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Thesis code: BEC-80433

Master thesis

Risk mapping as a communication tool: eliciting risk perceptions of specialized versus multifunctional Dutch dairy farmers

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by

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Wageningen, June 2016

Executive summary

This graduation master thesis investigated the risk perception of Dutch dairy farmers. In the current agricultural economics literature, there is a lack of in-depth information about risk perception. Risk is often examined with simplified questionnaires and most of the time risk is only related to the effects on income. In reality, risk has effect on many more goals than only generating sufficient income. Furthermore, questionnaires are not an adequate tool to give a holistic view on risk perception as risk perception is too complicated to capture. A literature review showed that the technique "risk mapping" was a promising tool to perform this research. All this resulted in the following main research question:

What role can risk mapping play as a tool to give a holistic view on risk perception and as a communication tool for comparing specialized versus multi-functional Dutch dairy farmers?

The main research question is decomposed into four sub-questions:

1. What are the main goals of Dutch dairy farmers?
2. What are the different risks perceived by Dutch dairy farmers and what are the relationships between them?
3. What are the differences in risk perception between specialized and multifunctional Dutch dairy farmers?
4. What role can risk mapping play to help farmers and researchers communicate about risk?

The research is conducted on ten multifunctional and ten specialized dairy farmers in the area Alblasserwaard – Vijfherenlanden, the Netherlands. A literature review and two test interviews showed that the risk mapping method Fuzzy Cognitive Mapping (FCM) was the best suitable method to perform this research. A FCM contains nodes of variables that can be connected with arrows. These arrows are valued with a mark to show the size and direction of the effect of one node on another.

Results show that dairy farmers have more goals than only generating sufficient income. Also working with cows, be your own boss (freedom) and entrepreneurship are goals of both multifunctional and specialized dairy farmers. Multifunctional dairy farmers have one additional goal: contact with people. The risks perceived by farmers in this research do not differ much from the risks typically cited in literature. However, the results show that these risks are interrelated and also relate to the goals of dairy farmers. The results do not show large differences between multifunctional and specialized dairy farmers in terms of risk perception. The results show that FCM helps in the communication between farmers and researchers. It gives structure in open conversations without the need for a questionnaire list. It is furthermore a great way to present the results of an interview. It helps to present a holistic view on the risk perception of a farmer.

The final concluding answer to the main research question is as follows:

The results of the research show that the risk mapping method FCM can present a holistic view on risk perception. The live visualisation on paper of spoken information enables to keep on track during conversations about complex networks of information, like the

network of risk perception. The produced maps can present the results of the risk perception of both individual conversations as well as group conversations. It is possible to compare specialized and multifunctional Dutch dairy farmers. Aggregated individual maps of both groups or so called social FCM's, and focus group FCM's are compared.

We found evidence that FCM has great potential to use in the communication between dairy farmers and researchers. More in general, we expect that there is great potential to use FCM as a method to communicate about complex issues. FCM may be a method to improve the communication between farmers, researchers, stakeholders or mutually. Future research should focus specifically on this communication aspect and the advantage of this. This research shows that risk perception is a complex matter. Individual risks influences and/or are influenced by other risks. Together, these individual risks form a network of risks that are connected with each other. This research shows that risks cannot be treated individually. This implies that risk should always be examined with taking into account the network of surrounding risks.

Preface

In front of you is the master thesis report with the results of a project of six months. This was an important step for the completion of my study, to achieve the Master's degree in Business Economics, the specialization of the master programme Management, Economics and Consumer Studies at Wageningen University.

It was impossible to complete this research without the help of a several people. In the first place, I want to thank the participating dairy farmers for the individual conversations and in particular the dairy farmers who also participated the focus group. It was a pleasure to be in contact with people who are so passionate about their work. I want to thank my supervisor Yann de Mey for his great support, his open attitude and the constructive feedback. It was a pleasure to stay in close contact, sometimes even by video calling. I want to thank my sister Thea Kool for her support and the discussions we had. Finally, I want to thank everybody who supported me and gave me advice, like my thesis-buddies, friends and family.

It was my first time to perform such a large research project on my own. Sometimes it was arduous, but when I look back on this period, I learned a lot and it helped me to develop myself in the way I am now. I want to conclude with a quote of Franklin D. Roosevelt. He describes one important lesson I learned during the visits of the farmers: "happiness is not in the mere possession of money; it lies in the joy of achievement, in the thrill of creative effort".

Arie Kool

Wageningen, June 2016

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1 Introduction

A recent trend in Dutch agriculture is the multifunctional farm, namely a farm that produces more than only milk. Multifunctionality is distinct from the concept of diversification, which entails producing multiple commodity products within one business (OECD, 2009). Specialized farming can be defined as the opposite: *"The production of one main commodity product within one business"* (Hansson, 2008). Multifunctional farms differ from specialized farms in many ways. The income from multifunctional farms is no longer depending only on the fluctuation of one product. In general, many more social interactions takes place on multifunctional farms. These differences make the comparison between multifunctional farms and specialized dairy farms very interesting for scientific research. Nevertheless, in many fields it still lacks on scientific research on this topic. Especially risk and risk perception are underexposed. In many cases, risk perception is only related to income, while in reality risk perception is also related to many other goals of dairy farmers. Communicating with farmers about risk perception in this context in this is not straightforward, as they do not have a consistent grasp of the concept (Jurt et al., 2015). Therefore, other research methods than the traditional used surveys may be needed to capture the risk perception of dairy farmers.

1.1 The importance of multifunctional versus specialized dairy farming

The Central Bureau for Statistics in The Netherlands (CBS) calculated that in 2013 24,367 (36%) out of the 67,481 farms in The Netherlands gained income from broader activities such as: sales at home, storage of animals or goods, agro tourism, care farming, work for third parties, agricultural nature conservation and energy production. For 61 per cent of the farms with broadening activities, the revenues from broadening where less than 10 per cent of the total revenues, yet for 28 per cent this was between 10 and 50 per cent and for the final 11 per cent this was more than 50 per cent (Statline, 2014). Focussing on the dairy sector —which is of high importance for Dutch agriculture with 8 per cent share of the total agricultural export (LTO Nederland, 2012)— there is a clear divide between specialized and multifunctional farms. CBS calculated that in 2013, 29 per cent of the 17,000 dairy farms broadened their activities outside of dairy production (Statline, 2014). This means that 71 per cent of Dutch dairy farms are specialized in only the production of milk and by-products.

Multifunctional dairy farming is booming in the Netherlands and it has received much public and research attention so far. The turnover increased between 2011 and 2013 with € 14 million to €491 million. The turnover of care farming and farm shops increased with 20 per cent and the agricultural childcare increased even with 30 per cent in this period (Wageningen UR, 2015). Research has studied different aspects of multifunctional

farming. Heringa et al. (2012) shows that the economic impact of multifunctional farming is limited, but it does generate relatively much employment per additional unit of output. Seuneke et al. (2013) performed research on what entrepreneurship at multifunctional farms implies. His research shows that it takes long before farmers employ activities outside agriculture. A complex process asks for personal development. Oostindie (2015) performed extensive research on multifunctional farming. His research includes the relationship between multifunctional farming and family farming, the drivers for farmers' to start with multifunctional farming and the prospects of multifunctional farming in the Netherlands. In general, his results show that family farms are willing to adapt and choose for multifunctionality as a strategy to evade marginalisation. Drivers for farmers to start with multifunctionality are: re-establishing the more direct contacts with consumers and the society, the wish to regain influence on marketing and sales or a combination of these factors. The prospects are positive for multifunctional farms because of the better connection with the society. To emphasise how important multifunctional farming is in the Netherlands, there is even a specialized platform for sharing knowledge on, networking and the stimulation of entrepreneurship in multifunctional farming (Multifunctionelelandbouw, n.d.)

1.2 Research objective and research questions

A specific aspect that is overlooked in current literature is the difference in risk exposure between multifunctional farming and specialized farming. As multifunctional farming activities differ from specialized farming (Wilson, 2008) and the decision making of multifunctional farmers differs from their specialized counterparts (Jongeneel et al., 2008; Hansson et al., 2012), there is likely great variation in the risk exposure and associated risk perception between both systems. Diversifying income sources is traditionally seen as an effective way of managing business risk exposure (Barbieri & Mahoney, 2009). It remains unclear to date, however, whether multifunctionality truly contributes to this end in the Dutch dairy sector.

Analysing risk exposure and risk management has become major facet of agricultural research and has driven many policy discussions regarding European agriculture (Vrolijk et al., 2009). Yet, communicating and discussing risk with individual farmers is not straightforward as they do not have a consistent grasp of the concept (Jurt et al., 2015) and because great diversity exists in the risks faced by individual farms (OECD, 2009). Accordingly, there is a need for better risk communication tools that can bridge the gap between a farmer's risk experience and a researcher's research (van Winsen et al., 2013).

Objective of the study: this research will explore the risk perceptions of multifunctional versus specialized Dutch dairy farmers. The goal is to present a holistic view on risk and to further focus on the interactions between the risks by generating risk maps. These risks maps will then be evaluated as risk communication tools.

Main research question: the main research question is formulated as follows:
What role can risk mapping play as a tool to give a holistic view on risk perception and as a communication tool for comparing specialized versus multi-functional Dutch dairy farmers?

This question can be further decomposed into the following sub-questions:

1. What are the main goals of Dutch dairy farmers?
2. What are the different risks perceived by Dutch dairy farmers and what are the relationships between them?
3. What are the differences in risk perception between specialized and multifunctional Dutch dairy farmers?
4. What role can risk mapping play to help farmers and researchers communicate about risk?

1.3 Set up of the report

First of all, in chapter two the characteristics and differences between the groups of specialized and multifunctional dairy farms are elaborated. Followed up, the themes of the research questions are clarified. In paragraph 2.3 the goals of Dutch dairy farmers are clarified. Paragraph 2.4 investigates the risks in dairy farming. Following, paragraph 2.4 deals with risk perception in the Dutch dairy farming sector. Finally, paragraph 2.5 elaborates risk webs as a communication tool. This is a step-up to chapter three where the research method is clarified. Different risk mapping methods are highlighted. After the choice for one method, paragraph 3.2 shows the possibilities to analyze the results of the chosen mapping method. Paragraph 3.3 gives an overview of the steps taken in the research. Finally, chapter 3.4 deals with the sampling method and the sample size determination. The results of the research are in chapter four. First of all, paragraph 4.1 gives a general overview of the outcomes of the maps. Paragraph 4.2 to 4.5 deal with the results specific attributed to the research questions. After this, the discussion, including the recommendations, in chapter five and the conclusion in chapter six follow. The references are listed after the conclusion. In the four appendixes the different maps are included, e.g. 20 individual maps, 2 social FCM's and 2 focus group FCM's.

2 Literature review

2.1 The extremes of specialisation and multifunctionality

The sector of dairy farming is changing. The last decennia the dairy farms with a medium amount of cows decreased. Instead, large dairy farms with over 100 milking cows pops-up, already 30% of the farms has 100 or more cows (Boerenbusiness, 2015). On the other side on many places, other activities arise on smaller dairy farms. Multifunctional dairy farming is booming in the Netherlands (Van Apeldoorn et al., 2013). It seems that these two extremes are the only options for survival of dairy farms in the future. This research investigates therefore these extremes.

To narrow the research further down, the term multifunctionality is used instead of diversification. The definition of diversification includes production of one main commodity product combined with the production of one or multiple non-commodity or commodity products of services. Multifunctional agriculture excludes farms with the production of multiple commodity products. The dairy sector lacks of research on multifunctionality, while just multifunctionality becomes more and more important.

2.1.1 Specialized dairy farming

In fact, all dairy farms that produce one main product, milk, are specialized dairy farms. This seems a clear demarcation, but it needs more clarification. This research defines specialized dairy farms as *"the production of one main product (milk)"*. The term "one main product" is defined as: at least 90 per cent of the turnover should originate from this. The income of a specialized dairy farmer must originate for at least 90 per cent from the dairy farm. When the income of the farmer originate less than 90 per cent from dairy farming the risk perception of the farmer could be significant influenced by the non-farm income. So at least 81 per cent of the income of the farmer should originate from milk (90 per cent times 90 per cent).This is in accordance with the definition of Hansson (2008). Besides the definition focussed on turnover, specialization can also be defined based on labour. When the labour of a farmer is over 90 per cent used for milk production, the farm is defined as "specialized".

2.1.2 Multifunctional dairy farming

Definitions of multifunctional farming differ substantially from each other. The definition of bedrijveninformatienet includes revenues from contract work in multifunctionality (Roest et al., 2009), while Taskforce Multifunctionele Landbouw excludes this (Multifunctionele landbouw, n.d.). Barbieri & Mahoney (2009) found over seven different types of diversification, all with their own definitions. This research defines multifunctional dairy farming as: "*The production of one main commodity product (milk) combined with the production of one or multiple non-commodity products or services all*

within one business" (based on OECD, 2009.). The term "one main commodity product" is defined as: at least 20 per cent and at most 95 per cent of the farm turnover should originate from this. Non-commodity products/services include but are not limited to: care farming, nature conservation, recreation, child care, sales on the farm and many more. This list is non-exhaustive but only the five products/services with the highest turnover are highlighted.

Care farming

Care farming is booming in the last six years. The number of farms with care farming increased rapidly. In addition, the total turnover of care farming doubled between 2007 and 2013 (see table 1).

	2007	***2009***	***2011***	***2013***
# farms	756	870	1050	1100
Turnover in million €	45	63	80	95

Table 1: Development of care farming 2007 – 2013 (Meulen et al., 2014)

Care farming has a potential for 30.000 care recipients. The target group mainly consists of ex-detained people, long-term unemployed, partly incapacitated people. The development of the sector depends partly on the budget of the government. In the last years, this budget decreased with 25 per cent. Research from Wageningen University and Research centre, networking platforms like multifunctionelelandbouw.net and support of LTO caused a strong professionalization of the sector and therefore also growth of the sector (Bremmer & Migchels, 2014; Hassink et al., 2015; Poelarends et al., 2015)

Agricultural childcare

The agricultural childcare is organised in the cooperation VAK, Vereniging Agrarische Kinderopvang. The goal of the cooperation is to support farms to start and exploit childcare (Agrarische kinderopvang, N.D.). The development of the turnover in agricultural is shown in the table below. The turnover is increasing rapidly and so does the number of farms.

	2007	***2009***	***2011***	***2013***
# farms	20	64	209	219
Turnover in million €	4	14	20	26

Table 2: Development of agricultural child care 2007 - 2013 (Meulen et al., 2014)

Farm sales

Farmers that sell products on their farms are organised in many organisations. Landwinkel is one of the best known cooperation in sale on farms. Local products are of high importance for the sale on farms. The foundation Streekeigen Producten Nederland

(SPN) developed a certification mark that guarantees the high quality of local products (Veen et al, 2012).

The number of farms with sales of their own product decreases between 2011 and 2013, as shown in the table below. This is because of a more strict definition of farms with sales. This is also the reason why in these figures the turnover per farm increased with 20% on average. In reality, the number of farms with sales is rather stable, the turnover increased slightly.

	2007	***2009***	***2011***	***2013***
# farms	2850	3000	3300	2720
Turnover in million €	89	128	147	142

Table 3: Development of sales on farm 2007 – 2013 (Meulen et al., 2014)

Nature conservation

The number of farms with nature conservation decreased between 2007 and 2013. The total turnover in this sector still increased slightly (see table 4). This implies an increase of the turnover with 30% per farm. Because of the decrease of governmental support for farmers on nature conservation, it is not possible to extrapolate these numbers to 2016.

	2007	***2009***	***2011***	***2013***
# farms	15300	14500	12500	12500
Turnover in million €	71	70	72	75

Table 4: Development of nature conservation 2007 – 2013 (Meulen et al., 2014)

Farm recreation

Recreation on farms decreased slightly between 2011 and 2013, both in number of farms and in turnover (see table 5). The economic situation and the heavy competition in the sector are the reason for this.

	2007	***2009***	***2011***	***2013***
# farms	2432	2240	2887	2777
Turnover in million €	92	121	156	151

Table 5: Development of recreation 2007 – 2013 (Meulen et al., 2014)

Turnover and trends in turnover of multifunctional farming

The total turnover of multifunctional farming in the Netherlands was 491 million euros in 2013 (WageningenUR, 2015). This is just only a fraction of the potential of multifunctional farming in the Netherlands. Veen et al., (2012) estimated the potential of multifunctional farming in the Netherlands on 1.5 to 4.5 billion euro. The large difference in this expectation shows a considerable uncertainty on potential of multifunctional farming in the Netherlands. However, even in the pessimistic estimation of 1.5 billion euro, the sector still can grow with factor three. In the optimistic estimation of 4.5 billion euro, this would be an increase with the factor nine.

2.2 Goals of dairy farmers

The first research question of this research is about the goals of dairy farmers. The goals of farmers can be of large impact on risk perception but most available literature on risk perception on dairy farmers focuses on only the relation of risk perception and the goal "income" of the dairy farmer (Meuwissen et al., 2001; Meuwissen et al., 2006; Wauters et al., 2014). Therefore, we start the research with the investigation of the goals of the dairy farmers.

Goals depend on strategic and entrepreneurial behaviour (Bergevoet et al., 2004). The research is conducted with the help of a questionnaire with a sample size of 257 Dutch dairy farmers in the Northern part of The Netherlands. They found as the top five of goals for Dutch dairy farmers: 1) enjoy my work, 2) producing a good and safe product, 3) work with animals, 4) contribute to a positive image of my professional group, 5) realize an income high as possible. It shows that the goal "income" is not the only goal and not the most important goal of dairy farmers. Not known are the differences between the goals of multifunctional dairy farmers and specialized dairy farmers.

Jongeneel et al. (2008) examined under which conditions farmers are tend to start multifunctional farming. Unfortunately, this research gives not a clear view on the differences in goals and risk perception between multifunctional and specialized dairy farmers. However, it indicates that income stabilization is one of the reasons to choose for multifunctional farming. This might be translated in a possible lower risk perception of milk price fluctuations at multifunctional dairy farms.

The relationship between the goals of dairy farmers (besides the goal "income") and risk perception is not investigated yet. This may be because of the difficulty to measure the effect of risk perception on these goals.

2.3 Risk in dairy farming

The second research question questions what the risks are in dairy farming. The definition of risk according to Hardaker et al, (2004) is as follows: *uncertainty with consequences*. This is in contrast with the term uncertainty that can be defined as imperfect knowledge, but it has not necessarily an impact. Price and production risks in dairy farming are of often a topic of interest in literature, as well diseases and cow health management are extended investigated (Bartels et al., 2010; Huijps et al., 2010; Lam et al., 2011; Berentsen et al., 2012). Besides, also financial, human and institutional risks play a role in agriculture. Prices of the farm outputs are rarely known on the long term. The volatility of prices in dairy in the Netherlands increased enormous in the last years because of the abolishment of the dairy quota. In various steps, the quota is abolished and from April 2015 farmers are allowed to produce unlimited amounts of milk (Samson et al, 2015). The weather, pests and diseases heavily influence the agricultural

production. These unpredictable factors can have a huge impact on the results of the farm. Institutional risks have large impacts on the dairy farm results. The abolishment of the quota led to a huge increase of the production of dairy. Therefore, the government is currently analysing the possibilities of new restrictions to stop the unbounded growth of dairy farming (Boerderij, 2016). Human or personal risks play also an important role. Many dairy farms are family farms. In case of illness of the farmer, the farm is directly in need of external support.

2.4 Risk perception in dairy farming

The third research question includes the subjective part "perception" into the objective part "risk". Risk perception can be defined as: "*People's judgments and evaluations of hazards they (or their facilities, or environments) are or might be exposed to"* (based on Rohrmann, 2008). Research on risk perception faces many challenges. Often surveys are used to examine risk perceptions (Rohrmann, 2008). He argued that the challenges with research on risk perception arise because risk perception arises intuitively which implies quick and emotional unconscious thought, rather than "head", i.e. conscious thought. Risk perception in itself is subjective, but when research is performed on it, the data is objective as in any other scientific research (Rohrmann, 2008). Results from research in Norway shows that organic farmers perceive to be less risk averse than conventional farmers. For both groups, institutional risk is the primary source of risk. This is mainly about the uncertainties with the governmental farm support. Conventional farmers perceive the costs of inputs and the development in animal welfare policy as the most important risk factors after the institutional risks. Organic farmers perceive decrease of price premiums and the change of organic regulations as main risks. However, the regression model of the same research also suggests a high degree of farm-specific risk perceptions. This may imply that conventional and organic farmers both do not differ in risk perception. The high governmental support and the governmental regulation of agriculture clearly influenced the results of this research (Flaten et al., 2005). Nowadays governmental support of dairy farmers in Europe is decreasing rapidly. The governmental role in dairy farming is also changing. Therefore, the results of the Norwegian research may differ from the risk perceptions of dairy farmers in the Netherlands nowadays.

Meuwissen et al. (2001) investigated with the help of a questionnaire survey the risk perception of (dairy) farmers. This research concluded that price fluctuation is the main concern of dairy farmers. This is remarkable because around the year 2000 dairy farming had the lowest income fluctuations of all agricultural sectors (Melyukhina, 2011). Furthermore, Meuwissen et al. (2006) concluded that dairy farmers worry more about small and frequent disruptions but less about disastrous events.

