Project acronym: SURE-Farm
Project no.: 727520

Start date of project: June 2017
Duration: 4 years

FoPIA-SURE-Farm 2 Case Study Report Flanders

Work Performed by P3, EVILVO

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Due date	31/May/2020 (part of D5.5)
Version/Date	Final 27/May/2020
Work Package	WP5
Task	T5.3
Task lead	INRAE
Dissemination level	Public

Supplementary Materials B. FoPIA-SURE-Farm Case Study Report Belgium

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Please cite this report as:

Bijttebier, J., Wauters, E., Coopmans, I., 2020, 'FoPIA-SURE-Farm 2 Case Study Report Belgium'. In: Accatino, et al. D5.5 Impacts of future scenarios on the resilience of farming systems across the EU assessed with quantitative and qualitative methods. Sustainable and resilient EU farming systems (SURE-Farm) project report.

This Project has received funds from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 727520

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1 Introduction

1.1 Desk study for the Belgian FoPIA-SURE-Farm 2 workshop

Due to the COVID-19 crisis, it was not possible to run the second FoPIA-SURE-Farm workshop for the Belgian case study. This report constitutes a desk assessment based on previous activities done with stakeholders and on literature. We consider this report as a preliminary analysis that could be confirmed and completed in a second moment with the contribution of stakeholders. Performances of main indicators and relevance of challenges could be elaborated starting from the material of the FoPIA-SURE-Farm 1 workshop. Besides unforeseen challenges, we considered that challenges occurring in the present are likely to affect the system in the future. Concerning the development of alternative systems (both system decline and improved systems), we started by drawing the causal loop diagram describing all the causal relationships between indicators related to main challenges and functions in the system. This CLD enabled us to identify interacting thresholds when an indicator trespasses its tipping point. Without stakeholder input, we were unable to identify future alternative systems nor tipping points for individual indicators resulting in system decline. We described current levels of indicators, and discuss whether they are close to a tipping point based on literature and earlier activities. Instead of describing future alternative systems, we describe strategies that potentially might be applied in the near future to deal with current (and probably) future challenges. Finally, we describe how the current system and these potential future strategies are compatible (or not) with the Eur-Agri-SSP scenarios. In the discussion, we touch upon the impact on unforeseen challenges (with the example of the COVID-19 situation), and how it might affect and change perceptions of stakeholders.

1.2 Main indicators, resilience attributes and challenges

The case study in Belgium is the intensive dairy farming system in Flanders, located in the north of the country. The region is characterized by a very high population density (484 inhabitants/km^2 in 2019). Agricultural activities in the region vary widely, with about 12% of the total farm population being dairy farms. The main functions of the farming system are providing affordable and healthy food and maintaining natural resources (soil, water, and air) (Coopmans et al., 2019). At the farm level, the system needs to ensure a viable farm income and a good life quality for farmers. Indicators that are most representative for these main functions (function indicators) are presented in Table 1. In general, based on the results of FoPIA-SURE-Farm 1 workshop, stakeholders believe function indicators have a low-to-moderate performance (Table 1). The general resilience in the area is mostly realized by the resilience attributes as presented in Table 2. Presence of these attributes is low to moderate.

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Table 1. Main indicators and their performance and development. Source: Coopmans et al. 2019

Main indicators	Current level (score 1:5)	Current level (explanation)	Current development
Real price for the consumer	**3.1**	There is an increased availability of more expensive “luxury” milk on the market	The real price of milk has been decreasing for decades, due to technological development. However, in more recent years, prices have been **rising**.
Labor income	**2.3**	Rather low (low margins due to increasing costs of production combined with fluctuating milk price), although high differences between individual farms	**Fluctuating**, very much following trends in fluctuations of the milk price
Total carbon footprint	**3.3**	Agriculture responsible for 9.34 percent of the total Flemish GHG emissions in 2016, of which more than one third due to rumen fermentation	Total GHG emissions in agriculture: Strong decrease in the period 1990-2008 **Stagnation and even increase** from 2008. CH4 emissions by livestock production have decreased since 2000 with 2%. Evolutions in CH4 emissions are related to total number of livestock units, and milk production/cow.
Total milk production in Flanders	**3.2**	4 billion liter (Belgium); average of 625 000 liter/farm (Flanders) (2018)	**Rising**: During the last decade, milk production in Belgium has increased by more than 30%. In 2018, milk production increased by almost 4% compared to 2017. This makes the Belgian dairy sector one of the largest growers in Europe.

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Table 2. Main resilience attributes and their presence in the farming system. Source: Coopmans et al. 2019; Platteau et al., 2018.

