Analysis of positive deviants among organic dairy farmers in The Netherlands

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MSc thesis Farm Systems Ecology

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Preface and acknowledgements

This thesis was developed within 'Excellent Organic Farmers', a project by Walter Rossing and Gerard Oomen of the Farming Systems Ecology Group (Wageningen University and Research Centre). Since we were free to give our own interpretation to this project, we decided to ask organic dairy farmers about their opinion on excellent farming: which aspects are important? We carried out an analysis of these farmers, evaluating their performance on farm level (Roos) and on environmental aspects (Kawire). It became a broad and multi-disciplinary analysis of excellent organic dairy farmers in the Netherlands, hereby connecting science with practice. However, due to personal circumstances, it was not possible to realize a joint thesis report. Therefore, two separate thesis reports were written, with a joint introduction, based on an analysis of the same organic dairy farmers. The reports have a different focus, as indicated above: Roos focuses on performance of excellent farmers at farm level, whereas Kawire focuses on the performance of farmers on environmental aspects.

Throughout the period of this thesis, we received help from a number of people and here we would like to give a word of thanks to all those who helped us. First of all, we would like to thank our supervisors, Jeroen Groot and Carolien Kroeze. You were always available, even abroad, to answer questions or to give useful comments on the work done. Thank you so much for your tireless support, advice and guidance throughout the whole process. Furthermore, we would like to thank Kees van Veluw, who distributed the questionnaire among organic dairy farmers and was always willing to listen to our thoughts and made us think in another way. You really broadened our minds, and without you, we would not have had as many respondents as we had now. We would like to thank Gerard Oomen for helping us prepare the farm visits; we appreciated your help and patience very much.

It would not have been possible to write this thesis without the help of all farmers we visited. We are very grateful for their time and their enthusiastic, passionate stories about the farms they have. We are also very thankful to Wichert Koopman, Halewijn de Smet, Irene van der Voort, Jan Wieringa and Pieter Seuneke for their useful comments on the questionnaires. We are grateful as well that Nick van Eekeren, Edith Finke, Kees van Veluw and Jan de Wit advised us on the selection of the farmers. We owe special thanks to Edith Finke for sharing her findings of the strategy group with us and to Nick van Eekeren, who provided us technical data concerning pastures.

Roos de Adelhart Toorop
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Summary

There are around 350 organic dairy farms in the Netherlands. Although all meet the requirements set by SKAL (the Dutch certification agency for organic farming), farms perform differently on criteria such as milk production, farm income and nutrient losses. This thesis focuses on positive deviants among organic dairy farmers: farmers who distinguish themselves in a positive way with respect to those and other criteria. They are often innovative and deviate from the average, which enables them to find better solutions than other farmers. Positive deviant farmers can inspire other farmers and in that way contribute to development of the sector. The objective of this study was to *identify positive deviant farms and to evaluate these farms with respect to criteria for excellence from literature and expressed by farmers*. This study was conducted in four stages:

- Criteria for excellence were defined and positive deviant farms were selected according to these criteria;
- Interviews were conducted with positive deviant farmers during farm visits;
- Based on the information from the interviews, farms were assessed both on biophysical characteristics as well as on farmers' goals, challenges and success factors;
- This assessment led to a classification of farmer types in a semi-quantitative farm typology.

This study started by identifying positive deviant farmers. Twelve criteria for excellence were identified from a literature review. In a second step a questionnaire was distributed among Dutch organic dairy farmers to find out which criteria they considered the most important. The criteria enhancing soil quality, farm income, maximizing pasture time, closing nutrient cycles, minimizing the use of antibiotics, climate friendly farming emerged as most important from the questionnaire. Finally, experts were asked to identify farmers that scored high on these criteria. This resulted in the selection of nine positive deviant farms, which were analysed in further depth on both structural and managerial farm characteristics.

The results from the farm assessment showed that the nine positive deviant farms were very diverse. Farms varied on both structural characteristics and managerial characteristics and were driven by the personal philosophy of the farmers. Farm management was focused on balancing the whole farm system rather than on optimizing one component. Farmers performed on average high on most studied criteria for excellence, but not exceptional compared to the averages for organic farming found in literature. None of the farmers was evaluated as a frontrunner or innovator.