Wauters et al. (2014) investigated risk perceptions of Flemish farmers, based on a sample of 614 farmers. The research shows how dairy farmers perceive the probability of

occurrence of an event and how they perceive the impact if a certain event occurs (see table 6).

	Weather	*Pests*	*Prices*	*Costs*	*Margin*	*Policy*	*Land*	*Personal*	*Subsidy*
Probability	3.05	2.74	3.50	3.54	3.49	3.44	4.19	2.71	3.64
Impact	3.60	3.67	4.08	4.00	4.01	3.76	4.06	3.68	4.00

Table 6: Risk perception of farmers rated on a scale between 1 - 5, where 1 is low and 5 is high (Wauters et al., 2014).

The conclusion of Walters et al. (2014) is that farmers in general are more concerned about the structural evolutions such as the margins, land availability and governmental policies, rather than short-term volatilities.

2.5 Risk communication

Rohrmann (2008) defines risk communication as *"[…] the exchange of risk information between interested parties".* It is a social process which can contain three parts: Firstly, people can receive information about hazards. Secondly, people are influenced towards change in their behaviour. Thirdly, people can take part in decision-making. To make risk communication effective, a good understanding of risk perceptions and attitudes of the farmer is essential (Rohrmann, 2008). Risk behaviour is studied intensively but nearly no established measurement tools do exist. Rohrmann (2002) highlighted some instruments to perform research in this field. The Risk Orientations Questionnaire (ROQ), Risk Propensity Questionnaire (RPQ), Risk Scenarios Questionnaire (RSQ) and the Risk Motivations Questionnaire (RMQ) where highlighted as research instruments. The conclusion of this research shows that the highlighted methods where useful, but other methods are needed for the understanding of the risk mind-sets of people.

Van Winsen et al. (2011) investigated the opportunities of cognitive mapping as a method to explain and present the risk perception of farmers. Cognitive mapping is a tool that provides insight in the broad spectrum of risk perception. Therefore, it should be possible to use it as a method of risk communication. This research investigates what the role of risk webs or risk mapping can fulfil in the communication about risk between farmers and researchers.

3 Material and Methods

This research uses the method of risk mapping to examine the risk perception of multifunctional and specialized dairy farmers. As this type of mental mapping method has been used in agricultural economics research before, the next section presents an overview of several alternative mental mapping methods. Next, the optimal approach for this particular study is determined and the practical implementation is discussed.

3.1 The risk mapping method

3.1.1 Mental mapping methods

The idea of mapping the thoughts of humans comes from the idea that every human simplifies the world in their head. Psychologist Craik (1943) proposed that people have a simplified model in their head about how the world works. This is called the *mental model.* Later, psychologist Johnson-laird (1983) reasoned in line with Craik that people have a simplified reasoning mechanism in their working memory. In line with Johnson-laird, the risk perception and risk management decision making of farmers works according to a simplified model in the head of the farmer (Jones et al, 2011).

Mapping methods were developed to extract the mental model or the reasoning mechanism from the head of people. Eden & Ackermann (2002) used the term *cognitive mapping* as a general description of mapping methods to describe a person's thinking about a problem or issue. Cognitive maps differ from word and arrow diagrams, influence diagrams, mind-maps or brain maps in the sense that cognitive mapping is a formal modelling technique with certain development rules. The cognitive mapping technique is based on personal construct theory, developed by Kelly (1955). The aim of all mapping methods is the same, namely to understand relationships. It is easier to understand visually represented relationships than verbal or written descriptions of these relationships (Davies, 2011). Mapping methods are popular in research, but there is no consensus in literature about which specific techniques to use (like valuing connections in words or in numbers) for the mapping (Hodgkinson et al., 2004).

3.1.2 Cognitive mapping methods

Different methods are available for cognitive mapping. Below, causal mapping, semantic network mapping, decision analysis based mental models, concept mapping and fuzzy cognitive mapping are considered.

The analysis of causal mapping is in depth described by Montibeller & Belton (2006). Causal maps can be decomposed in many sub-methods like reasoning maps and preference elicitation. In summary, all these methods have in common that they are too simplistic lacks on analysis methods and are limited used in research. Semantic network mapping method, invented by Collins & Quillian (1969), is described in dept by Mitchell &

Lapata (2010). This method is compared with other methods in research of Wood et al. (2012). They compare three different mapping techniques to be used in the field of risk management. The research compares (i) decision analysis based mental models, (ii) concept mapping and (iii) semantic network mapping. Their conclusion shows decision analysis based mental methods cannot be used in this research because the method is not suitable to compare expert groups. Concept mapping is a promising method because of highly standardized procedures but unfortunately, it suggests relatedness of concepts but not causality. Semantic network mapping is the most simplistic method to use, but the creation of diagrams is highly subjective. Van Winsen et al. (2013) use the semantic network mapping as a tool to elucidate and present the risk perception of 19 Flemish (Belgium) farmers and conclude that *"Cognitive maps can be used as a communication tool, a risk management tool, and a tool to stimulate bi-directional learning amongst farmers, policy makers, researchers and extension agents"* (pp. 42). Kosko (1986) was the first researcher who used Fuzzy Cognitive Maps (FCM). His FCM is based on causal cognitive maps but adjusted with the use of real numbers in the range of -1 to 1. Özesmi & Özesmi (2004) elaborately describe FCM construction and the use of it. FCMs are graph structures, which represent fuzzy causal relationships. It is used in situations with a system or relationships are fundamentally fuzzy or are unknown. Because of the systematic approach, FCM is still suitable for these situations (Kosko, 1986). With FCM, the knowledge of individual farmers can be compared in a quantitative way by using weights on the relationships between nodes in the maps (Özesmi & Özesmi, 2004). Van Vliet et al. (2010) describe the use of FCM as a communication and learning tool. The results show that FCM is a structured way of understanding the system of the perceptions of participants. The participants perceive this method as easy to understand and easy to use in a short period of time. Christen et al. (2015) investigate what role FCM can play in the communication between farmers, in combination with policy design. He concludes that FCM can be used as a structured way to identify differences in perceptions between two groups of farmers. Most recently, Li et al. (2016) use FCM to evaluate the interest of fishers into scientific information, showing the driving variables and constraints for fishers to use scientific information.

3.1.3 Choice of risk mapping method

In order to choose the mapping method best suited for this research, two test interviews were conducted. During two sessions of half an hour, two respondents were interviewed, both FCM and semantic mapping were applied, and the outcomes compared. Both test interviews revealed a preference for FCM over semantic mapping based on practical reasons such as (i) the map becomes messy and not understandable when connections are described with words (especially in complicated maps with many connections), (ii) it is hard to explain in what way the connections in semantic mapping should be described

and (iii) the respondents find it easier to value a connection with a mark rather than having to describe it in words. Combined with the limited use of semantic mapping in literature and the extensive and recent use of FCM in agricultural research, FCM was chosen as the mapping method best suited to perform this research. Figure 1 shows what a FCM can look like.

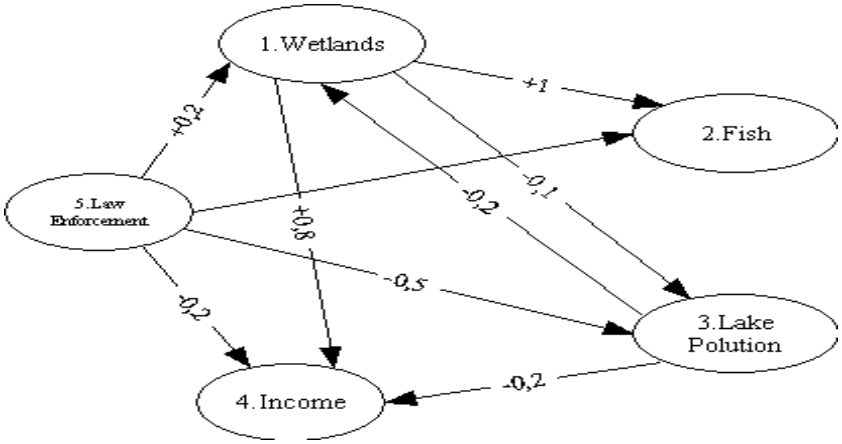

Figure 1: Example of FCM

3.1.4 Obtaining FCM

Özesmi & Özesmi (2004) give four different ways to obtain a cognitive map: (1) using questionnaires, (2) extraction from written texts, (3) from causal related data and (4) with the use of live mapping during interviews. Live mapping and extraction from transcripts seems to be the most appropriate methods for the research questions in this research because these methods can be used in combination with open interviews. The result of the two test interviews further showed that live mapping was possible; it may be the preferable method. Live constructing of the FCM resulted in more nodes and more connections between the nodes, i.e. a richer FCM. In addition, the participants needed less support of the researcher when the map was constructed live. This shows that live mapping decreases the chance of the researcher influencing the outcome. The choice for live mapping is further emphasized by recent research in the field of agricultural economics that successfully uses live mapping (Christen et al., 2015; Van Vliet et al., 2010). In addition, Fairweather & Hunt (2011) used live mapping to understand complex farm processes. In contrast to Özesmi & Özesmi (2004), they experienced that it is essential to list concepts regarding the subject on beforehand, otherwise farmers needs up to 30 minutes to list these factors. The approach of the test interviews did not give certain problems. This may be because the participants were not asked to list the important factors on beforehand, but these were discovered during the construction of the map.

3.1.5 Guidelines regarding the construction of FCM

The guidelines for the construction of FCM are not univocal and not stringently used in research. Brightman (2003) constructed guidelines, based on Kelly's theory (Kelly, 1955):

- Not only words can represent a node, also short sentences can be used. However, at all time, there should be only one idea per node
- The sentence should be stated in the imperative form, i.e. have sufficient income
- The use of opposite poles is allowed (e.g. have sufficient income rather than high income). The words "rather than" can be replaced with three dots (...)
- Use factors that are "easy to manipulate", i.e. which operate on a relatively short and similar temporal scale and on which indications on the relative importance can be given
- Build ideas into a hierarchy: start by defining outcomes. This is followed by defining causes/effects and how's/why's
- The strength of connections between nodes is valued between -1 and 1
- The value 0 is never used because zero means that there is no relationship.

In FCM, values between -1 and 1 are used to determine the strength of the connection. During the first test interview, the respondent was free to decide what description method to use. The respondent chose to use the + and – signs rather than values between -1 and 1. Later on, the respondent was asked to use numbers between -1 and 1 because this gives more opportunities for the analysis and this follows the guidelines of FCM. This resulted in many extreme answers, i.e. -1 and 1 numbers. It seemed that the respondent perceived this as a dichotomous scale, while it was clearly stated that the respondent could rank with differences in steps of 0.1. Based on this experience, we opted for a numerical scale in favour of words and was adopted a 10-points scale in order to improve its validity, as used by Christen et al. (2015). During the second test interview, this 10-point scale was tested and resulted in a better use of in-between ranks. Again, this respondent found it difficult to describe the connections between nodes in words, underscoring our decision not to use a word-based scale.

3.1.6 Advantages and disadvantages of FCM

Based on the reviews by Kosko (1986), Kim & Lee (1998), Özesmi & Özesmi (2004) and Kok (2009) the following advantages and disadvantages of FCM can be identified:

Advantages:

- Enables understanding complex systems with an holistic view
- Can model situations where little scientific information is known
- It allows feedback processes
- Easy to use and understand for non-experts
- Direct insight into individual risk web

- Enables construction of general risk web

The most important advantages of FCM for this research are (i) the opportunities that FCM has regarding the understanding of complex systems. This, in combination with the opportunity to present a holistic view on risk perception. Risk perception often partly examined, mainly in combination with financial risks. We want to present a broad view on risk perception, which his is a highly complex matter. And, (ii) it is highly important that non-experts understand the research method because the map is created in co-creation with the non-expert.

Disadvantages:

- Limited statistical analysis possible, no parameter estimation
- Loss of information because by using numbers instead of words to describe connections
- The interviewer can influence the results significantly, both verbally and non-verbally
- The ignorance and misconception of the farmer are all encoded in the maps
- "What-if" reasoning can be modelled, but "why's" are not captured by FCM

The most worrying disadvantages are the influences of the researcher on the results and the ignorance and misconceptions of the farmers that can be encoded in the maps. For both of these disadvantages, strict protocols can help to decrease the risks of these. Nevertheless, the influence of the researcher will be always there both verbally and non-verbally. The preparation of the researcher is essential to prevent misunderstandings of the farmer. Well-developed interviewing techniques are of crucial importance.

3.1.7 Constructing a focus group FCM

All the information above focuses on the construction of an FCM individually. This research will use both the individual and the group process to construct FCM. The group process differs in many ways from the individual process. Different authors already highlighted the process to construct the focus group FCM. Van Vliet et al. (2010) use FCM to bridge the gap between storylines and models. They create the FCM with the help of a focus group as follows:

1. Write down post-its with issues (individual)
2. Cluster individual issues and discuss importance (group)
3. Define which relations exist (two small groups, four people per group)
4. Define sign and strength of relationships
5. Define if the relation is positive or negative
6. Define the relative strength of the relationships in four classes (++, +, -, --)

Fairweather & Hunt (2011) also use a group process to create a FCM. The steps in their research are as follows:

1. Determine important factors for the FCM by performing a questionnaire
2. Construct individual FCM's of farmers using a pre-determined list of factors. The farmers decide which factors they use from the list
3. The researcher, using a matrix of in an Excel spreadsheet, creates a general FCM
4. Validate the constructed general map in a focus group

None of both researches is a blueprint for our research to construct a focus group FCM. The main difference between our research and the research of Van Vliet et al. (2010) is the use of clusters and not the use of nodes with concepts. Furthermore, our research differs because we first construct individual maps and later on in a focus group a general map. The research of Fairweather & Hunt (2011) differs in the numbers of concepts and the number of respondents. Because of the pre-determined list of 41 concepts, the variety is much lower than in our research. In addition, the number of respondents (farmers) is with 34 much higher than in our research. This leads to a lower variance in the concepts named and the used concept appears in more (individual) maps. Furthermore, the general FCM created by the researcher is the basis of the focus group while this is not the case in our research.

Based on elements from the two previously cited sources and our experiences with the individual interviews, we developed the following set-up to construct a focus group FCM.
The farmers are at the start of the meeting asked to create a map that will represent the "typical dairy farmer of their group" in our region (Alblasserwaard - Vijfherenlanden). This means, the multifunctional dairy farmers are asked to create a map for the typical multifunctional dairy farmer whereas the specialized dairy farmers are asked to create a map for the typical specialized dairy farmer. Next, the following steps are followed:

1. The most important goals (most times named) during the individual FCM creation are the starting point. These are short discussed.
2. Write the goals down on a large piece of paper (A1-size). We ask the farmers one by one to name a factor that influence one of the goals or one of the other factors. When a farmer names a factor, a short discussion follows and the relation(s) with the goals and other nodes are constructed. When all farmers named one factor, a second round starts and all farmers can again name one new factor. This process continues until no more factors come up and a final map is obtained.
3. The connections are then evaluated and by (i) defining if the relation is positive, negative or both and (ii) valuing the connections on the same scale as used during the individual process: ranging between -10 and 10. The valuing of a connection starts with asking one farmer to suggest a number. This value is then adapted based on the opinions of all participating farmers in the focus group. This

takes place for all connections valued. In turn, the farmers are asked to do the first suggestion of a number.

4. In the final phase, the farmers are asked if they want to add or change something in the final map. After all farmers gave their opinion, the focus group FCM is finished.

3.2 Analysis of FCM

The analysis of FCM is divided into two parts. Firstly, several indicators exist to evaluate the individual FCM's. Secondly, we can merge the individual maps in one combined map, which is called a social FCM.

3.2.1 Analysis of the individual FCM

Fuzzy cognitive maps are not suited for advanced statistical analyses, i.e. one cannot estimate parameters. However, FCM can be analysed on terms of shape of the map, the number of connections, the number of nodes and the type of nodes. Below, the used methods for the analysis are elaborated.

- *Islands of themes*: in extreme cases, within one map can be nodes and arrows that connect to each other. There can be "islands" of nodes and arrows. The extreme form is when nodes do not connect to each other, and there are no arrows. In the other extreme, all nodes connect to each other. This is more likely when the ratio arrows-to-nodes is high (Eden, 2004). The ratio of arrows to nodes gives an indication about the robustness of the cognitive map (Özesmi & Özesmi, 2004). The islands of themes are simple visible in the FCM's. The ratio of arrows to nodes is calculated by hand. We calculate the amount of nodes and the amount of connections for every map.
- *Networks of problems*: each node in the map supports other nodes. Other nodes can support these supporting nodes. Together, these subsets of nodes form a hierarchical structure. The subset of hierarchical nodes is also named "cluster". The clusters can give a different view on the issue, and can identify sub-problems (Eden, 2004). The most interesting networks of problems are visible in the social FCM's, as these are the summary of the most important parts of the individual FCM's. The social FCM's are closely examined on the existence of networks of problems.
- *Finding potent options*: the definition of a "potent" node is when it appears in two or more different clusters. The identification of these potent nodes can help individuals to manage complex issues (Eden, 2004). Here, also the social FCM's are the most interesting. These are examined on the existence of potent options.
- *Analysis of the goals*: in the start of the conversation, the farmer explains what for him the most important goals are. There is no limit on the amount of goals. In

the analysis, the goals of the farmers are compared. The goals that exist four or more times are considered as the most important goals of the dairy farmers.

- *Analysis of risks*: the risk categories named by Wauters et al., (2014) are the guidance for the analysis of the risks. The social FCM's and the focus group FCM's are analysed in order to discover networks of risks that are linked to the categories. The individual maps are used to make nuances.

The described analysis methods above describe the created maps in numbers. It is used in the general description of the different maps. The in-depth analysis of the maps cannot be done with only numbers. It is also not efficient to compare individual maps one by one. Therefore, the social FCM is used.

3.2.2 Analysis of social FCM

In literature, to social FCM is referred in a several ways. Vanwindekens et al., (2013) uses the term Social Cognitive Mapping (SCM) while Khan & Quaddus (2004) uses the term Group Fuzzy Cognitive Mapping (GFCM). We prefer to use the term social FCM because of the consistency of the report. Social FCM is a method that we can use to summarize/aggregate the individual maps of several farmers. Basically, all nodes and connections of the individual maps are put together in one matrix. In the cells of the matrix, the number of times that these unique connections exist is counted (Özesmi & Özesmi, 2004).

Then, the matrix is translated into a map. Contrary to the individual FCM, the number on the connection line does not value the strength of the connection, in a social FCM it reflects on how many individual maps this connection exist. In this research, two social FCM's are made, one for the group of specialized dairy farmers and one for the group of multifunctional dairy farmers. Note that social FCM differs from the focus group FCM (see section 3.1.7). The social FCM's of both groups can be compared with each other. This shows the differences between both groups based on the individual processes. The same is done with the focus group FCM's. This shows the differences between both groups based on the group processes.

3.3 Practical implementation

Practically, we implemented the following three phases in our research to create the individual FCM's and focus group FCM's (largely based on Özesmi & Özesmi (2004):

Phase I: Preparation

1. Identification of risks perceived by dairy farmers by use of a literature review and by conducting two test interviews
2. Choose the best suitable mapping method

3. Construct a risk web for multifunctional dairy farmers and one for specialized dairy farmers based on the literature review
4. Construct a risk web that does not related to this topic to be used as an example to explain the FCM method to the farmers
5. Construct open-ended questions about risk perceptions to guide the live FCM construction

Phase II: Individual FCM (step 6-9 were repeated for each individual farmer)

6. Identification of the goals of the dairy farmer
7. Explain the practical implementation of the FCM method to the farmer with the help of the unrelated FCM risk web from step 3
8. The researcher and the farmer jointly construct the risk web on paper (size 50 by 70cm), with as a starting point his/her goals defined at step 5
9. Asking open-ended non-directional questions in order to let the farmer extend his risk web
10. Asking questions about the use of the FCM method

Phase III: construction of a social FCM and a focus group FCM (steps 11-12 were repeated for both groups of farmers)

11. Analysis of the risk webs of the individual farmers based on social FCM
12. Organising two focus groups, one for multifunctional and one for specialized dairy farmers and construct together a focus group FCM

3.4 Sampling methodology

3.4.1 Sample size

The sample size is based on research of Özesmi & Özesmi (2004), Baarda (2009) and Van Winsen et al. (2013). Baarda describes that the sample size needs to suit within the time available for the study and the purpose of the research. The purpose of this research was to continue the process of mapping until not many new variables appears on the individual maps. Research of Van Winsen et al. (2013) show that the first respondent gave 43 unique variables. The map of the fifth respondent resulted in only four new variables. Özesmi & Özesmi (2004) show that there is a steep decrease in the number of new variables after the third new map (figure 2). After the seventh new map, the number of named new variables stays rather the same.