Main resilience attributes	Current level (score 1:5)	Current level (explanation)	Current development
Spatial and temporal heterogeneity	**3.4**	Participants think that there is a wide diversity in farm types regarding their economic size, degree of intensification and of specialization.	Stakeholders were convinced that the general direction of the system will remain towards **more intensification and scale enlargement.** The market is constantly pushing farmers to be more efficient and to deliver high quality products for lower prices.
Coupled with local and natural capital (production)	**3.0**	The moderate score for this subject is somewhat contrasting to what would be expected of an intensifying system. In literature it is argued that intensification often results in a negative resource balance. However, the participants of the FoPIA-SURE-Farm 1 workshop argued that nowadays less input is needed for a higher output due to the higher production efficiency.	
Socially self-organized	**3.1**	Many farmers are engaged within an agricultural organization. Half of Flemish dairy farmers are member of the cooperation Milcobel for processing their milk: *"The objective of Cvba Milcobel is to purchase and transport the milk produced by the dairy farmers on their farms and to develop activities that guarantee a sustainable sale of the milk and that allow a fair milk price to be paid."*	Due to the size of this cooperation, part of the member believe that their participation in decision making is insignificant. Government stimulates development of producer organizations to improve bargaining power of farmers selling milk to private companies. This should further **increase social self-organization**.
Infrastructure for innovation	**3.0**	One of the strengths of Flemish dairy farming is the high level of technical know-how. A wide spectrum of formation/education activities is available, a lot of initiatives to stimulate networking and knowledge exchange between farmers.	Intensification and scale enlargement are very often accompanied by making large investments. **This decreases flexibility towards change and innovation capacity.**
Supports rural life	**3.0**	there is a moderately balanced population in sense of age and that there is a moderate availability of facilities	Succession rates are low within the farming system, just as the availability of external labor force.
Appropriately connected with actors outside the farming system	**3.1**	Some retailers are taking initiatives to set up long-term contracts with individual farmers. This is a positive evolution as farmers are more secure on sales and milk price. However, this connection should be improved in the future as more cooperation within the value chain is needed to deal with price volatility in international markets.	Government stimulates development of producer organizations to improve bargaining power of farmers selling milk to private companies.

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Main challenges for the farming systems are:

- *Low profitability* due to a combination of high production costs and periods with persistently low market prices. The European market was highly protected for the last decades and milk prices were relatively stable. However, since 2007, the dairy sector has been subject to high price volatility. This is mainly due to the gradual decrease of protection measures by the CAP, with the abolishment of the quota in 2015. The market in dairy products is strongly reliant on export, and as a consequence, milk price fluctuations have a major impact on pursuing a stable income year after year.

- *Climate change* (both mitigation and adaptation). Extreme weather events (drought, wet conditions etc.). Farmers have suffered from several years of extreme droughts which have affected profits in more recent years. Furthermore, livestock sector is responsible for a substantial part of GHG emissions in the region. This has a negative impact on the image of dairy farms, and puts pressure on the sector to take action.

- *Stringent and complex manure legislation*: Water quality in the region results in very stringent manure legislation. Manure legislation in Flanders has become more and more stringent as water quality in the region is still suboptimal. For farmers with a high livestock density, manure surplus might increase, making it more difficult to get rid of manure (increase of costs).

- *Land availability* (high competition for land combined with high land prices). Competition for land, accompanied with high land prices and low availability of land, makes it difficult to acquire additional land. Even if land is available, it is often too expensive to buy as a farmer. Even if the land is rented, the owner of the land might change or the owner might decide to sell the land, which makes farmers insecure about land availability. In a region where scale enlargement is a major strategy to deal with low margins, access to land is a major challenge for many farmers.

- *Labor pressure*. Many farmers are dealing with a 'labor dilemma': they should decide to either relying on family labor, and/or thinking of hiring external labor, or to invest in automation in order to be less dependent on expensive labor. It is not easy to find external labor to help farmers on a structural basis. Temporary work force is available through specific organizations but the quality of these workers is perceived as unpredictable.