For the investigation of social criteria, farmers were asked to define goals, challenges and success factors for their farm practice. The aspects mentioned can be seen as themes on which the farmer is working. Soil quality management, production of feed crops and closing nutrient cycles were the most important themes. These themes led to a typology consisting of five types of farmer: the fine tuner, intuitive farmer, steady farmer, entrepreneurial farmer and integrated farmer. While all types work according to the principles of organic farming, their personal interests and character lead to a specific emphasis within the same focus.

The results from the evaluation of the criteria for excellence show that for each criterion, most of the evaluated farmers scored higher than average. This is in line with expectations as these farmers were identified as positive deviants by their peers. However, for most criteria there were also farms that scored below average. No farm stood out through excellent scores on all criteria. However, all farmers deviated through their ideals and social function as farmer. Balancing the farm system and integrating different farm components in order to keep healthy animals turned out to be a key concept for the farmers in this study. The low use of antibiotics can be seen as proof that the systems are optimized in terms of animal management. The goals and challenges mentioned in interviews

clearly showed that these farmers do more than meeting the SKAL rules. They all contributed in their own way to the image of the sector by fulfilling an example function.

Figure 1 Most frequent terms used in this thesis (size of the term represents the number of times a term is mentioned in the text).

1 Introduction

1.1 Scientific background

Organic agriculture "emphasises the concept of wholeness implying the systematic connection or coordination of parts in one whole" (Scofield, 1986) p 5. as cited in (Rigby and Cáceres, 2001). Organic farmers are expected to work according to the health, ecology, fairness and care principles set by IFOAM (2013). This entails sustaining both the biophysical as the social environment in which food is produced. Attention to soil, plant, animal, human and planet needs to be given with respect to ecological cycles and should be built on fair relationships. Management should "protect the health and wellbeing of current and future generations and the environment" (IFOAM, 2013). Organic livestock farmers are expected to manage the interactions between the various components (soil, plant, animal, manure and human) with respect to these ideals. Changes in one component will affect the whole system, and therefore the organic farmer needs to be able to balance the farming system. Multi-disciplinary research is necessary to create a system's overview in order to evaluate a farming system. The scientific community has been studying the impact of farming systems on several aspects individually (e.g. impact on environment, climate or landscape) and during the past decades, integrated research has been conducted (multi-disciplinary research) (e.g. (Meul et al., 2008).

There are around 350 organic dairy farms in the Netherlands, and although they all meet the requirements set by SKAL (the certification agency), farms act differently with regard to e.g. milk production, economic and environmental performance and nutrient cycles. This thesis focuses on positive deviants among farmers: farmers who distinguish themselves in a positive way. Positive deviants' innovative behaviour and ability to experiment with new techniques and management styles can contribute to better living conditions and social, political and agro-ecological circumstances (Pant and Hambly Odame, 2009). They often have the inventiveness to innovate and to deviate from the average, which enables them to find better solutions than other farmers (Pascale et al. 2010).

Farmers' management can be divided into farming styles, which refer to the socio-technical network of the farm. This network consists of both social and biophysical elements and the interaction between these elements (Van der Ploeg, 1999). Van der Ploeg (1999) developed a conceptualization with seven farming styles which provide impressions of the socio-technical environment. Within a style different types of farmers can be identified. Understanding and analysing 'farming styles' of positive deviants and identifying different types within a style, can help the sector to develop and achieve improvements.

Some research on positive effects of agriculture has taken place. For instance Hendriks et al. (2000) assessed the "potential contribution of farming systems to landscape quality" (p. 157). Research comparing conventional and organic farming analysed the positive (or decreased negative) effects of each of the systems on several aspects. Previous research has focused on average farms, paired case studies, etc. However, as far as we are aware, research aimed specifically at positive deviants has not yet been done.