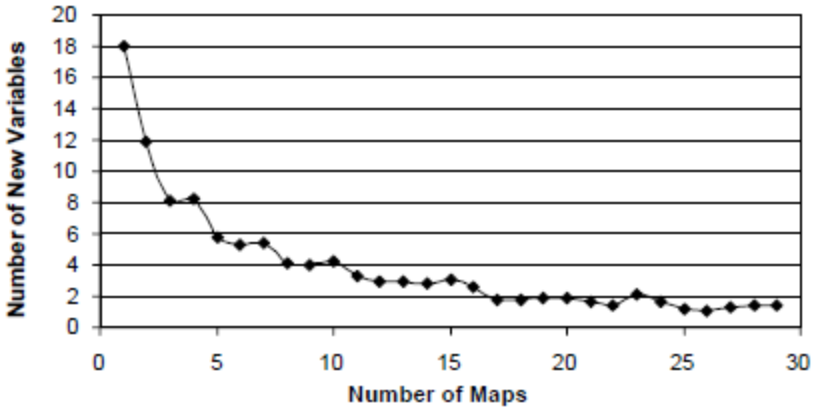

Figure 2: Number of new variables added per map (Özesmi & Özesmi, 2004)

We can conclude that the use of ten respondents per group should be appropriate considering the available time, the purpose of the research and the occurrence of new variables. In total ten respondents are visited per group, with two groups this means twenty respondents.

3.4.2 Sampling approach

There is chosen for a predetermined research area. The research compared two different groups of dairy farmers, (i) specialized dairy farmers and (ii) multifunctional dairy farmers. To be able to compare these groups, the environment in which they operate should be equal as possible. Governmental regulations and geographical characteristics differ strongly per area. For example, the manure regulations differ per area (Melkvee, 2015) and the soil is of strong influence on the production of the animal feed (Van den Ham et al., 2010). The second reason is the performance of a focus group. Farmers are visited individual and after all individual interviews are conducted, a focus group is organised with farmers who participated. The organisation of the focus group will be easier when the farmers are located in one area, relative close to each other. The Albasserwaard and the Vijfherenlanden, located in the province of Zuid-Holland are chosen as the area of the target group. In this area operate enough specialized and multifunctional dairy farmers for the sample size of this research.

The snowball effect is chosen as a method to reach the dairy farmers. The advantage of snowball sampling method is that the target group is reached more easily. The existing network of the researcher is used as a starting point. From there on, dairy farmers are asked if they know other dairy farmers that would possibly want to participate. The disadvantage of the snowball method is that the sample conducts only respondents of one group of friends or acquaintances. This is prevented by contacting also dairy farmers from my outer layer of my network. Furthermore, the respondents are asked to recommend people from the outer layer of their network. According to Baarda (2009) this is an effective method to overcome this disadvantage.

During the sampling, the definitions of specialized and multifunctional dairy farmers (as stated in paragraph 2.1) are used to contact the right dairy farmers. The dairy farmers are asked what percentage of their income is coming from milk sales or what percentage of their working time is linked to the milk production. In situations where it was unclear in what category the farmer should fit, the farmer is not included in the sample. Especially for the multifunctional dairy farmers, we took care that farmers with different types of multifunctionality where included in the sample.

3.4.3 Sampling implementation

The interviews are planned by calling farmers ahead and asking their willingness to participate. Around the time of 10:00, 12:30 and 15:00 appeared to be most effective because they are typical break times of farmers. Calling between 16:00 and 18:00 is by definition not successful because farmers are busy with milking the cows. The success rate of this stage was around 40%. After seven interviews were planned by phone, a different method of planning was used. Farmers were visited randomly and are personal asked if they want to participate in the research by having an interview. The farmer was asked if there was the possibility to have the interview directly, or if it could be planned otherwise. The experience shows that planning on the short term (e.g. within one week) was the most preferred. Around 9/10 was willing to participate the research when it was asked in this way. The weather is of strong influence on the willingness of the farmers to participate the research. In the spring, the farmers do not have time when the sun is shining. Even planning interviews is not successful on a day with good weather. All interviews therefore took place on rainy days. Lastly, the researcher needs to be flexible. Some farmers do not have time during the daytime. Therefore, several interviews took place in the evening hours.

4 Results

This chapter describes the results of the research, based on the three different maps: twenty individual FCM's (appendix 1 and 2), two focus group FCM's (appendix 3) and the two constructed social FCM's based on the individual maps (appendix 4).

4.1 General outcomes of the different maps

Here, the general outcomes of the maps are described. This means: the characteristics description of the maps, based on the analysis methods described in paragraph 3.2

4.1.1 Results of the individual maps

The individual maps of both groups show hardly any islands of themes. Only the map of respondent 8 has one node that is not connected to other nodes. This is clearly visible in the ratio of arrows to nodes. The map of respondent 8 has the lowest value for this ratio (see table 7 and 8). This is in line with the conclusion of Özesmi & Özesmi (2004) that a low ratio of arrows to nodes can lead to islands of themes. The higher the value of this ratio, the more robust the map is.

Participant number	***3***	***6***	***7***	***8***	***9***	***12***	***17***	***18***	***19***	***20***	***Average:***
# Nodes:	25	29	22	16	23	28	21	17	13	24	21,8
# Connections:	30	34	24	15	32	32	26	26	18	33	27,0
Ratio arrows to nodes	1.2	1.2	1.1	0.9	1.4	1.1	1.2	1.5	1.4	1.4	1.2

Table 7: Characteristics maps specialized dairy farmers

Participant number	***1***	***2***	***4***	***5***	***10***	***11***	***13***	***14***	***15***	***16***	***Average***
# Nodes	18	21	16	23	28	19	15	19	20	18	19,7
# Connections	25	24	19	27	30	21	18	27	22	21	23,4
Ratio arrows to nodes	1.4	1.1	1.2	1.2	1.1	1.1	1.2	1.4	1.1	1.2	1.2

Table 8: Characteristics maps multifunctional dairy farmers

In the individual maps, four networks are visible:

- Regulations: The regulations by the government have influence on goals such as freedom and having sufficient income. Regulations are connected with different variables like politics and uncertainty of regulations. Politics are again influenced by citizens and they are partly influenced by the farmers themselves.
- Health of animals: the health of the cows influences the pleasure of working with cows directly. Indirectly the income is influenced. The health of the animals influences the milk production, the milk quality and therefore the milk price. The health of the cows is influenced by the quality of the feed.
- Entrepreneurship: Entrepreneurship is the connecting element in the most maps. It influences income both directly and indirectly. It provides freedom but it also influences the regulations.

- Milk price: The milk price strongly influences the income of the dairy farmers. At the same time, the milk price is influenced by the market, but also indirectly by the farmer by taking care of the health of the cows, and therefore the quality of the milk. The milk quality influences the milk price.

The networks of regulations, health of animals and entrepreneurship are interconnected and hence cannot be individually considered. Therefore, we can conclude that these named networks are potent options because they appear in two or more different clusters. Therefore these are more important than other nodes because their influence more than one networks within the map. The maps of all individual participants are enclosed in appendix 1 and 2

4.1.2 Results of the focus group FCM's

The focus group of the multifunctional dairy farmers is performed with four people of three visited families (i.e farmers 1, 2, 14 and the spouse of farmer 2). In the focus group of the specialized dairy farmers, seven people of six visited families participated (i.e. farmer 3, 8, 9, 12, 18, 20 and the spouse of farmer 8). The focus group FCM of the specialized group is extreme dense with a ratio of arrows to nodes of 1.9.The ratio of arrows to nodes for the multifunctional group is average with 1.2 (table 9). This is likely because only three farmers of the multifunctional focus group participated and the double number of farmers participated the focus group of specialized dairy farmers.

The focus group FCM's of both focus groups are enclosed in appendix 3

	Focus group FCM multifunctional	*Focus group FCM specialized*
Nodes	28	24
Connections	34	46
Ratio arrows to nodes	1.2	1.9

Table 9: Characteristics focus group FCM

4.1.3 Results of the social FCM

Like Fairweather (2010) described, it would be difficult to present and interpret all connections and nodes in the social FCM. For the multifunctional group this would be 205 unique connections, for the specialized group this would be 218 unique connections. Therefore, in the social FCM, only the connections are displayed that exist in more than one individual map. The social FCM of both groups show a low ratio of arrows to the nodes (table 9). Not surprising, some islands of themes exist in the maps.

The specialized social FCM has more nodes and the ratio of arrows to nodes is higher (table 10). This is because of two reasons: firstly, specialized dairy farmers have in the individual maps on average 27 connections, while multifunctional dairy farmers have only 23 connections. Secondly, the multifunctional dairy farmers have many more unique

nodes than the specialized dairy farmers. The social FCM's of both groups are enclosed in appendix 4.

	social FCM multifunctional	*social FCM specialized*
Nodes	17	32
Connections	15	33
Ratio arrows to nodes	0.9	1.0

Table 10: Characteristics of the social FCM's

4.1.4 Comparison individual FCM, social FCM and focus group FCM

Social FCM uses the information of the individual maps. Therefore, it is not possible to compare the number of nodes found in the social FCM with the amount of nodes in the individual maps. Social FCM can be seen as the summary of the individual maps. Social FCM highlights the most named connections on the individual maps. Compared to the individual maps, social FCM shows much less information. Only the most important information of the individual maps is summarized and displayed.

The focus group FCM led to more nodes and more connections than on the individual maps. The multifunctional group produced a map with 28 nodes and 34 connections where 21 nodes and 25 connections were the average of the individual maps of the participating people. For the specialized group the difference was even larger, during the focus group 24 nodes and 46 connections where created while the individual maps led to an average of 22 nodes and 28 connections of the participating farmers. The discussion during the focus group resulted in better-argued values of the connections. While on individual maps many extreme values of "10" appear, the focus group FCM contains hardly any.

Compared to the focus group FCM, the social FCM shows much less and completely different information. The social FCM show the most important issues based on individual maps. It does not show a complete overview of the reasoning network of farmers. The focus group FCM's does. For this reason, we cannot compare social FCM directly with the focus group FCM, but we can use both to analyse differences between the two groups of dairy farmers in the next sections.

4.2 Goals of dairy farmers

The first research question of this research is wondering what the main goals are of Dutch dairy farmers. This research question is an important start because at the onset of this research we assumed that risk is not only related to the goal "having sufficient income". The results show that farmers have more objectives than "having sufficient income". The main goals of the participating specialized dairy farmers are: working with animals (cows in particularity), be your own boss (in the context of "freedom"), have

sufficient income and be an entrepreneur. The main goals of the participating multifunctional dairy farmers are: working with animals (cows in particularity), freedom, have sufficient income, be an entrepreneur and have contact with other people.

The goals of multifunctional and specialized dairy farmers do not differ much. Specialized dairy farmers describe freedom more as "be your own boss", while multifunctional dairy farmers describe this more as "freedom". Not very surprisingly, the multifunctional dairy farmers see "have contact with other people" as one of their goals, but specialized dairy farmers do not. Some specialized dairy farmers do describe contact with people as a factor in their map, but none of them describes it as a goal. Bergevoet et al. (2004) describes "enjoy my work" as the main goal of dairy farmers. This goal is not formulated as such by the dairy farmers in this research, but the combination of the goals in this research could be summarized as "enjoy my work". The second goal found by Bergevoet et al. (2004), producing a good and safe product, is not stated by any farmer in this research, neither the goal "contribute to a positive image of my professional group". Also the contribution to a positive image of the professional group is not named as a goal, but it is named as one of the nodes in the social FCM's and the focus group FCM's. The fifth goal of Bergevoet is the most conflicting with our result. Bergvoet describes the fifth goal of dairy farmers as: "realize an income high as possible". The farmers in our research also describe "income" as a goal, but they all stress that having "sufficient income" is their goal and for sure not an income as "high as possible". As shown in both our research and the research of Bergevoet et al. (2004), income is a goal of dairy farmers but many other goals play an important role.

The results show a strong connection between risk (perception) and the goals of dairy farmers. This becomes clearly visible in the individual maps in appendix 1 and 2

4.3 The main risks perceived in Dutch dairy farming

The second research question is questioning what the different risks in Dutch dairy farming are, and what their relationships are. The main risks found in literature and the risks found in the research are elaborated. The relationships between the risks are evaluated with the help of the social FCM and the focus group FCM.

4.3.1 Production risk

According to the USDA (n.d.) these production risks are caused by adverse weather, pests, disease, human error, and misuse of new technologies. As stressed in the results of the goals of dairy farmers, risk is not only related to income. Production risks are also strongly connected to the goals "working with cows" and the goal "be an entrepreneur" (see figure below). Especially the health of the cows is of high importance for the satisfaction of the farmer, e.g. working with cows. The figure below shows the outcome of the focus group FCM's.

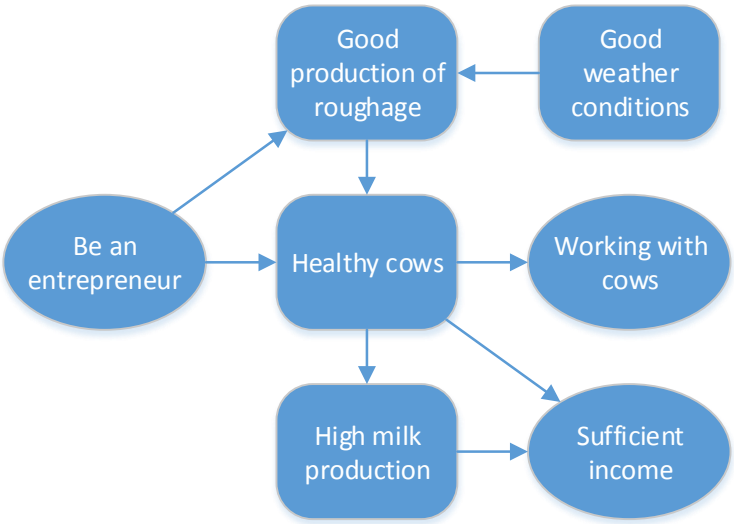

Figure 3: The network around production risks

4.3.2 Price risk

The risk webs of both multifunctional and specialized dairy farmers show a large impact of the milk price on their income. Milk price as such is not a price risk. The fluctuations of the milk price (and especially decrease of the milk price) are a price risk. The dairy farmers all described milk price in the FCM's as a risk. It may be caused by the current milk price that it is described as a risk, and it is not specified as fluctuations of the milk price. The goal of farmers to have "sufficient income" is largely influenced by the milk price. Most of the specialized dairy farmers score the strength of the relation at a ten, the highest possible value. Multifunctional dairy farmers score the strength of the relation also high, but slightly lower than their specialized colleagues. Remarkable is that two out of the ten multifunctional dairy farmers did not even mention the milk price as of influence on their income. This may be because of their specific situation; one makes cheese of all the produced milk and one is a biological farmer. The multifunctional dairy farmers produce besides milk also other products that have an effect on the income. Therefore, the relationship between milk price and having sufficient income is slightly lower for these farmers. Overall, it is understandable that farmers rate the relationship between milk price and their income high. The current milk price is far below the average cost price (critical milk price of €32,58 per 100 kg milk and a milk price of €29,29 per 100 kg milk in May, 2016); therefore dairy farmers experience the influence of the milk price on income the hard way (Melkvee, 2016). A few dairy farmers named other price risks, like the price of calves and cows. Only two farmers named the price of concentrated feed. These farmers score the connection of the concentrate price and the income high, a seven on the scale from zero to ten.

4.3.3 Policy risk

Both the multifunctional and the specialized dairy farmers are concerned about governmental policy. According to most farmers, these governmental regulations have a

strong negative impact on their income, freedom and entrepreneurship. The most frustrating aspect is the inconsistency and the unpredictability of the government. The most recent topic is the discussion about the separation of calves from their mothers (BoerenBusiness, 2016). It frustrates dairy farmers that the government can decide on regulations without taking into account the perspective of the farmers. The clearest example of inconsistency of the governmental policy is the abolishment of the milk quota. The milk quota is abolished on the 1st of April 2015. Only one year afterwards, the government is thinking about new ways to reduce the milk production. Phosphate rights are one of the possibilities that the government can use to do so. The farmers link this strongly to the current low milk prices. Wauters et al. (2014) already mentioned this linkage in their research. At the same time, so called "phosphate rights" will limit the milk production in the future. Uncertainty about this new coming regulation makes dairy farmers insecure about their future. Most farmers see governmental and non-governmental regulations as an infringement on their freedom as a farmer. In contrary, a few farmers see these regulations as an opportunity to perform better than their colleagues do. These farmers, or better-said entrepreneurs, see opportunities rather than threats. A changing business environment creates chances to outperform their colleagues. These farmers have the opinion that the ability to adapt is something that is connected with being a farmer or being an entrepreneur.

Citizens elect the government; therefore, there is a strong connection between citizens and the government. The dairy farmers see a strong connection between the government and the regulations. Bos et al. (2008) concluded already that citizens have a low trust in dairy farming. The results of this research show also that there is a weak connection between citizens and dairy farmers. It is not surprising that most multifunctional dairy farmers perceive a stronger connection between them and citizens than their specialized colleagues. The figure below shows a quick overview based on the information above and based on the focus group FCM's.

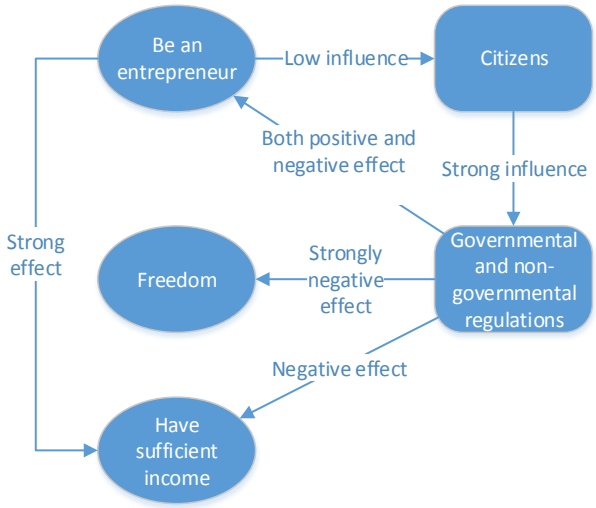

Figure 7: The network around governmental policy network

4.3.4 Personal risk

Personal risk was not extensively elaborated during the individual conversations. But the farmers that named it, valued it as highly important. It seems that this risk is assumed as "logic". It seems that farmers do not name it because "of course" this is of large impact on all goals. On family farms, the entrepreneur or farmer is the central person. If this person is not able any more to fulfill the job, the farm will stop rather quickly. This became clearer during the focus group of the specialized dairy farmers. The farmers linked their health to many factors. The figure below shows an overview of the information above.

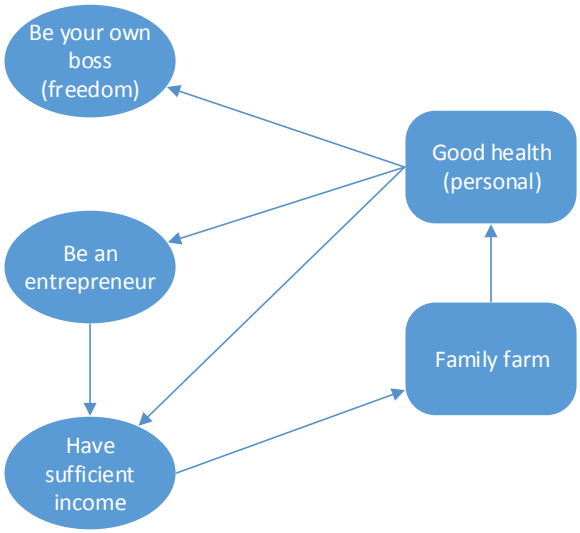

Figure 8: The network around personal risk

4.3.5 Subsidy risk

Subsidies are a special kind of policy risk. Policy risks are often related to governmental regulations. Subsidies are basically another category of policy. We name it separately because it is named in another structure in the maps. Subsidies are hardly named during the individual conversations. There was no difference between the two groups. During the focus group of the specialized dairy farmers, it is named. The figure below originates from the focus group FCM of the specialized dairy farmers. It shows that farmers have an influence on subsidies (whether or not they apply for subsidies. At the same time, regulations have an influence on the subsidies because the farmers are discounted on their subsidies when they violate regulations.

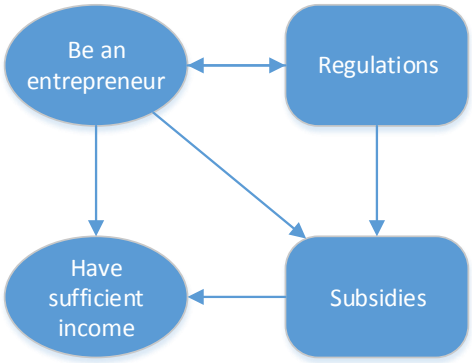

Figure 9: The network around subsidies

4.3.6 Margin risk

The word "margin" is not named at all during the whole research. It may be that this is overlooked because "have sufficient income" is named. This is not the same as "margin" but the margin is included in the income. Also, cost price and technical results are mentioned as an influence on the goal of having sufficient income. If we combine all these, we can conclude that the specific word "margin" is not mentioned but that it is captured in other terms that together capture the margin.

4.3.7 Land risk

Land is named by Wauters et al., (2014) as a perceived high risk factor by dairy farmers. With "land" is referred to the availability of land and the fluctuation or the risk of increase of the land price. The price of land is directly linked to the availability of land. The price of land is linked to the price of roughage which is an important input for the production of milk. Land is not named as such in any FCM, not in the individual FCM neither in the focus group FCM.

4.4 Differences in risk perception

Two methods are used to compare the specialized and the multifunctional dairy farmers. Social FCM is used to analyse individual FCM maps and merges these to one general map. Secondly, with the focus group FCM the differences between the groups based on the group process can be analysed.