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2 Status quo of the farming system

In this part of the report, we describe what is needed to retain the current state of the farming system. We will describe the main variables within the system, that need to be considered, to retain current development of the farming system. This is based on literature study. These variables and their relative position to the perceived critical threshold are provided in Table 3. Before going into the variables and the threshold values, we will briefly describe current state of the farming system. The dairy farming system in Flanders is mainly characterized by a decreasing number of farms but increasing milk production as a result of ongoing intensification and scale enlargement. This resulted in a 10% increase of the number of dairy cows between 2007 and 2017. The average number of dairy cows on specialized dairy farms increased from 50 to 85 dairy cows within the same period. The number of farms with dairy cows decreased, but the decrease is less pronounced for specialized dairy farms. Scale enlargement and intensification as strategies are mainly a response to react upon decreasing margins. Larger, more intensive farms seem to come with benefits regarding economies of scale. Another important aspect is that machinery and equipment can work closer to its maximum capacity on large intensified farms. This intensification can be represented by an increase in milk per input of labor, cows per worker, cows per hectare of agricultural land, milk per hectare of agricultural land. The intensification strategy is also supported by relatively high external input use (fertilizer, purchased feed, capital). Technological development allowed for improving production efficiency (per animal unit, per ha, per labor unit) and offered opportunities to deal with higher labor demand on these growing farms and contributes to the more fine-tuned use of inputs such as feed, fertilizer, pesticides and medicines. However, this process of increasing intensity of production is accompanied with environmental issues. The main issues are decrease in soil quality, groundwater pollution, ammonia emissions and greenhouse gas emissions. These environmental issues raised the attention by society to animal welfare and maintenance of natural resources.

Related to the current state of development of the farming system, both at the ecological, economic and social level, several challenges might interfere with further scale enlargement and intensification, as the main strategy within the farming system. In what follows, we describe these challenges and the current levels of corresponding indicators:

1) Low quality of water and soil as natural resources:

Despite increasingly strict regulations on fertilization, the quality of surface and groundwater remains inadequate. Every autumn, a large number of soil samples are taken from a selection of agricultural plots in Flanders for the determination of nitrate residue. In the winter year 2017-2018, the threshold value for nitrate and phosphate concentration in surface water agricultural areas was exceeded in 28% and 63% of these plots (Flemish Land Agency, 2019). Diffuse nitrate losses to surface and groundwater occur when at a certain

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point more nitrate is present in the soil than can be absorbed by crops. Main causes are over-doses of fertilisers, application at the wrong time, with the wrong fertilization technique or a fertiliser type not adapted to the actual situation. In addition, soil quality plays an important role as a precondition for an optimal yield. Soils of good quality are more resilient and more resistant to e.g., climate change, nutrient losses. Organic matter plays a real key role in soil functioning and are currently too low in most Flemish agricultural soils.

2) GHG emissions and global warming:

In 2010, the agricultural sector was responsible for a small 10% of the total Flemish greenhouse gas emissions. Various targets have been set to reduce greenhouse gas emissions. In the light of the emission targets for 2050 (reduction of emissions by at least 80%) the emissions of the agricultural sector will therefore also have to fall sharply and have been specified as follows:

- Enteric emissions will be reduced by 19% in 2030 compared to 2005.
- Emissions from manure management will be reduced by 21% in 2030 compared to 2005.
- Increased nitrogen efficiency (less N in feed and precision fertilization) will reduce soil emissions by 19% in 2030 compared to 2005.
- By saving energy and using renewable energy, energy emissions will be reduced by 44% in 2030 compared to 2005.
- In addition, the agricultural sector can also make a reduction contribution through carbon storage in the soil (see further under the chapter on land use, land use change and forestry).

Expectations regarding emissions from the Flemish agricultural sector in 2020 show that additional measures will be needed to achieve the 2050 objectives (Vlaams klimaatsbeleidsplan 2021-2030).

3) Low succession rate:

The average age of farm managers in Flanders has risen continuously in recent years from 50 years in 2007 to 54 years in 2016. In 2016, an average of 18% of specialised dairy farms indicated to have a successor. The share of dairy farms with a successor varies according to the economic dimension, but is highest for the largest farms (30% for standard output >25,000 euros) (Statbel, Statistics Belgium)

4) Small parcels, land availability and land prices:

Agricultural land is an important production factor, and because of the scarcity in the highly urbanised Flanders it is an expensive and strongly limiting factor for agricultural production. Many aspects play a role in the value of agricultural land. The price per hectare of agricultural land depends on the location with a lot of variation between provinces, the environment, the soil structure, the quality of the soil and the size of the plot. In addition, it is also important

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whether the land is rented and or not. The average price of a Flemish hectare of agricultural land in the first half of 2018 is 52,137 euros. This is an increase of more than 35% compared to 2014. In that period 2013-2018, the agricultural land price in Flanders increased annually by 6.2%. The average area of an agricultural plot sold in Flanders in 2018 is just over 1 hectare (Platteau et al., 2018). Several stakeholders (based on grey literature) indicate that prices have become unaffordable for farmers. Farmland has become unaffordable and may be of interest to investors, but it has become too expensive to farm it in a profitable way. Farmers are increasingly being competed away by other players in the open space. Farmers in Flanders are therefore increasingly looking for land elsewhere. More and more young farmers are crossing the border and French farmers are subletting their land to Flemish colleagues, for whom land prices in Flanders are becoming unaffordable.

