for the internationally connected Belgian sugar refinery. This also means that instead of meeting farmers halfway, the German parent enterprise prefers to lose one of its most profitable subsidiary companies. However, after three years of searching for sufficient financial resources, the plan to set up a refinery owned by farmers needed to be buried [66]. Thus, the unfortunate combination of factors, summarized in Table 4, created a situation that does not permit Belgian sugar beet farmers to vertically integrate.

3.2.2. The German rapeseed case

HERA and individual farmers face competition from the global market for oilseed crops. For that reason, they aim to develop a new strategy that helps to tackle the economic challenges. The objective is to realize prices or payments that compensate for agri-environmental services above the legal baseline, such as reduced fertilizer application, bee protection measures, etc. Since standards of arable farming and the related controls are relatively high in comparison to some Eastern European countries, for example, farmers agreed that either a self-organized marketing channel for the high-value product would be necessary or a payment for environmental-services would be needed. However, adequate strategies to implement such a business goal are still missing.

Since there is no public or private program available for the support of higher agri-environmental

standards in rapeseed cultivation, this idea was dismissed by the farmers' group. However, the development of a regional marketing strategy for vegetable oil from rape cultivation in Wetterau is currently being discussed as a potential strategy.

During the period of legislative support of alternative energy production, farmers' strategy with the producer association in Wetterau was a success story. However, with changing economic conditions, the producer organization adjusted its strategy, focusing instead on supplying the food industry, having a model contract including agri-environmental payments with a food corporation. As pointed out, with increasing global competition and the lacking engagement in sustainable oil production of the business partner, this path was no longer profitable. During recent years, the producer organization sold the farmers' harvest to different processors or sales companies. However, price negotiations are difficult due to the strong competition on the commodity market for oilseed crops. The highly concentrated processing industry purchases nationally and internationally. There are three potential strategies for the future that are related to vertical integration: (a) direct marketing of individual sales, (b) increasing public awareness, and (c) common marketing within Wetterau for a regional product.

The idea pertaining to direct marketing of individual sales has been realized. The producer organization supported an initiative of some farmers and farm shops to produce a small amount of vegetable oil in glass bottles. Around 1,000 bottles per year have been produced annually in the area. However, HERA managers cannot identify a potential market for increasing sales, so this is not a sufficient strategy for rapeseed farmers in the region. Apart from the lack of an ample market, the storage time of the final product is limited because the oil needs to be used within one year for quality reasons.

Farmers wish to increase public awareness about their sustainable production systems to customers and thus create added value. They agree that self-marketing of the high-value production process would be necessary, but an adequate strategy is still missing. They argue that regional and GMO-free production is appreciated by consumers, but currently not paid. Social media could be a suitable instrument to reach a wider public and (potential) consumers within the Wetterau area by communicating quality aspects of their product. It should be possible to highlight the quality asset of oilseed rape produced in Germany compared to imports.

Finally, common marketing within Wetterau for a regional high-quality product could be a promising strategy. Members of the producer organization and the farmers' union representatives are currently in the process of negotiations with a retailer who is currently interested in strengthening its regional and high-quality assortment. However, various issues have to be discussed. The processing needs to be subcontracted by a large-scale oil mill. Transport of seeds to the mill and the transport back into the region represents an additional effort. Processing in the mills needs to be separated from other seeds; otherwise, the project risks losing credibility. The size of containers or bottles is a key decision addressing the final buyer (individual households or catering/processing businesses). Regional production cannot depend on only one customer, as it would increase risk. Some meetings between key individuals took place already, and time will show whether a vertical integration strategy will emerge from the initiative aiming to establish a marketing channel for a locally produced high-quality rapeseed oil.

In contrast to the sugar beet industry studied, vertical integration was seen as a feasible option for Wetterau rapeseed farmers. This is because processing costs are lower, and diversification is possible. The factors contributing to the slightly more favorable situation of rapeseed farmers are summarized in Table 5. However, the investments (and related risks) that Wetterau farmers need to undertake remain considerable, so it cannot be guaranteed that vertical integration will be successful.

Table 4. Analytical framework applied to the sugar beet case.

	Perishability	Transportability	Homogeneity	Substitutability	Direct marketing	Processing	Processing costs	Value of end product	Emerging local or global market dynamics
Sugar beet	High	Low	High	Low	Impossible	Sugar factory facilities needed	Not applicable	Low	→Low market concentration, high dependency from processors, low competition among national farmers, high demand from processors, no added value.
Sugar	Low	High	Medium	High	Possible	Not needed	High	Low	→High concentration on national market, high dependency from farmers, high dependency buyers, high world market competition, increasing global demand, increased added value.

Table 5. Analytical framework applied to the rapeseed case.