4.4.1 Differences based on social FCM

The multifunctional social FCM shows four key nodes with the most connections with other nodes: regulations, freedom, self-employment and milk price/income from milk. "Regulations" is the most connected to other nodes. Six out of ten dairy farmers see regulations as a threat to their income. Node "milk price/income from milk" is the most named in relation to income. This map stresses again the importance to see risk in a broader perspective than only the relation towards income. Income risk is an important factor, but many other factors play a role like freedom and self-employment. The social cognitive map of the specialized dairy farmers also shows key nodes: regulations, entrepreneurship, sufficient income and illness cows. The most named are the relations

"cost price", "milk price" and price of calves" towards the node "sufficient income". In addition, four out of ten farmers named the health of the cows on the goal pleasure of working with cows.

4.4.2 Differences based on focus group FCM

The focus group FCM's are surprisingly similar. The multifunctional dairy farmers have one extra goal compared to specialized dairy farmers: contact with people. Nevertheless, the specialized dairy farmers also see it as their responsibility to inform citizens or consumers about the farm as an entrepreneur. The only difference is that specialized dairy farmers did not name their relation towards the neighbourhood. Specialized dairy farmers describe the farmland as one of the key factors to obtain good technical results. Furthermore, the specialized dairy farmers name subsidies as an important factor for the goal "having sufficient income". Multifunctional dairy farmers describe more factors around the goal "entrepreneurship". According to them, continuous change, quick reacting and growth are connected to entrepreneurship.

4.5 Risk mapping as communication tool

We analysed the method of risk mapping as a communication tool in two ways, both individually and in a group. All twenty farmers where asked about their opinion about the research method. Furthermore, the impressions of the researcher are used for the analysis of FCM as communication tool.

4.5.1 The individual process from the perspective of the farmers

Most of the visited dairy farmers are positive towards the interview method that is used during the conversation. The most frequent response was: "This method forced me to think about the subject". The moment that farmers needed to mark the different connections, new information came up. The mark itself is not of high value. According to Kok (2009) it is strongly influenced by the moment of the rating. Also, everybody has another perception of certain values. We see the mark as a useful tool to let people think. The participant is forced to think in depth to be able to give a value to a connection. FCM brings structure into the conversation. Feedback of dairy farmers learned that they perceive the nodes on the map as recognition points in the conversation. It gives them a good structure during the conversation. It also makes immediately clear what is already discussed. From there on, new topics can be discussed without repetition of already discussed topics. Finally, farmers see the created map as a good way to replace minutes. Without the need to read long minutes, the created map gives a clear overview about what is discussed.

4.5.2 The individual process from the side of the researcher:

The mapping method gives the researcher handhold without sending the interviewee in a certain direction. It also gives structure without the listing of questions upfront. This structure is needed in order to prevent repetition and to not forget subjects.

The mapping method gives opportunities in conversations with people who do not talk much. These people can look to the risk map to see what they already said. Some people tend to give short answers on questions, but with the use of the map they need to talk about connections, which cannot be answered with short answers. Conversely, the use of the risk map has advantages in conversations with people who are long-winded. Still, the researcher will need good interviewing techniques but the researcher can refer back to the map all the time. This will help to keep the conversation on track.

4.5.3 Risk mapping in the group process

Risk mapping as a method to organise a focus group is tested during two sessions. The used approach (described in paragraph 3.1.7) ensured that all participants where on the floor. In both sessions, the farmers where enthusiastic and the focus groups resulted in a great maps as described in paragraph 4.1.3 and 4.4.2. It is hard to conclude if FCM is the best method to communicate during a focus group because we did not compare this method with other methods. The results of this research only show that it is possible to use FCM as an approach to examine the risk perception of farmers.

5 Discussion and recommendations

5.1 Potential disadvantages of FCM

As stated in paragraph 3.1.6, FCM has some drawbacks. First, the interviewer can influence the results significantly (Eden, 2004). In this research, the researcher constructed the FCM live. The respondent named issues and the researcher put this on the paper. It is difficult to determine when something should be put on the paper. Not everything the respondent says needs to be in the map. A subjective process strongly depends on the researcher. However, this process is less subjective than creating FCM's, based on transcripts. The respondent is involved in the process of creating the map; this in contrast to the creation of FCM's based on transcripts where the respondent is only can evaluate the end product. Secondly, the ignorance and misconception of the farmer are all encoded in the maps (Kosko, 1992). For example, the risk of "margin" was not named during the whole research while other research found this as one of the risks. It could be that margin is an underlying risk of the named risk "having sufficient income". Thirdly, "what-if" reasoning's can be modelled, but "why's" are not captured by FCM (Kim and Lee, 1998). The models show connections between nodes. The connections are valued with a mark. However, the reason why there is a certain connection is not visible in the map. Some information of the conversations, both individual and in the group, is not used while it could be useful. Fourthly, limited statistical analysis is possible (Kok, 2009). Therefore, the analysis is more subjective. The outcomes of the research are different maps. It is possible to compare these maps based on the number of connections and the number of nodes. Furthermore, there are very limited statistical possibilities. Diniz et al., (2015) introduce a method to perform more extended statistical analysis on FCM but there are many concerns about these methods according to researchers. FCM in the context of risk and risk perception under (dairy) farmers has the most value because of the visualisation of complex networks, not because of the statistical potential.

5.2 Boundaries of FCM

There are four potential boundaries of FCM. Firstly, the FCM is never complete. The degree of detail is depending on the width of the research and the time available. Of course, it is possible to create a complete FCM but this would need a large amount of time. Within the scope of this research, the maps are not complete due to the shortage of available time. Secondly, the farmer can forget risks that he does perceive. Partly depending on the interviewing techniques of the researcher, the farmer can forget to name some risks. In this research, the farmers received the work-out of the map by email within a few days with the question to comment on it if there would be any mistakes or shortages included in the map. Only one map was slightly adapted by the feedback of the farmer. Thirdly, it could be that the farmer is not aware of a risk. These

could be risks that are not known by the farmer, but known by other farmers, researchers or stakeholders or could be risks that are known by no one.

5.3 Limitations of FCM

First of all, the research is limited because FCM results in simplification of the reality. As said, the FCM's in this research are not complete. Therefore the reality can differ from the information in the maps. Secondly, there are no standardized procedures and surveys to construct FCM's. Paragraph 3.1 describs the approch we used. We noticed during the focus group that it is needed to apply stricter rules in order to increase the quality of the research. For example, it makes a difference if the researcher first tries to reach an agreement about a certain node and then put it on paper, or that he put a node on paper and then tries to arrange an agreement. During this research, both approaches are used but not according to a structured approach. Hence, a clear protocol should have been constructed beforehand. Thirdly, due to the lack of procedures, the process was more relying on the researcher. One researcher performed the research and therefore we can assume that the process to become the FCM's consistent is performed. Lastly, as we speak about perceptions, these can be influenced by the cognitive biases. These are tendencies to think in certain ways that can lead to systematic deviations from a standard of rationality.

The sampling is a good representation of the Alblasserwaard-Vijfherenlanden. However, this is not a representation of all specialized and multifunctional dairy farmers in the Netherlands. This is because the area Alblasserwaard-Vijfherenlanden is not representative for the Netherlands. The area has slightly different regulations than other parts of the Netherlands. Furthermore, religion plays an important role in this area. This definitely influenced some individual FCM's and maybe also the focus group FCM.

5.4 Social FCM and focus group FCM

The social FCM is constructed, based on the individual FCM's. The amount of arrows to nodes is low, 0.9 for multifunctional dairy farmers and 1.0 for specialized dairy farmers. This leads to islands of themes, which is not desirable. To prevent this from happening again, it is recommended to increase the sample size with at least five extra farmers per category or to decrease the width of the research. We see this already in the difference between specialized and multifunctional dairy farmers. The specialized dairy farmers perceive less different nodes. Therefore, the value of arrows to nodes is higher and the number of islands of themes is lower than the social FCM of multifunctional dairy farmers.

There are three issues of discussion at the focus group held. First, not all participating farmers of the individual conversations participated in the focus groups. For the specialized group, seven out of ten participated. For the multifunctional group this was

only three out of ten. It is questionable if three out of ten people give a fair representation of the whole group. Secondly, the most participating farmers took their individual map with them. They used it mostly in the finalizing part to check if everything was included in the map created with the group. This influences the final map in a certain way. It is unclear what the exact effect is of this. Potentially, this harms the group process. It could lead to map that consist of aggregated individual maps. This, while the focus group FCM should be a product of the group process. In this situation, the influence of the individual maps was limited because they where only used in the finalizing part. Thirdly, it is unclear if we reached complete perfect group consensus. Even though we used a protocol (as described in paragraph 3.1.7) it could be that a participant was less active during the focus group.

5.5 Recommendations for future research

Future research in this field could focus on the comparison of different groups of (dairy) farmers. We compared multifunctional dairy farmers with specialized dairy farmers. We found that the specialized dairy farmers where rather similar to each other while multifunctional dairy farmers where more diverse. This was challenging especially with the creation of the focus group FCM.

We found evidence that FCM has great potential to use in the communication between dairy farmers and researchers. More in general, we expect that there is great potential to use FCM as a method to communicate about complex issues. FCM may be a method to improve the communication between farmers, researchers, stakeholders or mutually. Future research may focus specifically on this communication aspect and the advantage of this.

This research shows that risk perception is a complex matter. Individual risks are influences and/or are influenced by other risks. Together, this forms a network of risks that are connected with each other. This research shows that risks cannot be treated individually. This implies that risk should always be examined with taking into account the network of surrounding risks.

Lastly, this research is performed only in a bounded area in the Netherlands. Therefore it is not representative for the Netherlands. It would be interesting to use the same method to investigate this in a sample that is representative for the Netherlands.

6 Conclusion

The main research question: *what role can risk maps play as a tool to give a holistic view on risk perception and as a communication tool for comparing specialized versus multi-functional Dutch dairy farmers?*

The results of the research show that the risk mapping method Fuzzy Cognitive Mapping (FCM) can present a holistic view on risk perception. The live visualisation on paper of spoken information enables to keep on track during conversations about complex networks of information, like the network of risk perception. The produced maps can present the results of the risk perception of both individual conversations as well as group conversations. It is possible to compare specialized and multifunctional Dutch dairy farmers. Aggregated individual maps of both groups, social FCM's, and focus group FCM's are compared.

Research question one: *what are the main goals of Dutch dairy farmers?*

The main goals of the dairy farmers are extracted from the individual maps. The results show four main goals for specialized dairy farmers. Multifunctional farmers have one additional goal. Not stated in order of importance, the goals for specialized and multifunctional dairy farmers are: (i) working with cows, (ii) be your own boss (freedom, (iii) entrepreneurship and (iv) having sufficient income. The additional goal for multifunctional dairy farmers is contact with people.

Research question two: *what are the different risks perceived by Dutch dairy farmers and what are the relationships between them?*

While risk in literature is most of the time related to the income of dairy farmers, it is in reality related to many more goals. The results show that the risks as such do not differ much from the risks known from literature: production, price, governmental policy, personal are the main risks perceived. To a lesser extent, the farmers perceive also subsidy as a risk. The participating dairy farmers do not perceive margin and land as a risk.

Research question three: *what are the differences in risk perception between specialized and multifunctional Dutch dairy farmers?*

Based on the social FCM we conclude that the key nodes of multifunctional and specialized dairy farmers correspond for regulations. Besides, multifunctional dairy farmers had the key nodes of freedom, self-employment and milk price/income from milk. For specialized dairy farmers these are entrepreneurship, sufficient income and illness of cows.

The differences based on the FCM created in the focus group are as follows:

The specialized dairy farmers describe the farmland as one of the key factors to obtain good technical results. Furthermore, the specialized dairy farmers name subsidies as an important factor for the goal "having sufficient income". Multifunctional dairy farmers describe more factors around the goal "entrepreneurship". According to them, continuous change, quick reacting and growth are connected to entrepreneurship.

Research question four: *what role can risk maps play to help farmers and researchers communicate about risk?*

The results show that FCM helps in the communication. It gives structure in open conversations without the need for a questionnaire list. It is a great way to present results. It helps to present a holistic view on the risk perception of a farmer. The advantage of FCM is the valuing of the connections. Respondents found it difficult to give a value but at the same time, they explained that it forced them to think about the aspect in-depth.

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Wageningen UR. (2015). Retrieved at 28 January, from: http://www.wageningenur.nl/nl/nieuws/Omzet-multifunctionele-landbouw-opnieuw-gestegen.htm

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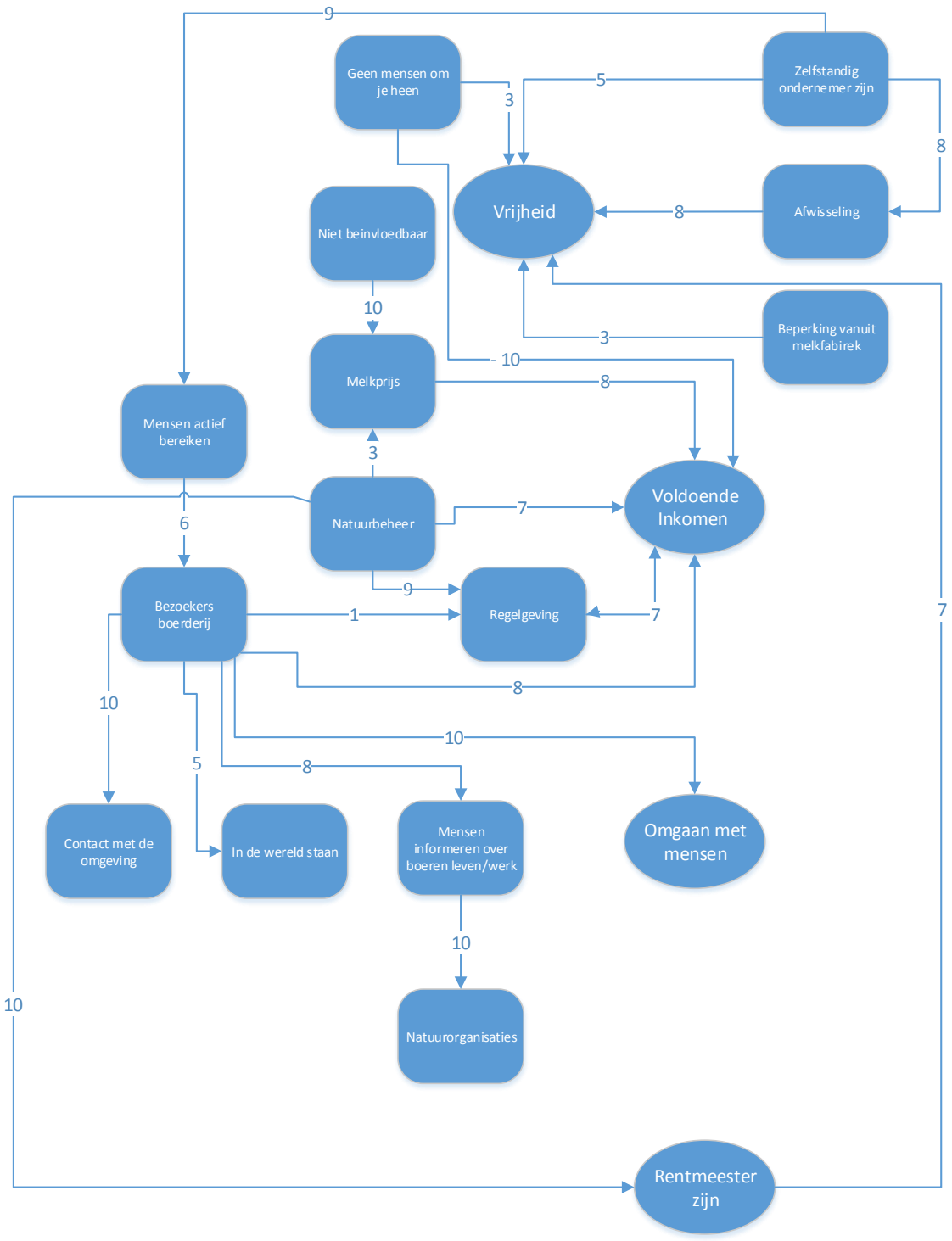
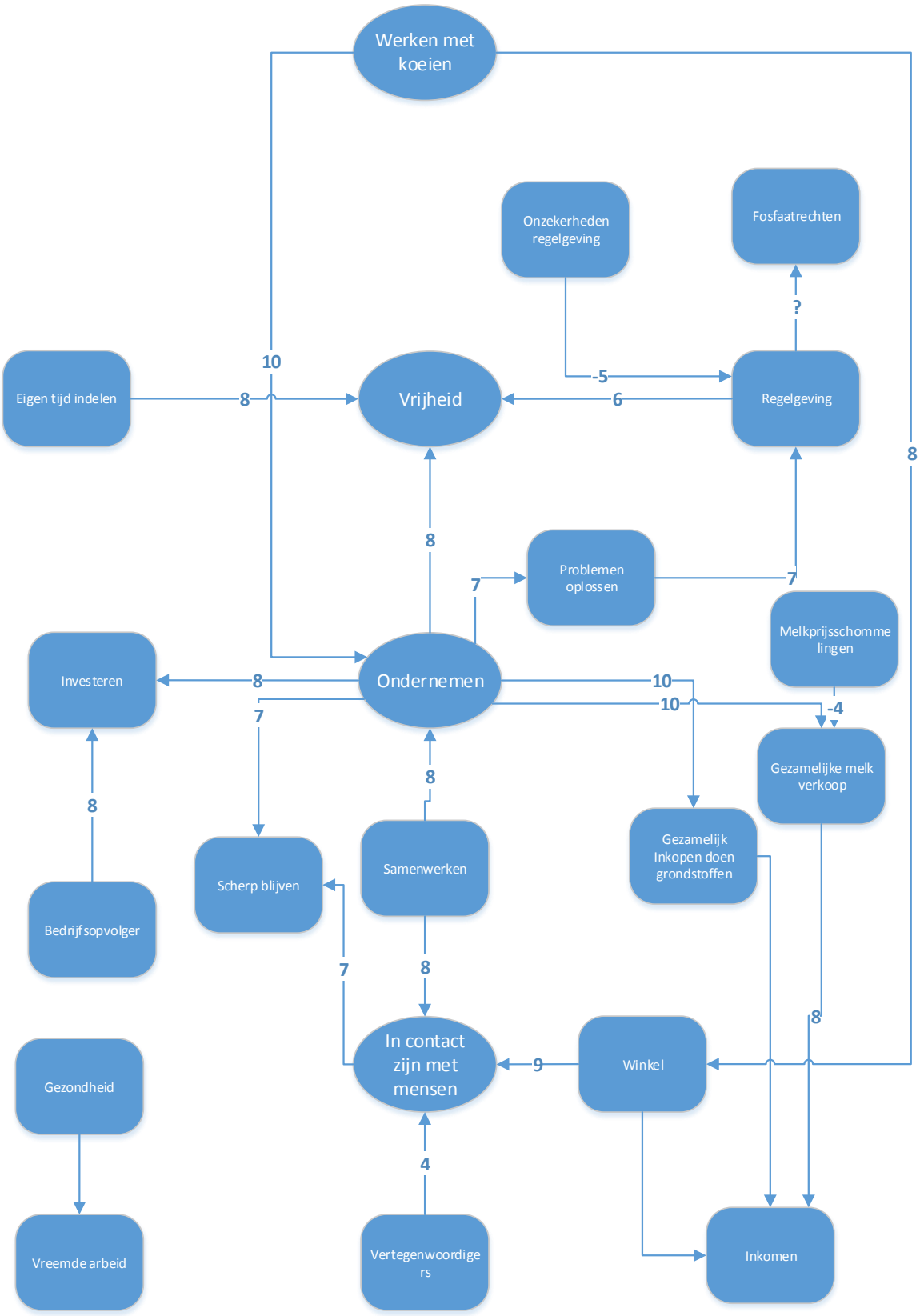
Appendix 1 Individual FCM multifunctional dairy farmers