5) Fluctuating milk prices:

Since government regulation of the EU market in agricultural products has disappeared (quotas, production levies, etc.) and the liberalization of free trade is increasing, operators in the primary sector have become dependent on market-oriented production. Most of the trade takes place with countries within the European Union. The dairy sector in Flanders is also characterised by sufficient processing capacity, which provides a fairly high degree of sales security for dairy farmers. During the last decade, the processing of raw milk into bulk products for export has decreased and there has been an increase in products with a high added value. The increasing production of added value products has a significant impact on the volumes of raw milk needed. For products with a higher added value (e.g. yoghurt drinks), less milk is processed as a raw material compared to what is needed to produce butter or cheese. In the processing chain there is also still insufficient economies of scale and creation of added value, and export opportunities are still insufficiently exploited. All this has contributed to very strongly fluctuating milk prices over the past decade. However, individual dairy farmers themselves have a weak bargaining position in the sales chain (Platteau et al., 2018).

6) Low farm income - High cost of production:

Despite the trend towards scaling up specialist dairy farms in Flanders, dairy farms in Flanders are rather small-scale compared to neighboring countries, which means that economies of scale are not yet fully exploited. The capital requirement of the farms is high, partly due to the high price of agricultural land, buildings and machinery. The return on investments is low. Moreover, due to the increasing market share of supermarkets, and market-oriented production, dairy farmers are often faced with additional demands that are not always accompanied by additional remuneration. The cost of purchased animal feed accounts for a large proportion of the total variable costs on a dairy farm. The general trend to be expected is that feed prices will rise and fluctuate more and more. Labor is also expensive and difficult to find, partly because the labor peaks (milking) are very specific.

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Table 3. Status quo of the system represented via current value for each indicator, and an estimation whether how close each of these indicators is towards a tipping point.

Indicator	Current level	Relative position towards tipping point
Water quality expressed as nitrate and phosphate concentration in surface water	The threshold value for nitrate and phosphate concentration in surface water agricultural areas was exceeded in 28% and 63% of the plots	**Beyond threshold (farming system needs to adapt)**
GHG emissions (enteric emissions and emissions from manure management)	Enteric emissions need to be reduced by 19% in 2030 compared to 2005. Emissions from manure management need to be reduced by 21% in 2030 compared to 2005.	**Beyond threshold (farming system needs to adapt)**
Land price	52,137 euros/ha	**Beyond threshold (agricultural land is increasingly used for other purposes)**
Milk price	fluctuating	**Varying (between individual farms and time as milk price is highly fluctuating the last decades)**

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3 Interactions between thresholds

Above, we have described main indicators and how they might affect current development of the dairy farming system in Flanders. In this part of the report, we describe interactions between variables and give some indication of the domains and scales at which the most critical threshold interactions are likely to occur. The interaction between indicators and variables is shown in the causal loop diagram (CLD) below (Figure 2). The variables are located at the farm level, regional level and global level. The more outwardly in the diagram, the more external the variables to the farming system. For example, global warming and global demand for dairy production variables are externally linked to the region, and measured at the global level. Variables such as population density, soil quality and water quality are measured on a regional basis, but are also external to the farming system. A number of variables are linked to the level of the farming system, including the total number of dairy farms and the capacity of the milk processing industry. Finally, a number of variables are measured at farm level, such as productivity, investment capacity, cost of production, etc. It is immediately clear from the CLD that variables at different levels interact with each other and influence each other directly or indirectly. Central in the CLD are the two strategies pursued by the majority of Flemish dairy farms, i.e. scaling up and intensification. The high labor costs and high cost of agricultural land encourage dairy farmers to intensify, which increases productivity per hectare, per labor force and per cow. Both strategies are aimed at increasing income. Higher income ensures that there is more room for investment, which encourages scale enlargement (reinforcing loop). However, scale enlargement does not necessarily lead to a higher labor income per labor unit, there is such a thing as the optimal scale, but it is not the same for every farm (Van der Straeten et al., 2015). Larger farms have better margins, but there is a limit to this: when the farm becomes too big, the margins per unit of product decrease again. Linked to this, growth strength also plays a role: not growing reduces farm income, but growing too fast again reduces the farm income. Somewhere between these two extremes lies the optimal growth path: the larger the farm, the more growth it can handle as a rule. Moreover, unlimited growth is not possible due to the limited availability of 3 production factors: land, capital and labor. The lack of labor can be partially tackled through automation of milking and/or feeding the cows. However, the lack of land is a lot more difficult, and the result of competition for land driven by the high population density. Intensification as a strategy is rather under pressure due to the negative impact on the environment. Intensification goes hand in hand with a high use of inputs such as fertilizers, purchased concentrates and crop protection products. These have a negative impact on soil quality and the leaching of nitrogen on the farm level, which in turn has a negative impact on water quality at regional level. By focusing on technology, this negative environmental impact is mainly tackled by focusing on efficiency. Through more efficient use of inputs, the negative impact on the environment can be reduced. Various sources indicate that many dairy farmers can still improve efficiency. However, it might be questioned whether improving efficiency will be sufficient to not exceed the tresholds of the variables linked to