	Perishability	Transportability	Homogeneity	Substitutability	Direct marketing	Processing	Processing costs	Value of end product	Emerging local or global market dynamics
Rapeseed	Medium	High	High	High	Impossible	Oil mill facilities needed	Not applicable	Low	→Low market concentration, medium dependency from processors, high competition on the vegetable oil fruit market, medium demand by processors, added value possible
Oil	Medium	High	Medium to low	High to low	Possible	Not needed	Medium	Low to high	→Medium market concentration, low dependency from local production, high dependency from food and energy industry, high world market competition, demand depending on global oil markets, increased added value compared to rapeseed

4. Discussion

The above-presented analysis compares two case studies: sugar beet in Belgium and oilseed rape in Wetterau, Germany. Although farmers are located in different countries and produce different crops, they share similar challenges, which are related to the characteristic of their production and the liberalization of markets. In both cases, farmers face the obstacle of direct marketing to final consumers due to the need to process the raw product. While farmers may process the crop themselves, this step is connected with substantial investment costs. Moreover, since profitable processing calls for a minimum scale, vertical integration is also related to logistical challenges. For these reasons in the past, farmers of our case studies abstained from this step and instead sold their crop to a processor. However, due to changing conditions, this sales strategy is no longer profitable.

The need for processing and the potential invisibility of the product in other food and non-food products has the effect that increasing consumers' value for their product is difficult. Consumer valuation could be increased by awareness-raising strategies. While there seems to be some scope in the rapeseed case, there is less so in the sugar beet case. The low valuation of the two case study crops by consumers reduces farmers' ability to negotiate higher prices.

It has been pointed out that farmers of both case studies identified and experimented with various strategies to maintain or increase their income (see Table 3). However, a bottleneck has been reached, as past strategies are exhausted, so new pathways need to be taken. In the sugar beet case, farmers strived to set up their own refinery, but failed due to the lack of capital. Wetterau rapeseed farmers assess three different pathways. A main aspect of these is increasing consumers' awareness about the product to, in tandem, increase the visibility of the product and consumers' valuation of rapeseed oil. This, together with either direct marketing or a strong partner who supports the marketing of the product, may be a fruitful future strategy.

The introductory section highlighted that European policies support vertical integration and horizontal cooperation to support farmers' market position. However, we found in both case studies that these options are either insufficient for various reasons or not available at all. While farmers can cooperate horizontally (farmers' unions CBB and HERA), this solution alone cannot counterbalance the overwhelming market power downstream the supply chain. In both cases, vertical integration was seen as an option by stakeholders of the industry. However, they did not see a way to realize such a solution. Therefore, the strategies supported by European policies have shown to be unsuccessful in ensuring farmers' income from sugar beet and oilseed rape production. The SUFISA project gave examples where EU policies supporting vertical integration have helped to maintain cost-effective farming systems. However, the two case studies selected for this paper indicate that the general idea that vertical integration is a way to ensure the profitability of farming operations does not apply generally. Vertical integration as a strategy to support farm income may work for other crops or other contexts. However, the case studies presented in this paper show, for the situation of high costs for investment in processing plants, that farmers might be unable to engage in vertical integration activities. For these situations, farmers' associations either need financial support for the realization of vertical integration, or alternative coping strategies need to be provided. The Belgian sugar beet case study shows that the barrier was not the lack of political support, but rather the magnitude of the endeavor and thus the capital needed. Though, it also needs to be highlighted that these conclusions are based on a comparative case study, including only two cases. Thus, further verification and thus further research is needed.

The developed analytical framework (Tables 2, 4, and 5) have been useful in pinpointing the product characteristics that create circumstances that make vertical integration as a strategy to increase farm income accessible or not. Factors such as product characteristics (for example, perishability), the need to process the product, and specifically processing cost have shown to be relevant in determining whether farmers can engage in vertical integration. For future analysis, it is relevant to take each factor into account as the composition of factors may change the respective situation. Comparing the sugar beet and the rape seed cases with other cases described in the literature, it seems that depending on the respective composition of different factors, the availability and effectiveness of vertical integration to increase farm income differs. For example, fish is perishable but easy to transport; there might be several processors fishermen can deliver to, and fishermen may also have the possibility to participate in direct marketing. Grape and wine production seem to be similar to the sugar beet case in terms of perishability and dependence on processors. However, differentiation to increase the value of the end-product does not seem to be an option in the studied sugar beet case. This is a potential advantage of rape seed, where consumer demand for high-quality oil could be created.

Thus, the applicability and success of vertical integration may be dependent on crop characteristics. Further exploratory and empirical research are needed to clarify the reasons for the failure of vertical integration. We suggest that the failures can be found in some common characteristics of the two studied crops (Table 2). The respective crop influences the need for processing, the homogeneity and thus the ability to create niche markets for that product, the perishability, transportability, and possibilities for substitution. These factors not only affect the bargaining power of farmers [36], they may also affect the applicability and successfulness of vertical integration. The common characteristics make vertical integration difficult or impossible. As pointed out above, for the rape seed case, some characteristics may be easier to change than others. Small-scale processing may be a viable option for rapeseed producers if demand for locally sourced and produced high-quality oil is created and maintained. Based on the results of this comparative case study, it is necessary to analyze whether vertical integration is a viable option at all in specific cases. Table 2 can provide a starting point for such an analysis. Further, the applicability and the success of vertical integration could potentially be supported through a combination of policies. In the rapeseed case, demand for locally produced oil could be instigated and maintained in conjunction, for example. The findings presented in this comparative case study are relevant to be considered in the policy discourse, as vertical integration may, in certain cases, not deliver the envisioned solution.

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Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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