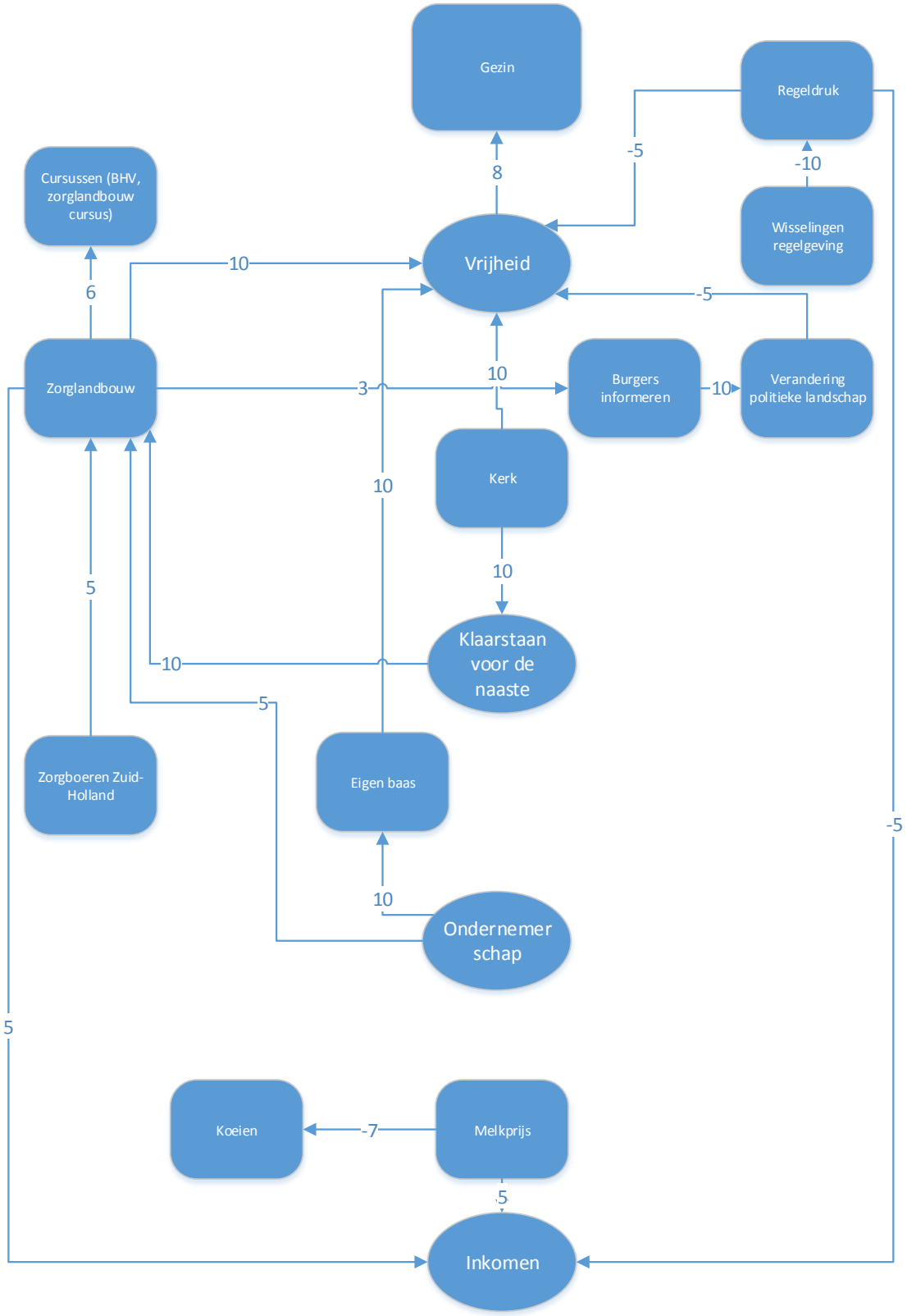
Farmer 1



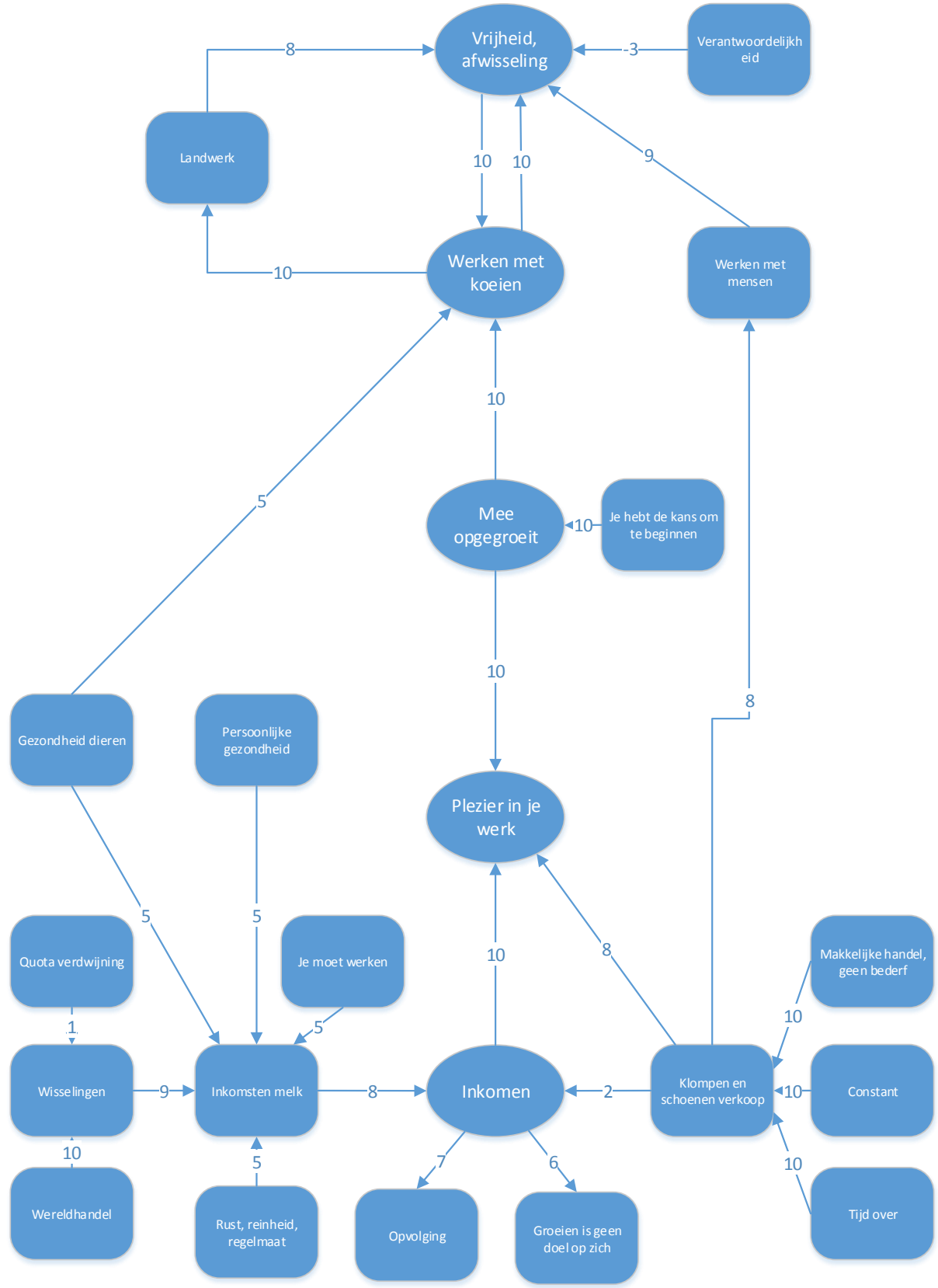
Farmer 2


Werken met koeien
Onzekerheden regelgeving
Fosfaatrechten
?
Eigen tijd indelen
10
8
Vrijheid
-5
6
Regelgeving
8
8
Problemen oplossen
7
7
Melkprijsschommelingen
Investeren
8
Ondernemen
10
10
-4
7
Gezamelijke melk verkoop
8
8
Gezamelijk Inkopen doen grondstoffen
Scherp blijven
Samenwerken
Bedrijfsopvolger
7
8
8
In contact zijn met mensen
9
Winkel
Gezondheid
4
Vreemde arbeid
Vertegenwoordigers
Inkomen

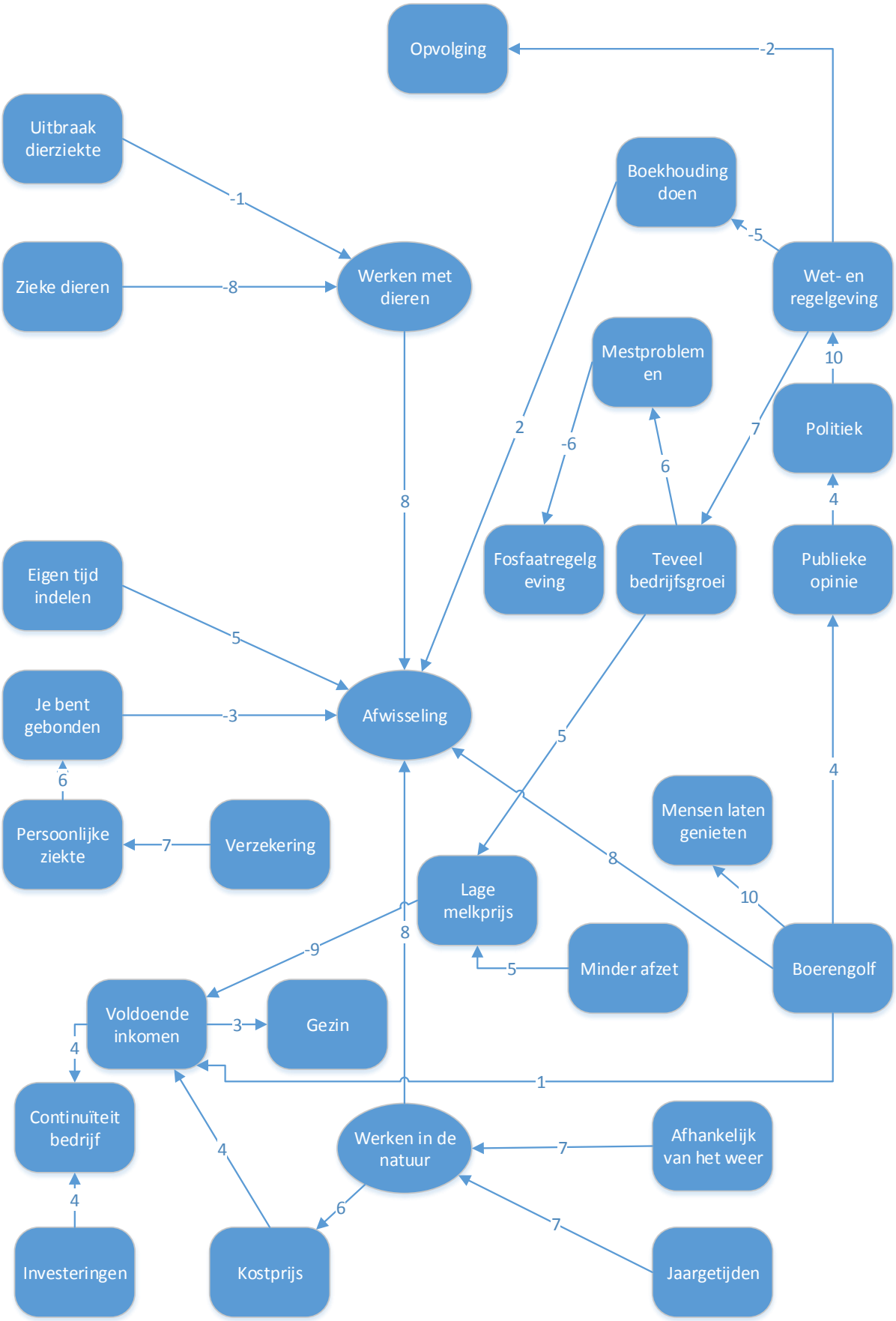
Farmer 4


Gezin
Regeldruk
Cursussen (BHV, zorglandbouw cursus)
Wisselingen regelgeving
Vrijheid
Zorglandbouw
Burgers informeren
Verandering politieke landschap
Kerk
Klaarstaan voor de naaste
Zorgboeren Zuid-Holland
Eigen baas
Ondernemer schap
Koeien
Melkprijs
Inkomen
8
-5
-10
6
10
-5
3
10
10
10
10
5
10
5
10
-5
-7
5
5
-5

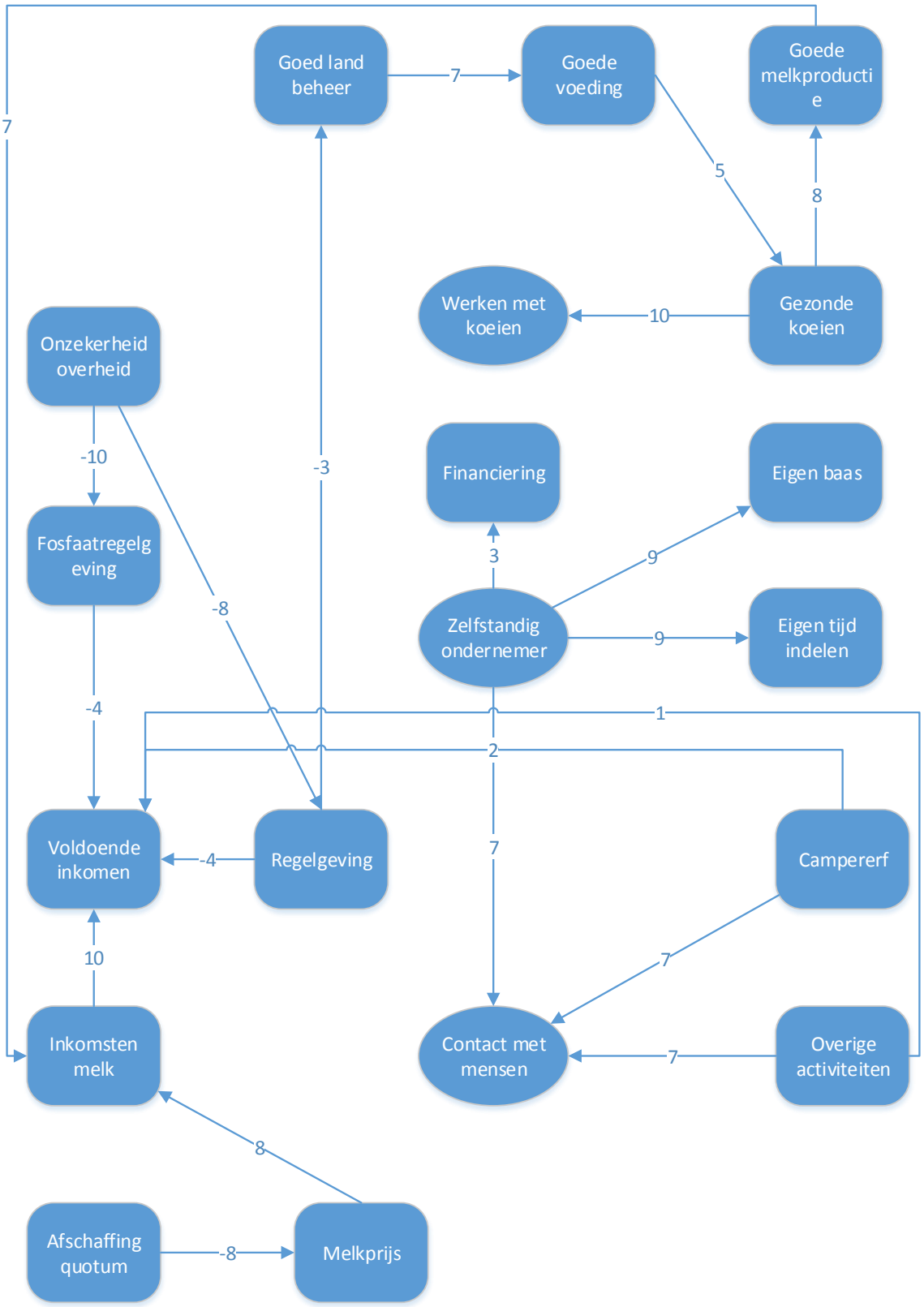
Farmer 5


Vrijheid, afwisseling
Verantwoordelijkheid
Landwerk
Werken met koeien
Werken met mensen
Mee opgegroeit
Je hebt de kans om te beginnen
Gezondheid dieren
Persoonlijke gezondheid
Plezier in je werk
Quota verdwijning
Je moet werken
Wisselingen
Inkomsten melk
Inkomen
Klompen en schoenen verkoop
Makkelijke handel, geen bederf
Constant
Tijd over
Wereldhandel
Rust, reinheid, regelmaat
Opvolging
Groeien is geen doel op zich
8
3
10
10
9
10
10
5
10
8
5
5
5
1
9
8
2
10
10
10
10
10
5
7
6

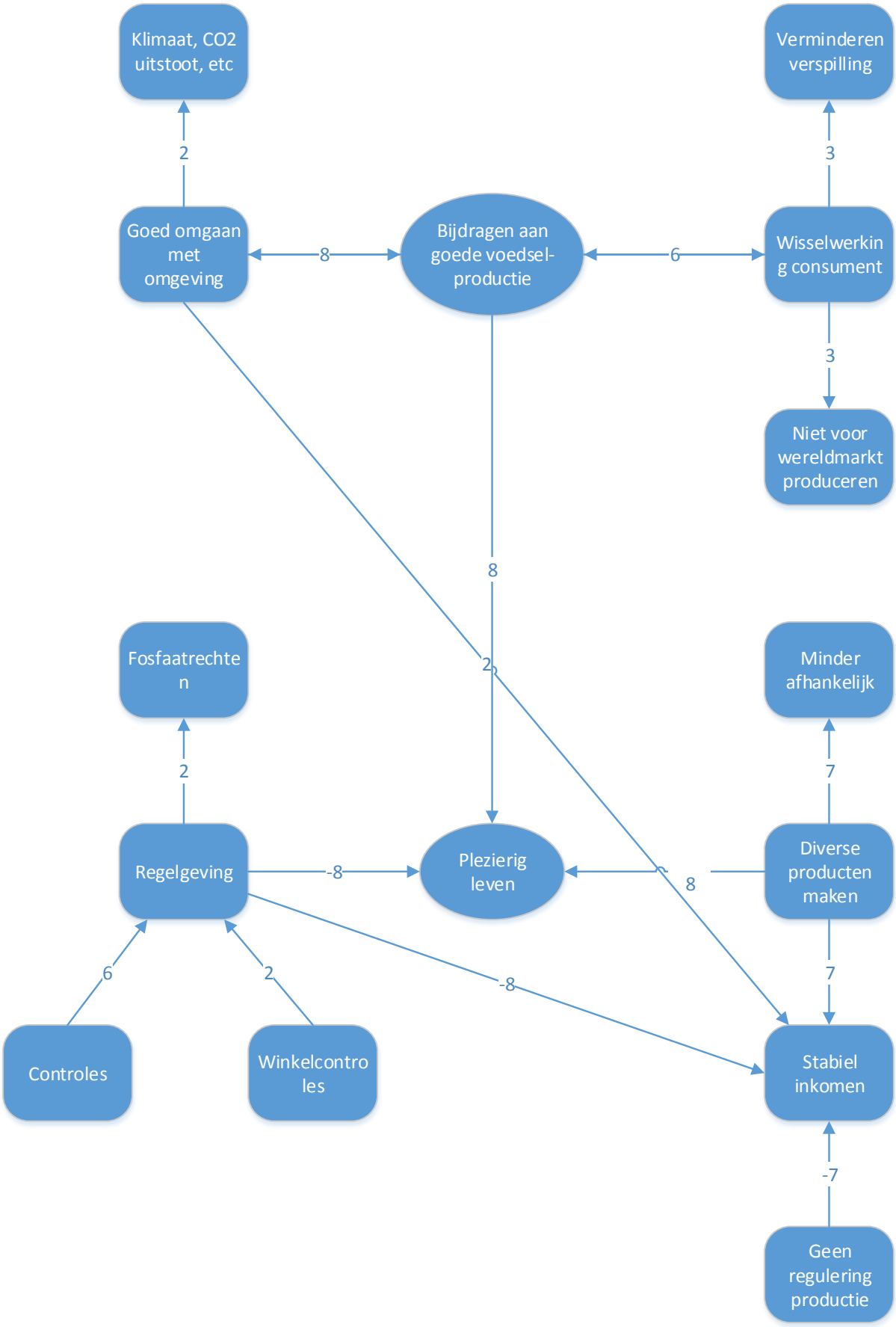
Farmer 10


Opvolging
-2
Uitbraak dierziekte
-1
Boekhouding doen
-5
Zieke dieren
-8
Werken met dieren
Wet- en regelgeving
Mestproblem en
10
2
-6
7
Politiek
6
8
4
Fosfaatregelg eving
Teveel bedrijfsgroei
Publieke opinie
Eigen tijd indelen
5
Je bent gebonden
-3
Afwisseling
5
6
4
Mensen laten genieten
Persoonlijke ziekte
7
Verzekering
8
Lage melkprijs
10
8
-9
Minder afzet
5
Boerengolf
Voldoende inkomen
3
Gezin
4
1
Continuïteit bedrijf
Werken in de natuur
7
Afhankelijk van het weer
4
4
6
7
Investeringen
Kostprijs
Jaargetijden