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environmental impact indicators both at farm, regional and global level. This will partly depend on development of particular attributes of the farming system, among which policy development and the strength of the research infrastructure for innovation. Another important factor that has an impact on labor income is the milk price. The dairy farmer has little impact on this, and since Flemish dairy farming is a strongly export-oriented sector, variables at regional as well as international level are decisive for the milk price. On the other hand, a strong sector also depends on a secure supply of milk, and therefore on a sufficient number of dairy farms. This number depends, among other things, on the extent to which the continuity of farms is assured. And that, in turn, is strongly determined by income and the availability of land. In conclusion, we can conclude that thresholds of specific variables can be exceeded at farm level as well as at regional and international level and have a direct impact on different dimensions at the other levels.

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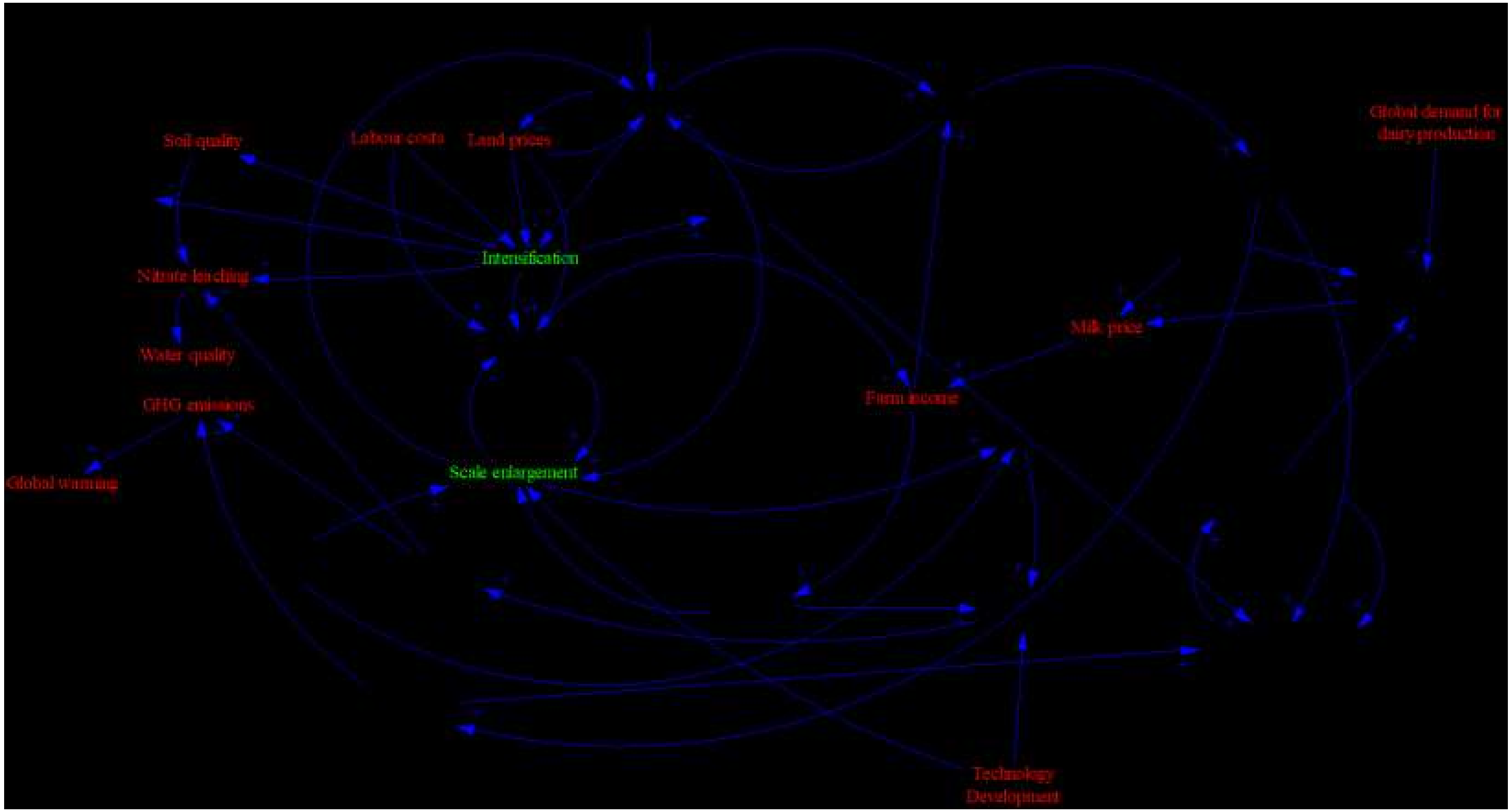