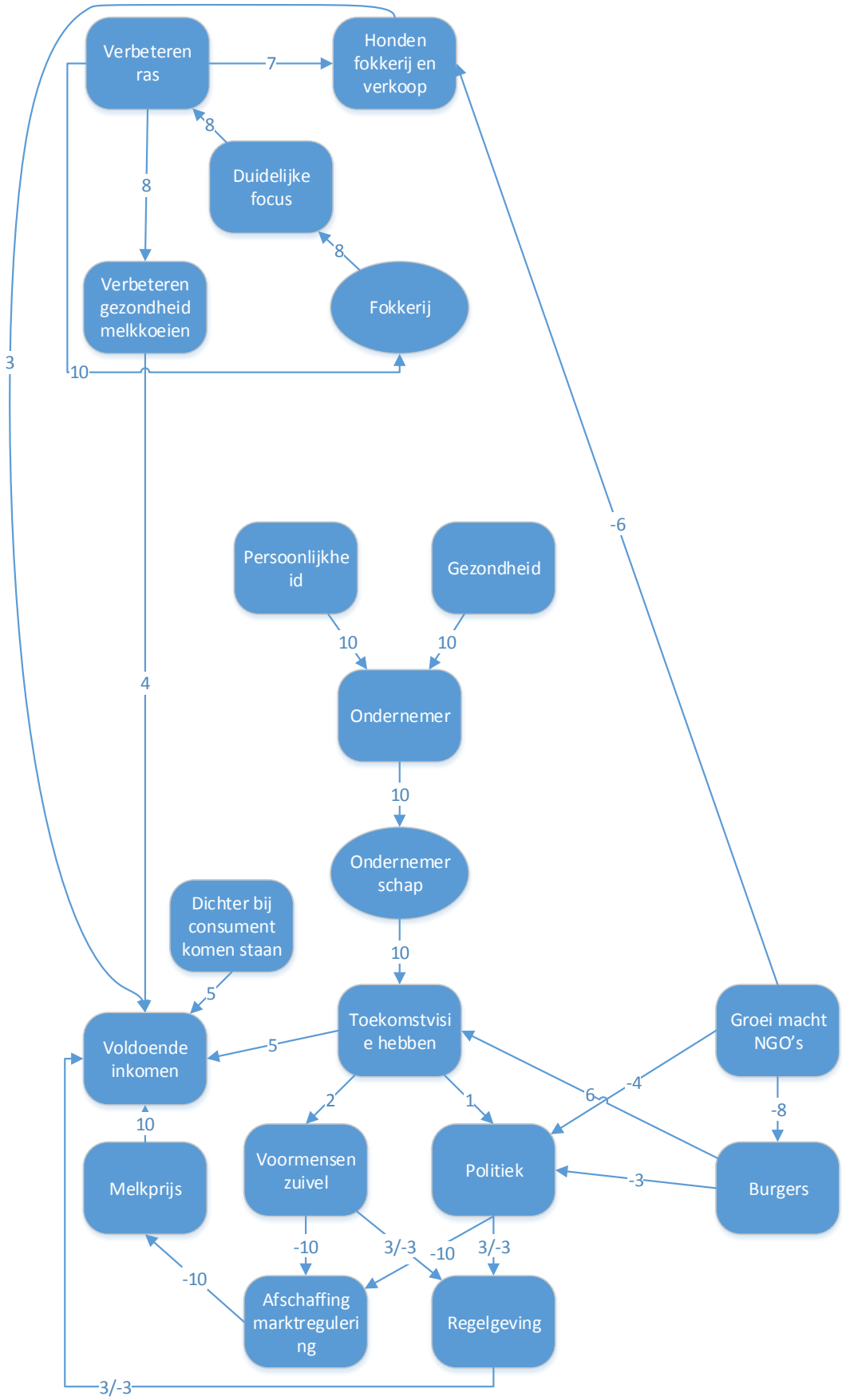
Farmer 11


Goed land beheer
7
Goede voeding
Goede melkproductie
7
5
8
Werken met koeien
10
Gezonde koeien
Onzekerheid overheid
-10
-3
Financiering
Eigen baas
Fosfaatregelgeving
3
9
-8
Zelfstandig ondernemer
9
Eigen tijd indelen
-4
1
2
Voldoende inkomen
-4
Regelgeving
7
Campererf
10
7
Inkomsten melk
Contact met mensen
7
Overige activiteiten
8
Afschaffing quotum
-8
Melkprijs

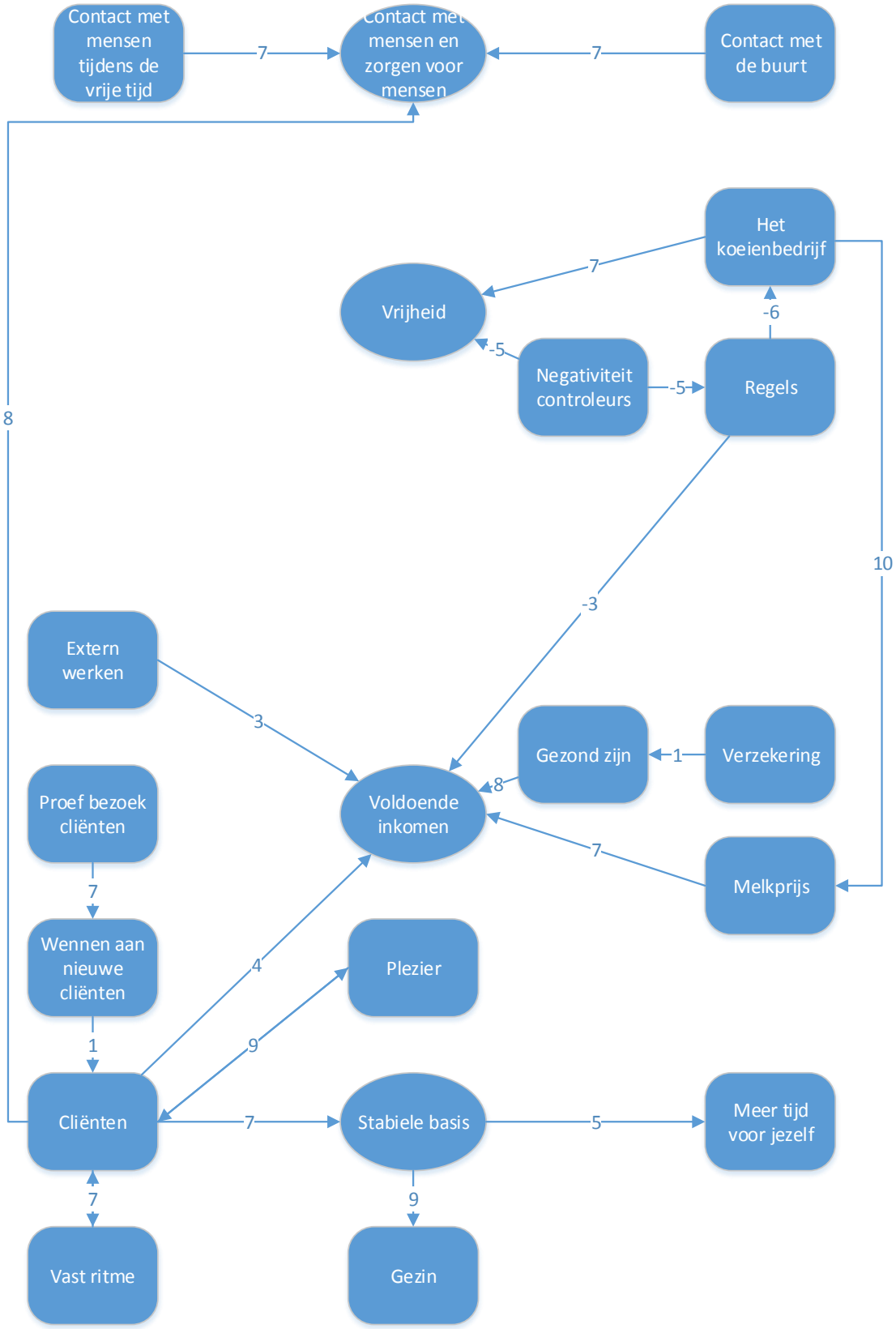
Farmer 13


Klimaat, CO2 uitstoot, etc
Verminderen verspilling
2
3
Goed omgaan met omgeving
8
Bijdragen aan goede voedsel-productie
6
Wisselwerking consument
3
Niet voor wereldmarkt produceren
8
2
Fosfaatrechten
Minder afhankelijk
2
7
Regelgeving
-8
Plezierig leven
8
Diverse producten maken
6
2
-8
7
Controles
Winkelcontroles
Stabiel inkomen
-7
Geen regulering productie

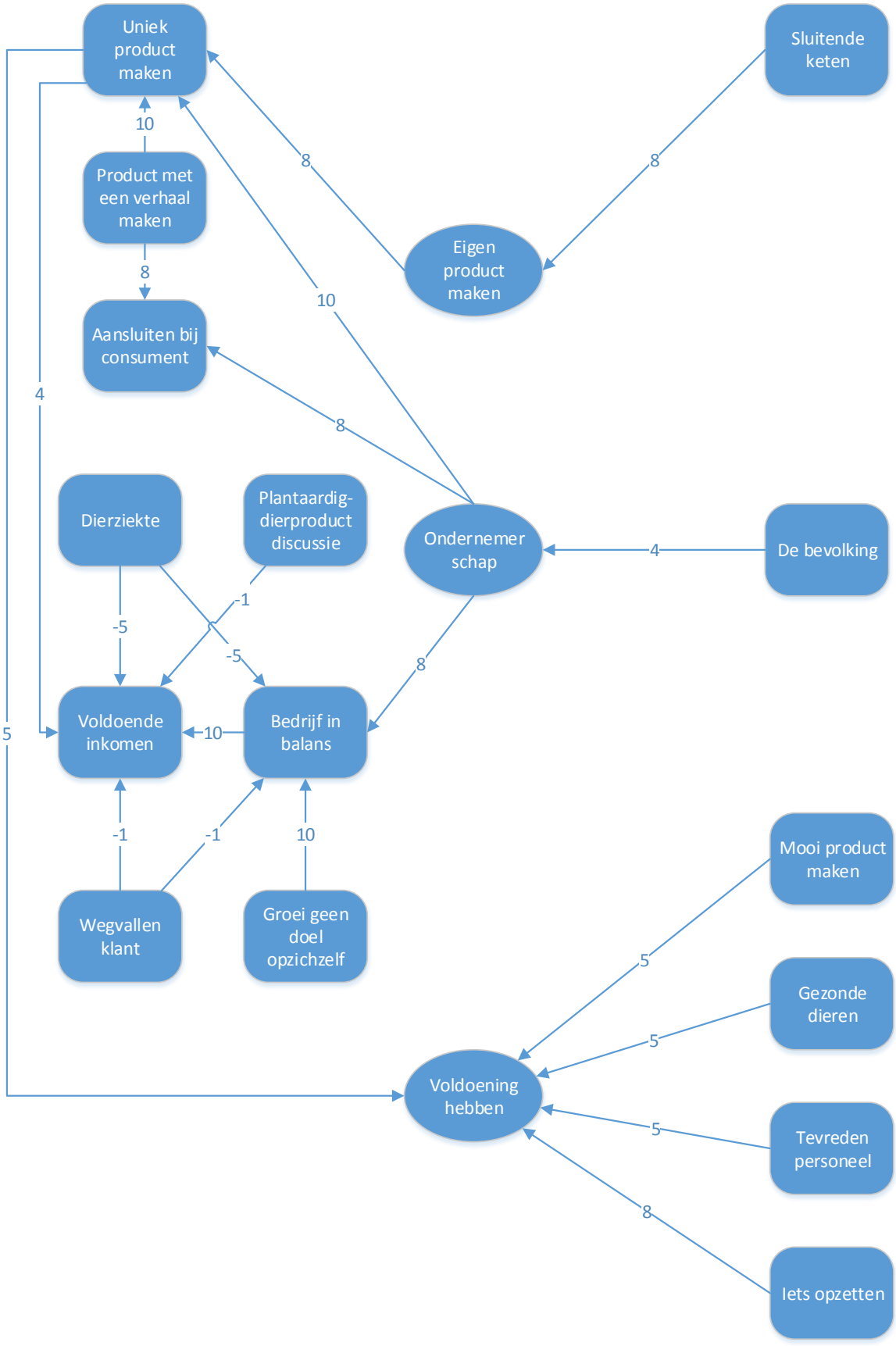
Farmer 14


Verbeteren ras
Honden fokkerij en verkoop
Duidelijke focus
Verbeteren gezondheid melkkoeien
Fokkerij
Persoonlijkheid
Gezondheid
Ondernemer
Ondernemer schap
Dichter bij consument komen staan
Toekomstvisie hebben
Voldoende inkomen
Groei macht NGO's
Melkprijs
Voormensen zuivel
Politiek
Burgers
Afschaffing marktregulering
Regelgeving
7
8
8
8
10
3
4
-6
10
10
10
5
5
2
1
6
-4
-8
10
-3
-10
3/-3
-10
3/-3
-10
3/-3

Farmer 15

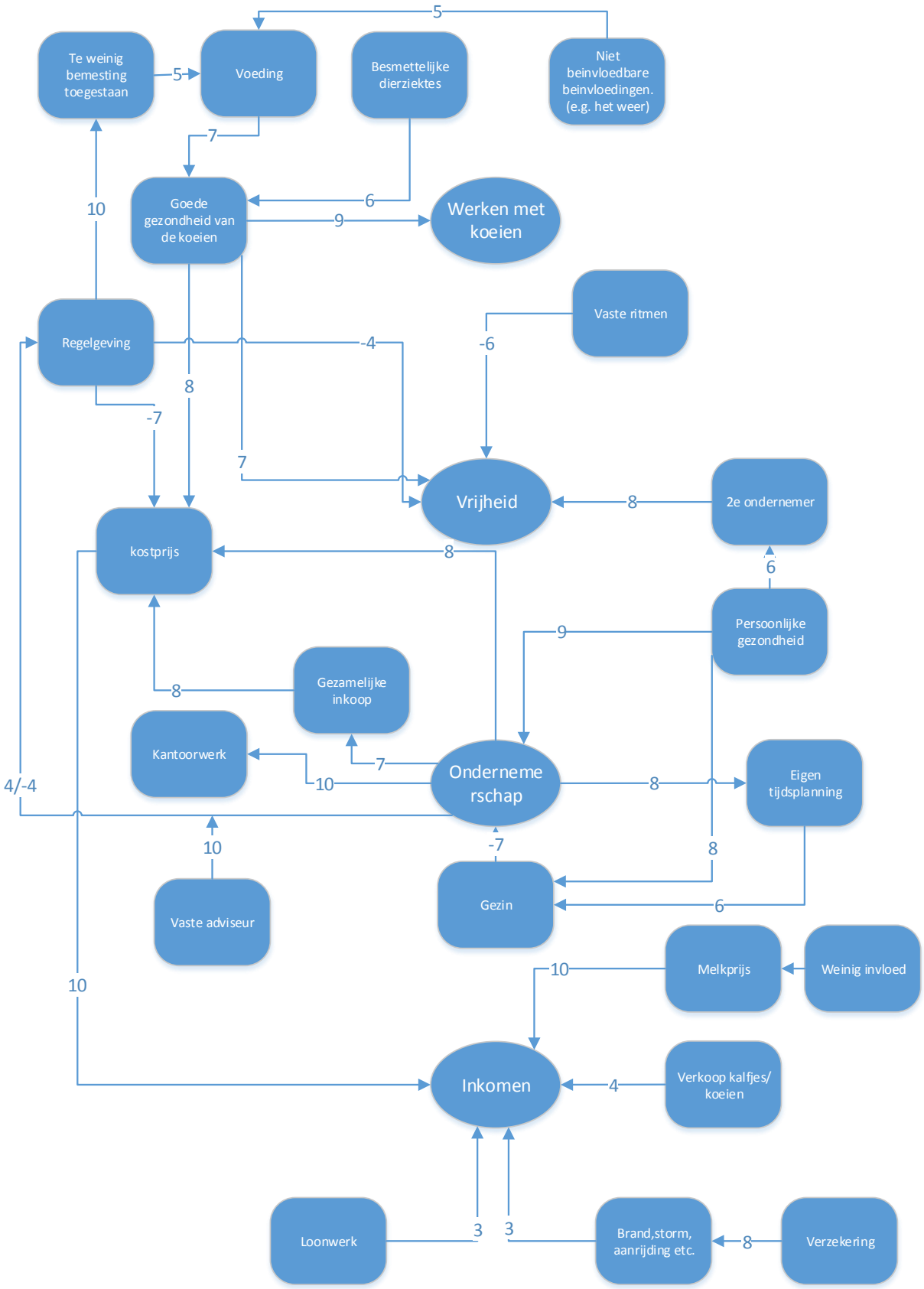

Contact met mensen tijdens de vrije tijd
7
Contact met mensen en zorgen voor mensen
7
Contact met de buurt
8
Het koeienbedrijf
7
Vrijheid
-6
-5
Negativiteit controleurs
-5
Regels
10
-3
Extern werken
3
Gezond zijn
1
Verzekering
8
Proef bezoek cliënten
Voldoende inkomen
7
Melkprijs
7
Wennen aan nieuwe cliënten
4
Plezier
1
9
Cliënten
7
Stabiele basis
5
Meer tijd voor jezelf
7
9
Vast ritme
Gezin

Farmer 16

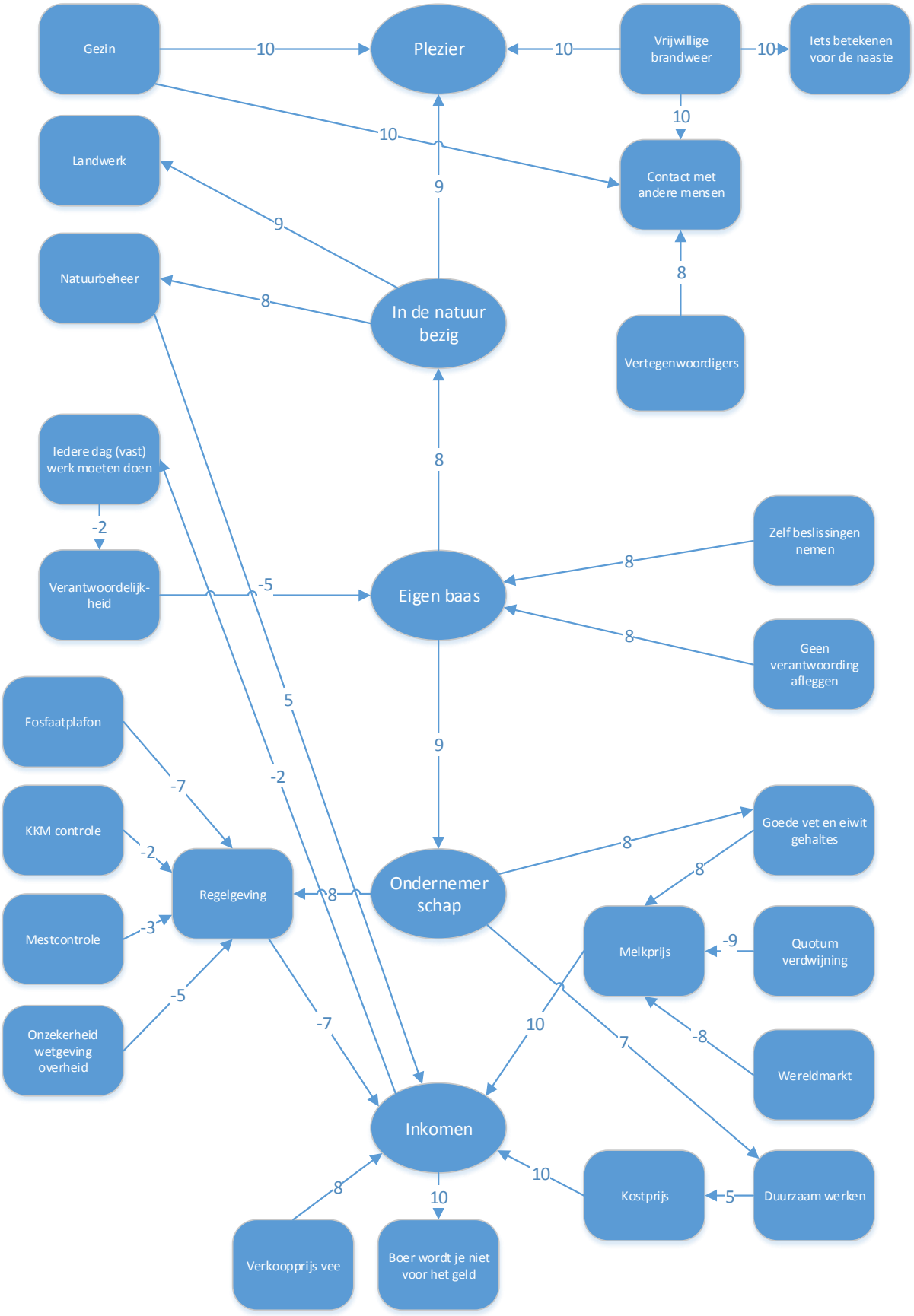

Uniek product maken
Sluitende keten
10
Product met een verhaal maken
8
8
Eigen product maken
8
10
Aansluiten bij consument
4
8
Dierziekte
Plantaardig-dierproduct discussie
Ondernemer schap
4
De bevolking
-1
-5
-5
8
Voldoende inkomen
10
Bedrijf in balans
5
-1
-1
10
Mooi product maken
Wegvallen klant
Groei geen doel opzichzelf
5
Gezonde dieren
5
Voldoening hebben
5
Tevreden personeel
8
Iets opzetten

Appendix 2 Individual FCM specialized dairy farmers

Farmer 3



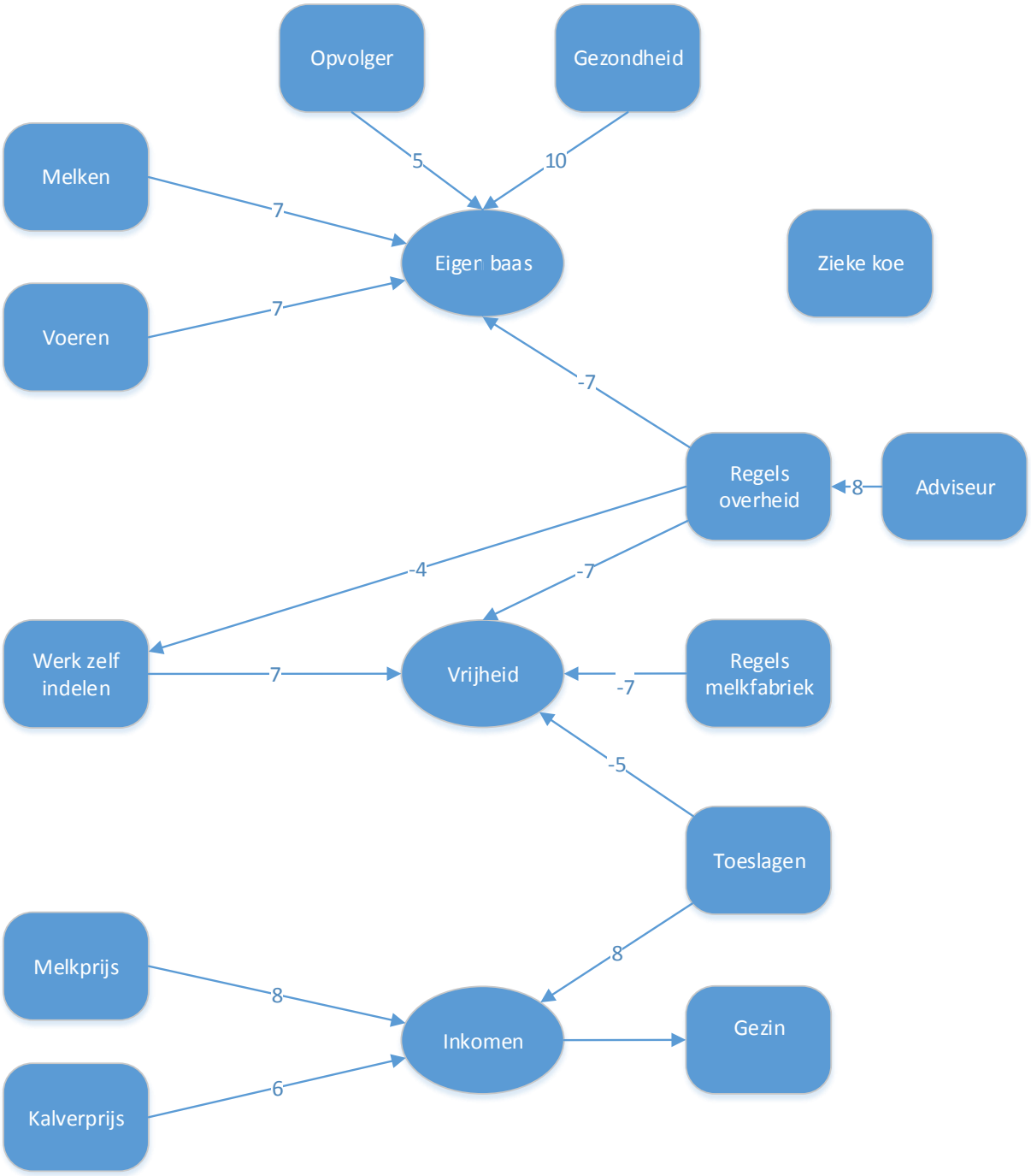
Farmer 6


Gezin
Plezier
Vrijwillige brandweer
Iets betekenen voor de naaste
Landwerk
Contact met andere mensen
Natuurbeheer
In de natuur bezig
Vertegenwoordigers
Iedere dag (vast) werk moeten doen
Verantwoordelijk-heid
Eigen baas
Zelf beslissingen nemen
Geen verantwoording afleggen
Fosfaatplafon
KKM controle
Mestcontrole
Onzekerheid wetgeving overheid
Regelgeving
Ondernemer schap
Goede vet en eiwit gehaltes
Melkprijs
Quotum verdwijning
Wereldmarkt
Inkomen
Kostprijs
Duurzaam werken
Verkoopprijs vee
Boer wordt je niet voor het geld
10
10
10
10
10
9
9
8
8
8
-2
-5
8
8
5
-2
9
-7
-2
8
8
8
-9
-8
10
7
-7
-5
-3
8
10
10
5

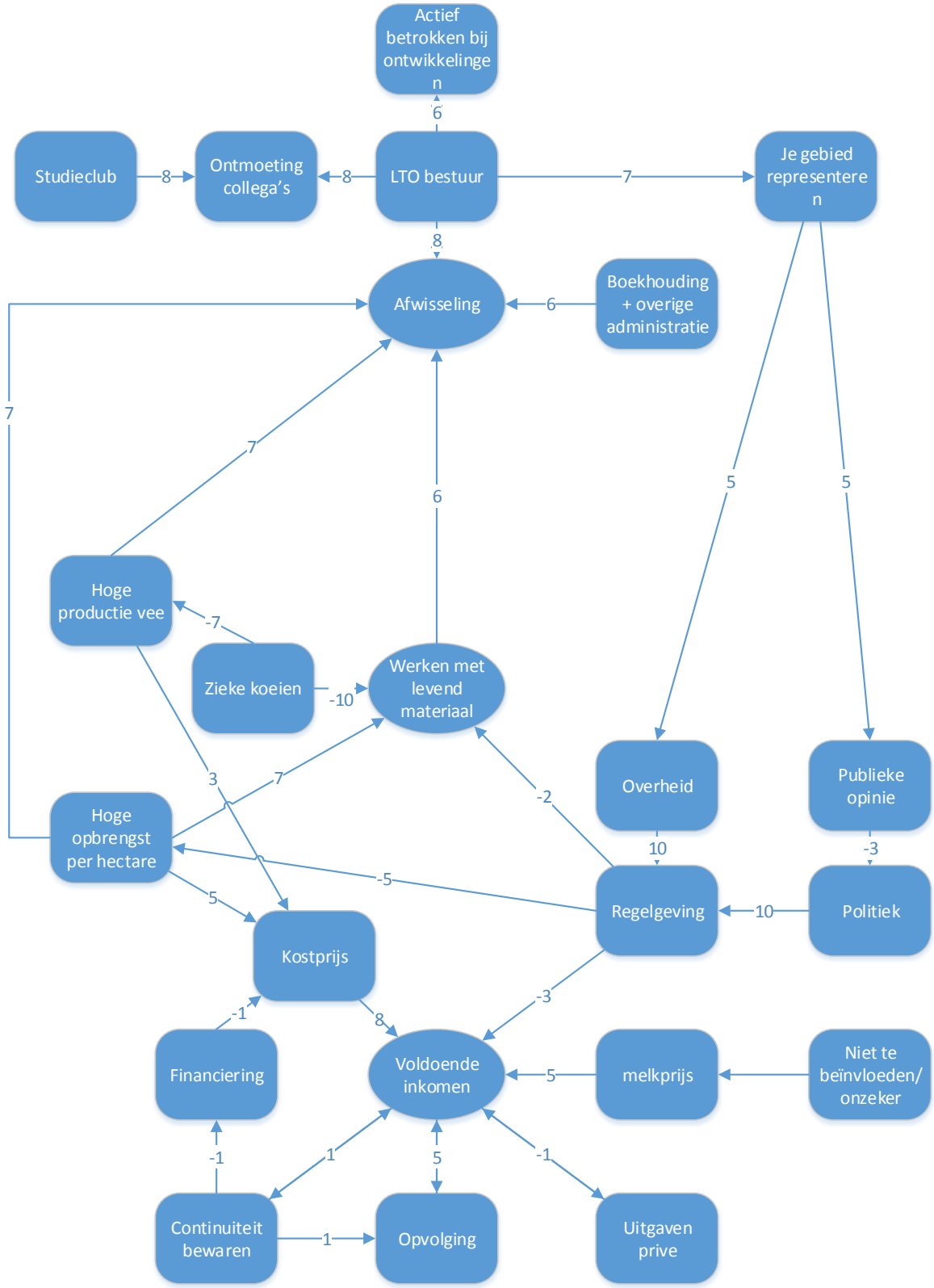
Farmer 7


In de natuur werken
8
Buiten werken
8
Gezonde lucht
8
Werken met koeien
-5
Ziekte koeien
8
6
Ziekte
-8
Voor jezelf werken
7
Je moet er altijd zijn
Vrijheid
7
-5
Schommeling
Zorgen voor goede voeding
8
Goede melkproductie
7
-5
Hoge kalverprijs
6
8
Goedkoper krachtvoer gebruiken
6
Hoog Inkomen
10
Hoge melkprijs
6
8
Goed groeiseizoen
7
7
Leningen
-5
Bedrijfsgroei
7
Opvolging
-5
7
Fosfaatrechten
Lichamelijke en geestelijke ontlasting

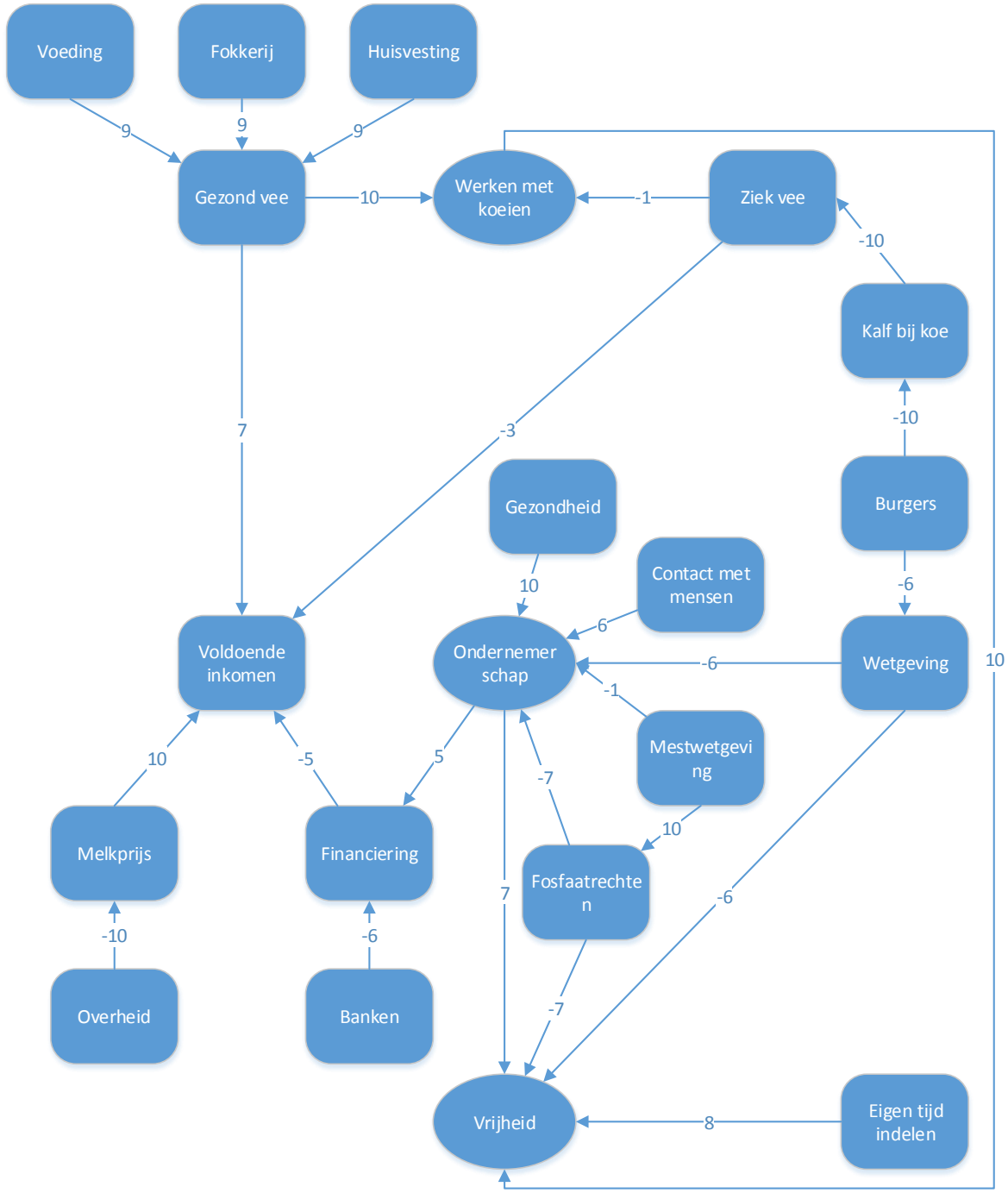
Farmer 8


Opvolger
Gezondheid
Melken
5
10
7
Eigen baas
Zieke koe
Voeren
7
-7
Regels overheid
8
Adviseur
-4
-7
Werk zelf indelen
7
Vrijheid
-7
Regels melkfabriek
-5
Toeslagen
Melkprijs
8
8
Inkomen
Gezin
Kalverprijs
6

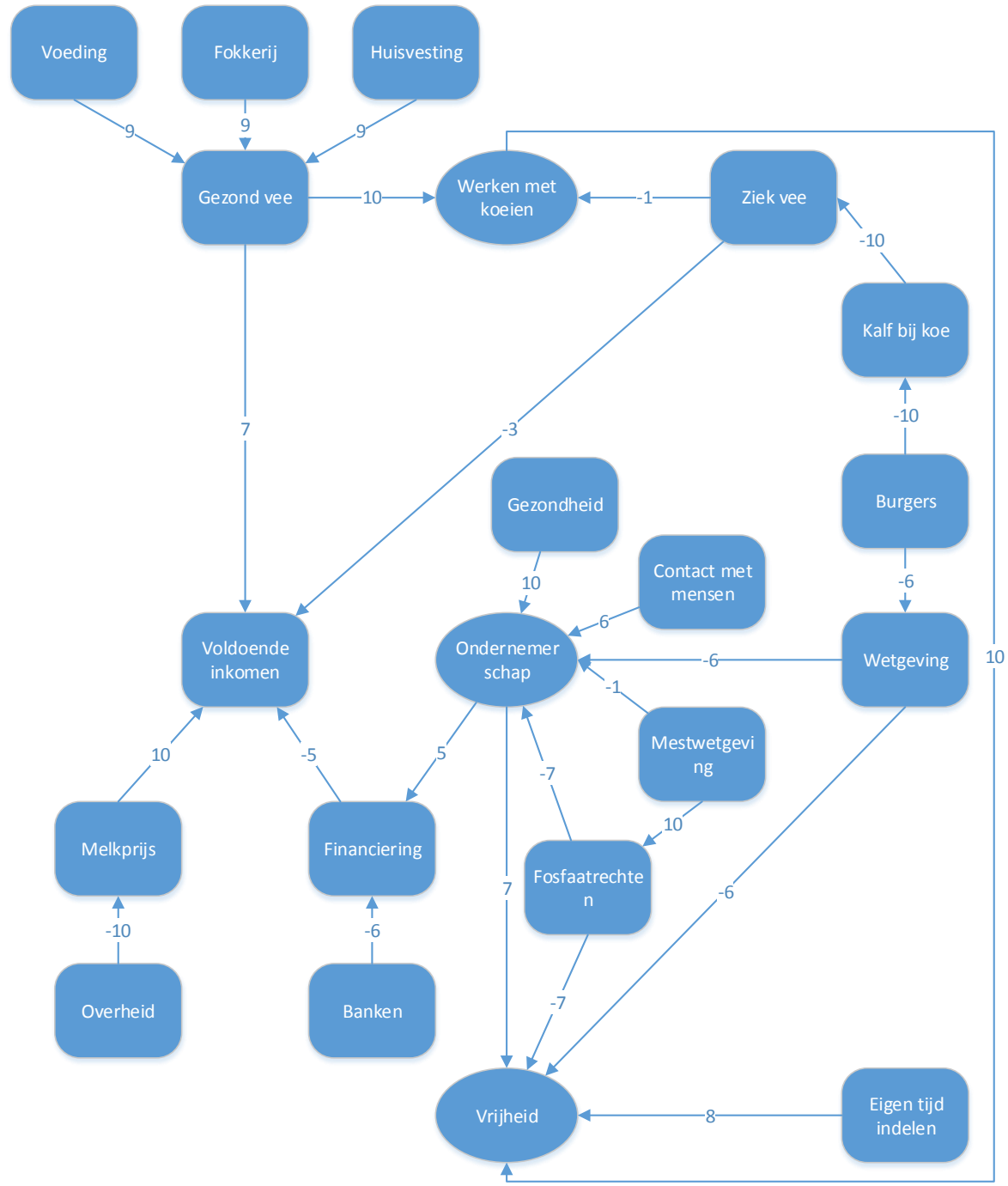
Farmer 9


Actief betrokken bij ontwikkelingen
6
Studieclub
8
Ontmoeting collega's
8
LTO bestuur
7
Je gebied representeren
8
Afwisseling
6
Boekhouding + overige administratie
7
7
6
5
5
Hoge productie vee
-7
Zieke koeien
-10
Werken met levend materiaal
3
7
-2
Overheid
Publieke opinie
10
-3
Hoge opbrengst per hectare
-5
Regelgeving
10
Politiek
5
Kostprijs
-3
-1
8
Financiering
Voldoende inkomen
5
melkprijs
Niet te beïnvloeden/ onzeker
-1
1
5
-1
Continuiteit bewaren
1
Opvolging
Uitgaven prive

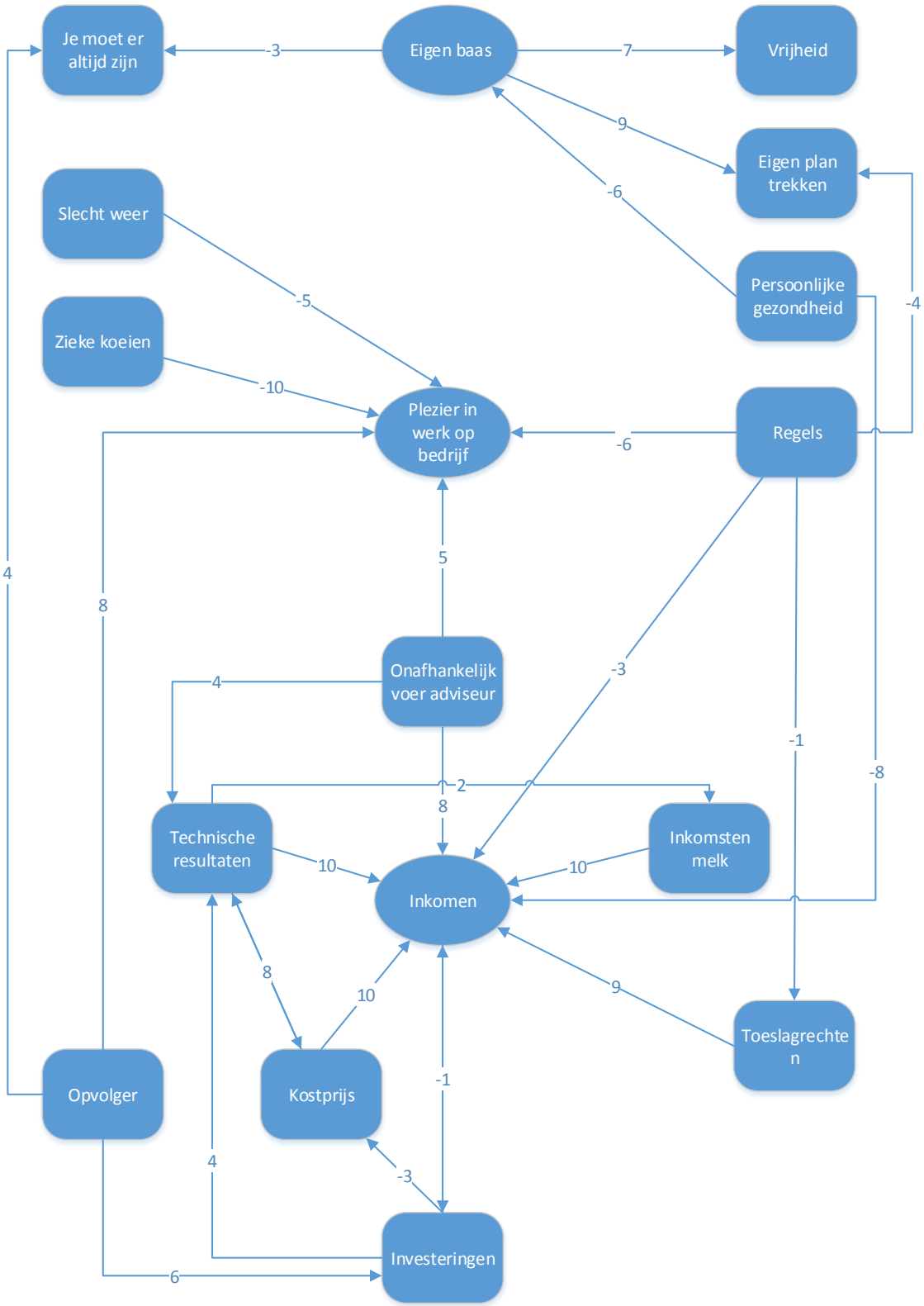
Farmer 12


Voeding
Fokkerij
Huisvesting
9
9
9
Gezond vee
10
Werken met koeien
-1
Ziek vee
-10
Kalf bij koe
-10
Burgers
-6
Wetgeving
10
7
-3
Gezondheid
10
Contact met mensen
6
Voldoende inkomen
Ondernemer schap
-6
-1
Mestwetgeving
10
10
-5
5
-7
Melkprijs
Financiering
Fosfaatrechten
-10
-6
7
-6
Overheid
Banken
-7
Vrijheid
8
Eigen tijd indelen