Figure 1: Causal loop diagram of the farming system in Flanders. + implies a positive cause-effect relationship and - implies a negative cause-effect relationship. B stands for a balancing feedback loop and R stands for a reinforcing feedback loop.

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4 System decline

Critical thresholds of important indicators might be trespassed, possibly initiating cascading effects, with an ultimate deep change in system functioning and identity. Defining the levels of the thresholds of the current state to remain as a possible future state is very difficult, as the level of critical thresholds largely depend on what is happening at other spatial, temporal and organizational scales of the system (Kinzig et al., 2006). These variables and their interactions are shown in the CLD. Below, we show a more simple presentation of interacting tresholds when milk prices are trespassing a tipping point on a majority of individual dairy farms. This presentation of critical parameters is based on Kinzig et al. (2006), who developed a model to distinguish thresholds at the ecological, as well as the economic and social/cultural domain across the patch, farm and region scale. If the milk price is low for a considerable period of time, farm income will drop. As a result, fewer young farmers will take over the farm. However, this will make land available for remaining farmers, which allows scale enlargement on these farms. Depending on the extent to which this increase in scale also results in an increase in the number of cows at the farming system level, it may become difficult to meet the target to reduce greenhouse gas emissions. Nevertheless, these interactions are also influenced by many cross-compliance conditions, which are not shown in the figure below for reasons of simplification. If, for example, the land of stoppers does not remain in the farming system, scale enlargement at individual farms and also at sector level will not occur.

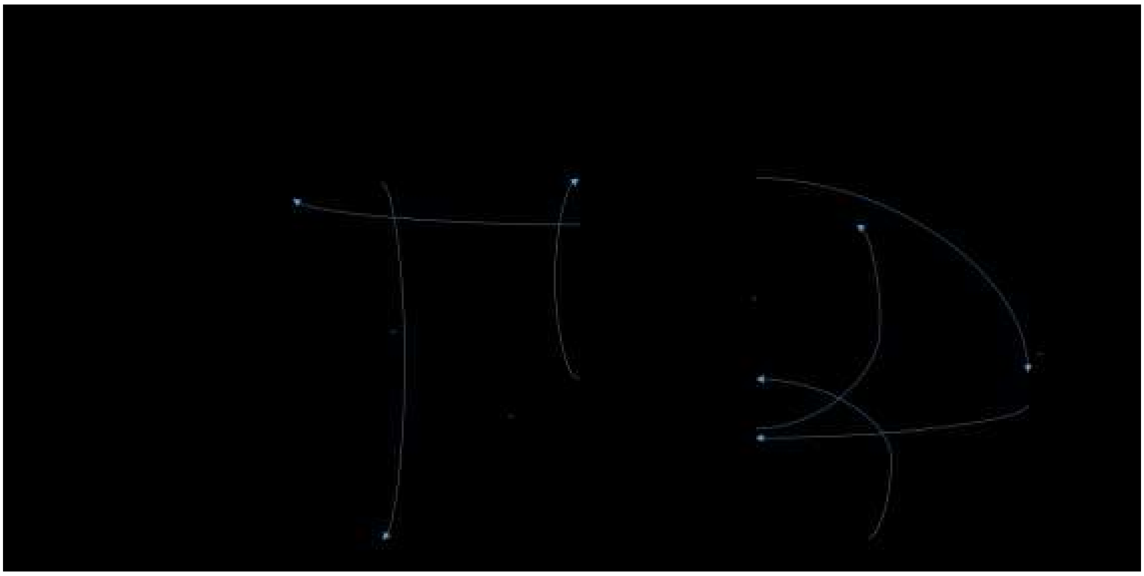

Figure 2: Interacting thresholds in the farming system. Based on framework of Kinzig et al. 2006

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5 Strategies and attributes to support future states

In this section, we will describe future strategies to deal with most important challenges described earlier. These again are based on previous activities with stakeholders just as literature. In addition, we will also describe some attributes that we believe will receive extra attention in the future to strengthen the resilience of dairy farming in Flanders.

5.1 Strategies to deal with environmental challenges:

5.1.1 Low soil and water quality:

In order to tackle the low water quality in Flanders, regulations are becoming increasingly strict. Meanwhile, a sixth 'manure action programme' (MAP6) has been introduced for the period 2019-2022 (Flemish Land Agency, 2019). With this MAP6, Flanders aims to reduce nutrient losses from agriculture and horticulture in order to bring water quality in line with European objectives. The regulations aim to create preconditions that guarantee that fertilization is carried out with the right type of fertiliser, in the right dosage, at the right time and with the most optimal fertilization technique. Measures to improve soil quality are also included. As a result of the strict regulations, the amount of manure that has been processed increased by 30% in the period 2012-2016. Due to the growth of the dairy herd after the disappearance and the stricter fertilization rules, dairy farms are finding it more difficult to deposit their manure on farmland. For farms with high livestock densities, the manure processing obligation entails higher production costs.

Some of the measures suggested by The Flemish Climate Policy Plan 2021-2030 to increase nitrogen efficiency and to reduce losses to water and air:

- low protein ration, own protein production and proteins from residual flows, ... for animal feed
- Precision agriculture: right dose at the right time and place
- more efficient N uptake through adapted crops (breeding, new techniques,...) and crop rotations (with e.g. butterfly-flowers)
- Reducing the use of artificial fertiliser by encouraging appropriate crop rotations and the use of artificial fertiliser substitutes
- transition manure processing from nutrient removal to nutrient recovery and reduction N losses
- development of digital tools

5.1.2 GHG emissions and global warming:

In contrast to most other sectors, emissions from the agricultural sector consist for the most part (about 75%) of non-energy processes. Livestock is the driving factor for non-energy emissions from digestive processes (CH_4) and manure storage (CH_4 and N_2O). The climate policy plan 2021-

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2030 for Flanders shows that measures to reduce enteric emissions from cattle are mainly based on optimising feed rations and/or feed efficiency and improving farm management. In order to reduce emissions from manure storage, the potential of manure fermentation is one of the objectives. By exploiting the potential of manure fermentation on pig and dairy farms, methane emissions from manure storage can be substantially reduced and at the same time biogas for green heat and electricity can be produced. Emissions of manure can also be avoided by applying precision agriculture, which will be fully utilized in the coming years.

5.2 Strategies to deal with economic challenges

Based on survey results, most frequently mentioned strategies by farmers to deal with economic challenges in the upcoming 20 years are based on cost efficiency and reduction of production costs, just as maintaining financial savings for hard times. Scale enlargement, investment in technologies and automation were mentioned as strategies to achieve cost efficiency and reduction of costs. However, a minority of the farmers did indicate to pursue diversification in other activities or to convert to organic production. During the risk management workshop, in which different stakeholder groups were involved, the 5 most important strategies to deal with economic challenges were maintaining financial savings for hard times, hedged part of the production with futures, optimization of using technology, cooperation with value chain actors and the use market information. These strategies are a combination of strategies that are already implemented or at least well known by many farmers just as strategies that are not well known but promising as future strategies. Strategies such as optimization by use of technology, and the use of market information are frequently used but participants agreed that implementation of these strategies should be improved and/or more widespread. Other strategies, such as hedging and cooperation with value chain actors, is not often applied yet (Soriano et al., 2020).

5.3 Attributes to deal with challenges of the farming system

5.3.1 Socially self-organized and appropriately connected with other actors

Stakeholders in the farming system are convinced that it will be important to focus on vertical cooperation within the chain. In this way, supply can be better matched to (expected) demand. They stated that sustainability of livestock sector in Flanders depend to a large extent on the way dairy farmers fit in as an integrated part of the chain, leading to market access and supply. Dairy farmers must continue to invest in horizontal cooperation among themselves, but also in solid vertical cooperation with processors, trade and retail. Producers will have to seize opportunities in this respect and also be prepared to co-invest in product innovation and promotion strategies (Platteau et al., 2018). Several producer organizations have been set up to represent the interests of a group of dairy farmers. In 2019 a branch organization was also set up (MilkBE).