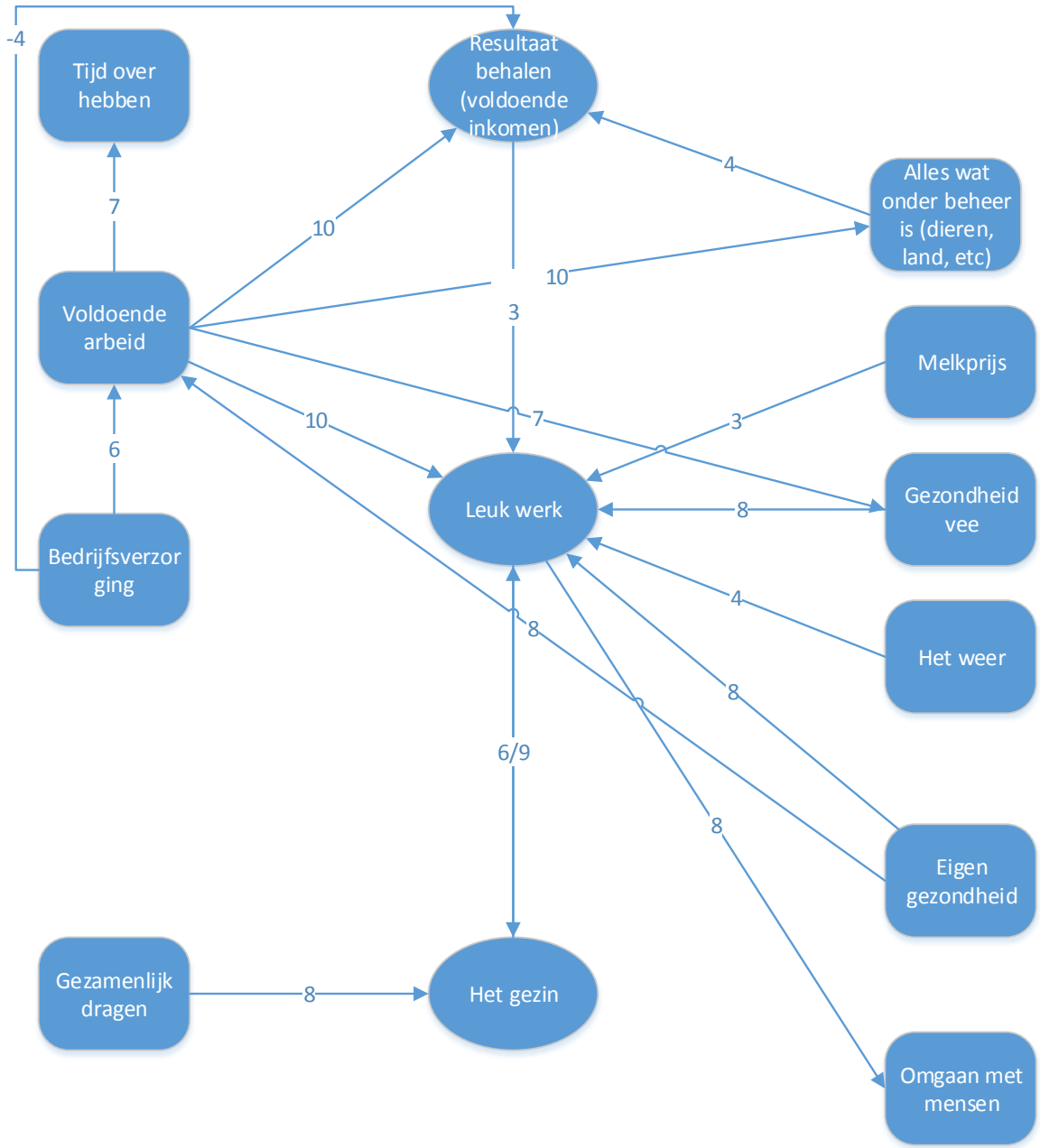
Farmer 17


Voeding
Fokkerij
Huisvesting
9
9
9
Gezond vee
10
Werken met koeien
-1
Ziek vee
-10
Kalf bij koe
-10
Burgers
-6
Wetgeving
10
7
-3
Gezondheid
10
Contact met mensen
6
Voldoende inkomen
Ondernemer schap
-6
-1
Mestwetgeving
10
10
-5
5
-7
Melkprijs
Financiering
Fosfaatrechten
-10
-6
7
-6
Overheid
Banken
-7
Vrijheid
8
Eigen tijd indelen

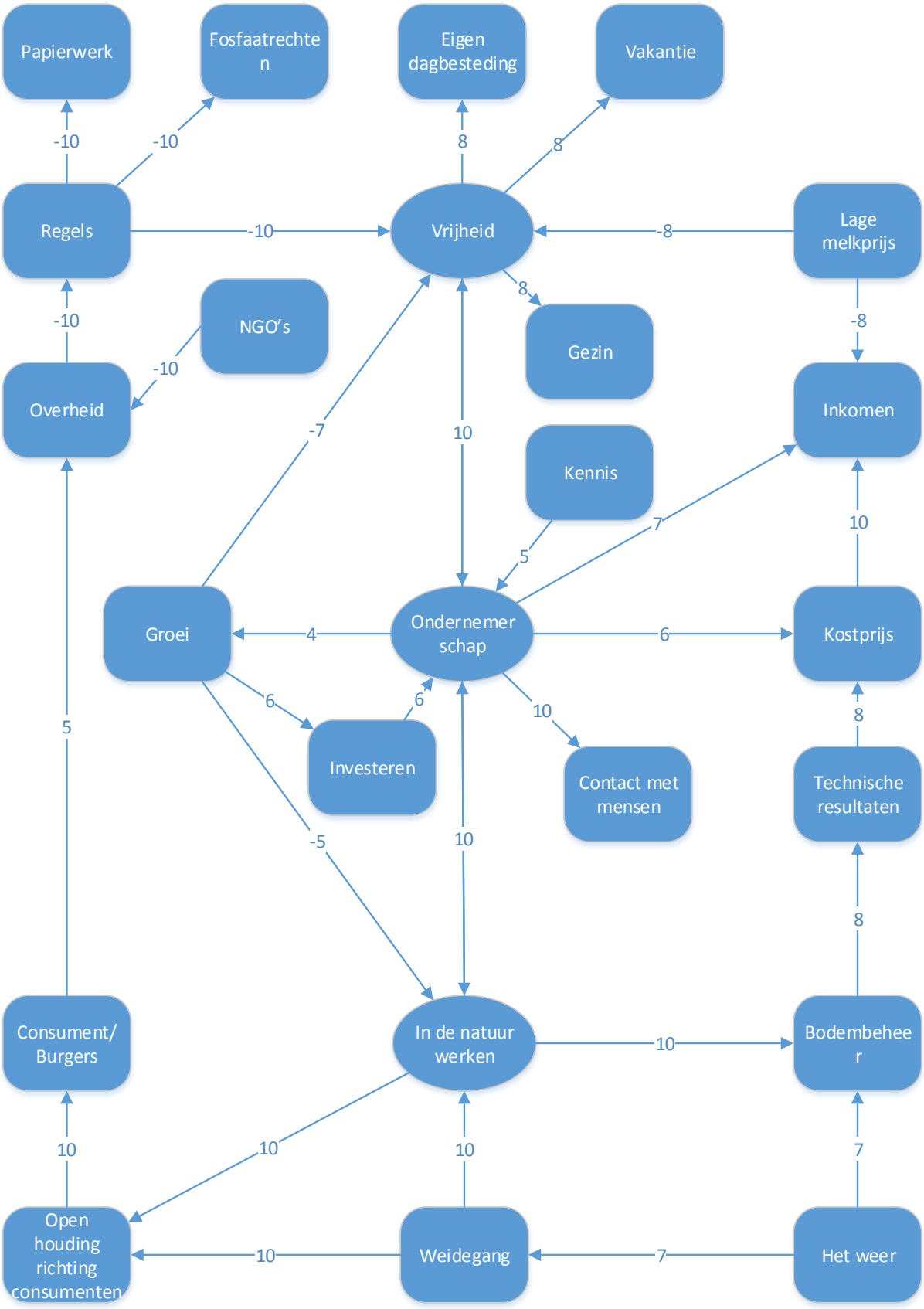
Farmer 18


Je moet er altijd zijn
Eigen baas
Vrijheid
Eigen plan trekken
Slecht weer
Persoonlijke gezondheid
Zieke koeien
Plezier in werk op bedrijf
Regels
Onafhankelijk voer adviseur
Technische resultaten
Inkomsten melk
Inkomen
Toeslagrechten
Opvolger
Kostprijs
Investeringen
-3
7
9
-6
-5
-10
-6
-4
5
4
8
-3
-1
-8
2
8
10
10
8
10
9
4
-1
-3
6

Farmer 19

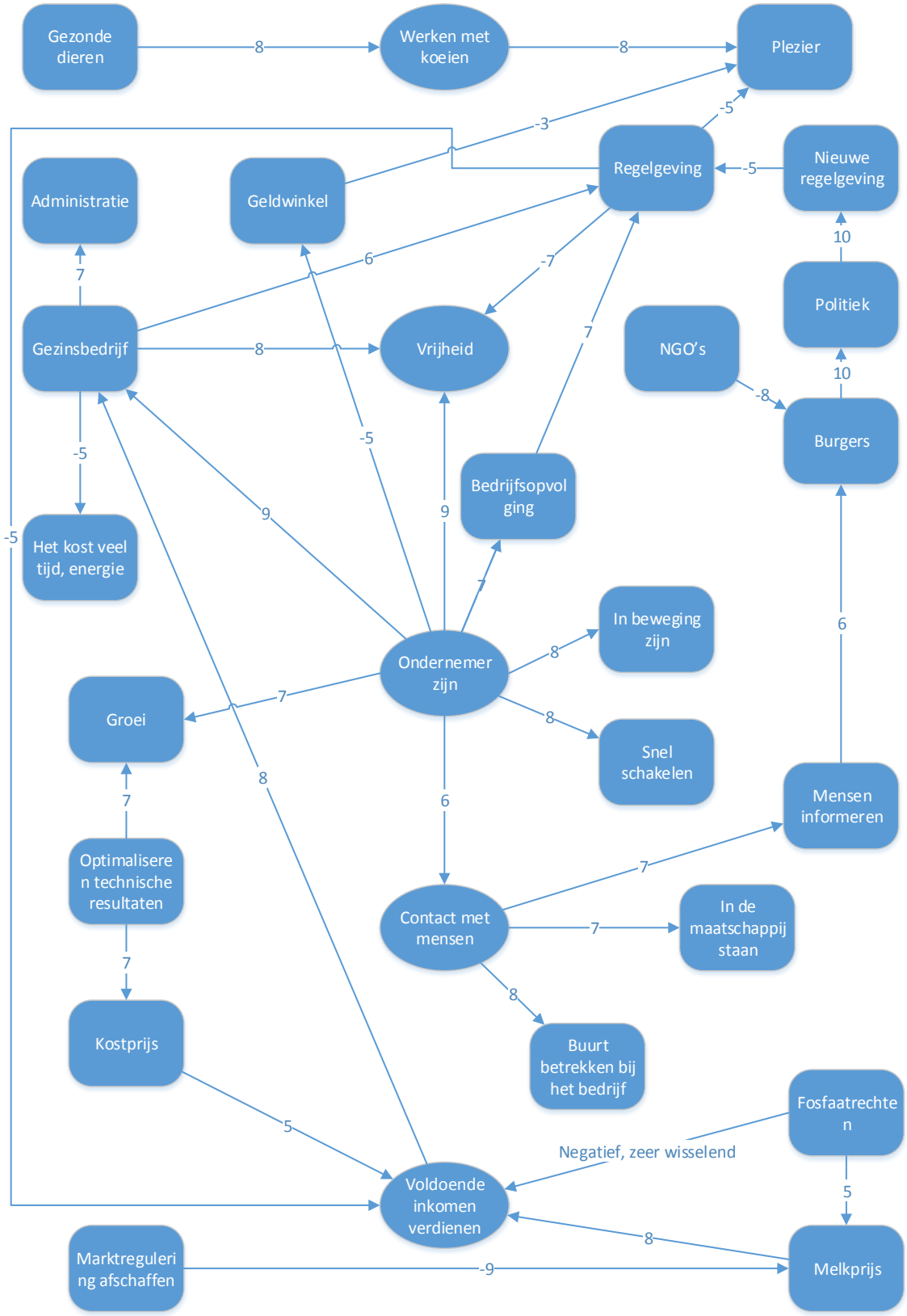

-4
Tijd over hebben
Resultaat behalen (voldoende inkomen)
4
Alles wat onder beheer is (dieren, land, etc)
7
10
10
Voldoende arbeid
3
Melkprijs
10
7
3
6
Leuk werk
8
Gezondheid vee
Bedrijfsverzorging
4
Het weer
8
8
6/9
8
Eigen gezondheid
Gezamenlijk dragen
8
Het gezin
Omgaan met mensen

Farmer 20

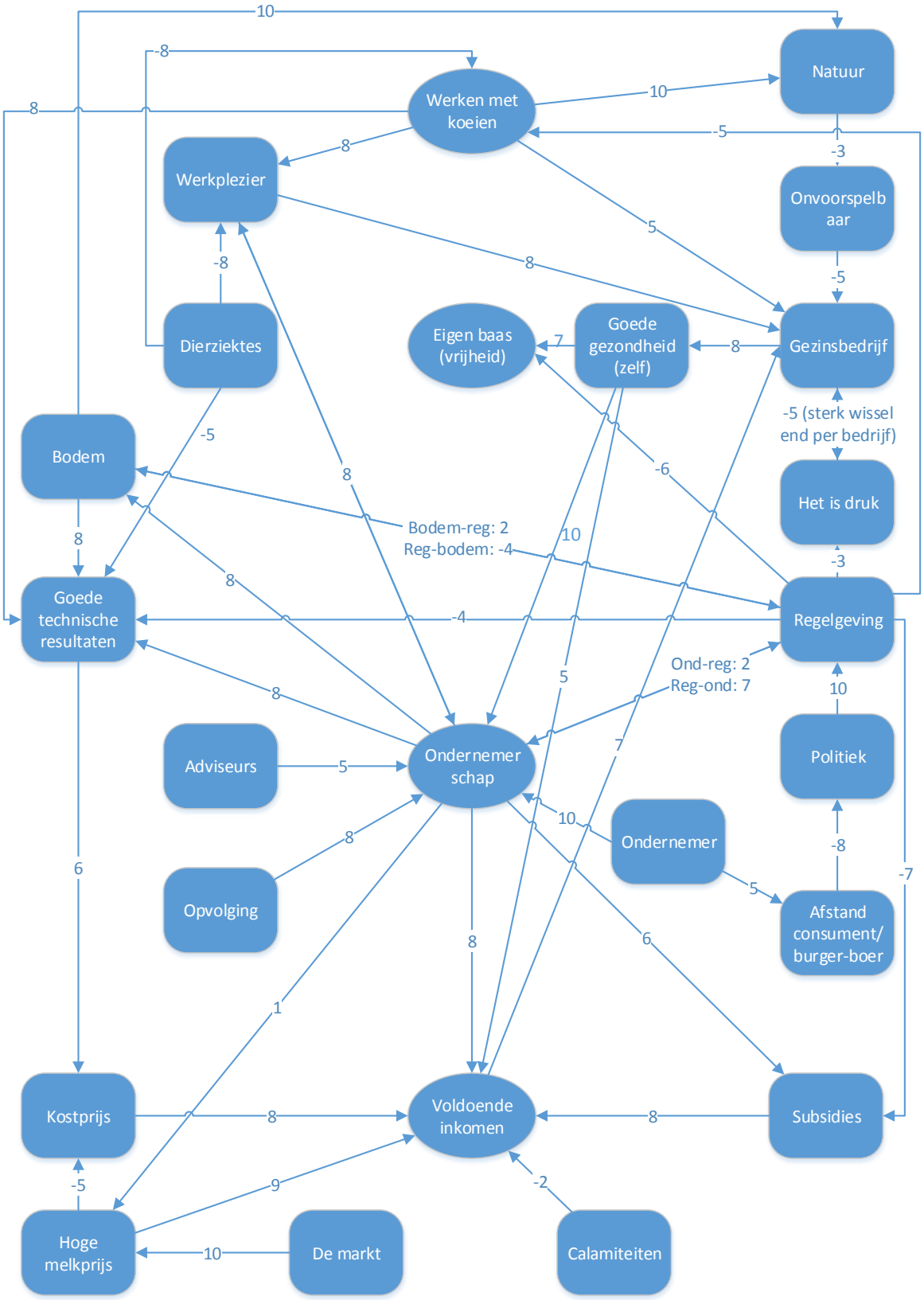

Papierwerk
Fosfaatrechten
Eigen dagbesteding
Vakantie
Regels
Vrijheid
Lage melkprijs
NGO's
Gezin
Overheid
Inkomen
Kennis
Groei
Ondernemerschap
Kostprijs
Investeren
Contact met mensen
Technische resultaten
Consument/ Burgers
In de natuur werken
Bodembeheer
Open houding richting consumenten
Weidegang
Het weer
-10
-10
8
8
-10
-8
-10
-10
8
-8
-10
-7
10
7
5
10
4
6
6
6
10
8
5
-5
10
8
10
10
10
10
7
10
7

Appendix 3 Focus group FCM

Focus group FCM multifunctional dairy farmers



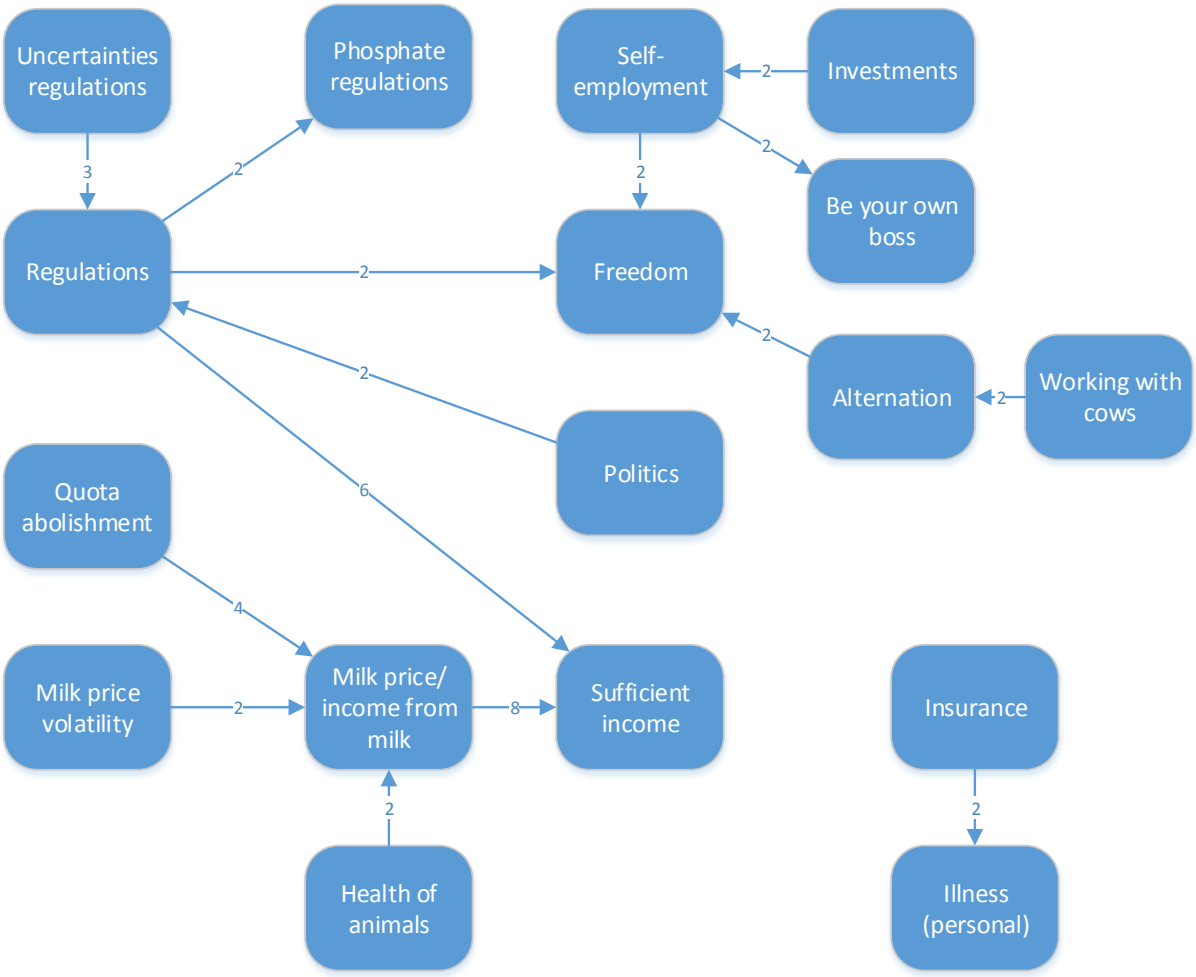
Focus group FCM specialized dairy farmers



Appendix 4 Social FCM

Note: the number on connections between one node and other nodes in the SCM does not measure the importance of the node; it only shows that it is influenced by many factors, or that it influences many factors.

Social FCM multifunctional dairy farmers



Social FCM specialized dairy farmers