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5.3.2 Infrastructure for innovation

Since there are still significant efficiency gains to be made in many dairy farms (Coulier et al., 2010), there is still an important role for the 'agricultural knowledge and innovation system' (AKIS) in the region to support farmers. According to the Strategic Working Group on AKIS (EU 2019), successful AKIS', special attention will have to be paid to ICT and big data and how the links between agriculture and other domains can be strengthened. Given the great importance of suitable business and policy models, attention needs to be paid to socio-economic themes in the research, just as collaboration with international partners. It will be necessary to strengthen interactive and transdisciplinary innovation processes and to continue experimenting with public-private partnerships.

6 Conclusion on the future state

The current trend of scale enlargement and intensification has been boosted by the phasing out of government regulation of the EU market in agricultural products. Based on current development, we might expect a further increase in total milk production rather than decrease in the near future. Many farms have made large investments in order to implement scale enlargement. This means that they are not quickly in a position to leave the chosen path of scale enlargement. In an attempt to analyze how certain challenges for agriculture will be more difficult or easier to tackle in the future, 5 scenarios were described with specific characteristics on population and urbanization, economy, policies and institutions, technology and environment and natural resources (Eur-Agri-SSPs).

Based on a combination of path dependency and policy plans for dealing with particular challenges in the farming system, we might assume that the current farming system might best thrive in scenario SSP2, agriculture kept on established paths. In that scenario, European development follows historical patterns resulting in slow but steady social, environmental and technological progress. Slow evolution to higher environmental standards, might assure the current farming system to adapt. In this scenario, agricultural policy is characterized by multiple support schemes to increase international competitiveness, productivity, efficiency, and the environmental status, which might support the farming system in improving its position on international markets. Individual farmers might further improve production efficiency to pursue higher farm income. Besides scenario SSP2, we might assume also strong compatibility with SSP1, agriculture encouraged for sustainability. In this scenario, farmers are more rewarded for their efforts to protect natural resources as external costs might be internalized in agricultural commodity prices. In addition, individual farmers might benefit from short and transparent

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agricultural supply chains. However, one might question whether the sector might adapt fast enough to thrive in this scenario. Moreover, in this scenario, livestock production should be reduced. The third scenario might be the least desirable one. In this scenario, mutual distrust and regional rivalry results in less efficient cooperation between national and European entities, more severe European and international trade restrictions. This is diametrically opposed to the current increase in milk production and the strategy of strengthening the position on the international markets. In order to produce more efficiently and deal with environmental challenges, the sector can benefit from innovation and technological development. This is reflected in the strategies that are proposed by policy makers in order to reduce nitrate leaching and greenhouse gas emissions. In a scenario SSP5, emphasis is on accelerated technological progress and diffusion in the agricultural and food sector, and expedited structural change. However, scale enlargement, as the current strategy, might be hampered in the farming system due to limited access to land, labor and capital. Access to land is one of the main challenges in Flanders, and might prevent taking full advantage of scale enlargement as a strategy. Limited access to capital and low farm income might prevent farmers from staying up to date with innovative technologies, which are at the core of SSP5.

So, in conclusion, system decline might be easiest to avoid in a scenario where agriculture is kept on established paths. In this way, the farming system might continue its current strategy of scale enlargement, without being challenged by too fast evolutions in directions at the core of either of the remaining scenarios. However, the current strategy of scale enlargement is also put into question. In the wake of the current corona crisis, the president of a leading farmers' organization puts it as follows: "The question that has sometimes been asked in the last few days is whether we as a sector are doing well with the relentless growth that we are seeing in a number of sectors, with the dairy sector as an example. A sector that is extremely sensitive to unforeseen market developments and disturbances beyond our control, and where for the last few years production no longer seems to be held back, with all the consequences that entails when anything goes wrong."

Despite this general trend towards enlargement, a minority of individual farms has been converting towards organic farming as an alternative. Several factors have contributed to this decision of farmers among which fluctuating prices in the conventional sector. The organic dairy sector currently offers more stability in the face of volatility. In addition, policy intervention has made conversion more feasible by aligning it with that of neighbouring countries. In the period from September 2017 to May 2018, Flemish organic dairy farming doubled from 6 to 12 million kilos of milk. However, organic dairy farming in Flanders still accounts for a very small proportion of total milk production in Belgium. The chairman of BCZ (Belgian confederation of dairy industry) puts it as follows: "Flanders is opting for intensification, while Walloon dairy farmers are increasingly opting for organic" (Vilt, 2019). Organic farming systems thrive best in scenario SSP1, where short and transparent agricultural supply chains are preferred and external costs are internalized in agricultural commodity prices and where there is a focus on technology development towards low emissions, resource use efficiency and chemical pesticide free agriculture instead of continuous agricultural technology development that aims to reduce production costs through a continuous increase in resource use efficiency.

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