Participatory research in developed countries is a rather new concept (Edwards-Jones, 2001). A participatory research approach aims to connect researchers and end-users of the research to achieve a more successful implementation of the research results, and to increase its practical applicability. Agricultural participatory research is initiated using knowledge, problems and priorities of the farmer, instead of knowledge, problems and priorities of scientists. Edwards-Jones (2001) stated that participatory research should involve farmer-driven problem identification, since the final impact of the research is highly dependent on the communication between researchers and the end-users, in this case the farmers, of the research.

This thesis aims to connect farmers' values and priorities to scientific concepts by analysing positive deviants in the organic dairy sector. Example farms, identified by other farmers, will be analysed in a multi-disciplinary way in order to obtain a comprehensive view of their (positive) on-farm and off-farm impacts. This may result in valuable insights for the organic dairy sector with regard to improvement of its management strategy, and for scientists with regard to the performance of positive deviants.

This thesis focuses on impacts on the farm level whereas the thesis of Kawire Gosselink focuses on the analysis of environmental aspects. Together, these theses give a comprehensive overview of their impact both on the farm level and on the ecosystem level, as shown in Figure 2.

Figure 2: Schematic overview of farm system, its boundaries and its surroundings. The processes within the farm system are depicted and their relation is shown.

1.2 Objective and research questions

The following research objective and research questions were formulated. Each research question is considered in a different chapter.

Research objective

To identify positive deviant farms and to evaluate these farms with respect to criteria for excellence from literature and expressed by farmers.

Research questions

1. What are criteria for excellence according to organic dairy farmers and literature, and which farms comply with these criteria?
2. How do positive deviants perform on criteria for excellence?
3. How can farms be grouped in a typology based on characteristics related to intensity and scale of farming and qualitative farmer features?

1.3 Setup of thesis report

This thesis comprises eight chapters, of which the first is the introduction. The methodology of the thesis is set out in Chapter 2. Chapter 3 treats the farmers' criteria for excellence according to organic dairy farmers (treating the first research question). Chapter 4 gives a short overview of selected farms. Chapter 5 evaluates the performance of positive deviants on physical characteristics on farm level (treating the second research question). Chapter 6 focusses on goals and challenges of the farmer and presents a farm typology (treating the third research question). The last two chapters contain the discussion (chapter 7) and conclusions of the research (chapter 8).

Because this thesis started as a joint project, all parts concerning the identification of criteria for excellence (chapter 3) was written together with Kawire Gosselink and can also be found in her thesis entitled "*Environmental performance of positive deviants among organic dairy farmers*".

2 Materials and methods

The research comprised four stages. This chapter describes the methodology of each of these stages.

1. Defining criteria for excellence and selecting positive deviant farms (§2.1);
2. Conducting interviews (§2.2);
3. Evaluation of positive deviants (§2.3);
4. Farm typology identification (§2.4).

2.1 Criteria for excellence, farmers' criteria and selection of positive deviants (research question 1)

During this stage the '*criteria for excellence'* were identified. In an online questionnaire farmers were asked to value both these pre-set criteria as to mention missing criteria. The criteria which turned out most important for farmers were identified as '*farmers' criteria*'. Based on farmers' criteria nine positive deviant farms were selected.

2.1.1 Criteria for excellence

Criteria for excellence were identified using literature studies that investigated the views of farmers on 'good farm practices', expert consultation[1] and discussions with farmers about their view on good farm management. This led to a list of twelve criteria for excellence which were used in the online questionnaire (see Chapter 4.1, Table 1).

Criteria that were found in the literature and incorporated in the questionnaire are the following: management of soil quality (land management), landscape management (landscape preservation/quality), innovative (progressive) attitude, farm income (making most money), maximizing pasture time (cattle grazing), closing nutrient cycles (to avoid eutrophication, acidification), minimizing the use of antibiotics (use of undisputable products) and climate friendly farming (global warming).

Some criteria that were found in the literature were not included in the questionnaire for a number of reasons. Some criteria were too far from the scope of the study (product quality, food safety, well-being of workers, satisfaction with life, well-established in farming community, owning land and not being indebted). Three criteria were too broad or vague and were therefore thought to be too difficult to be valued by farmers (animal health, animal welfare and biodiversity). On the contrary, two criteria found in the literature were found to be too specific and were therefore not included in the questionnaire (groundwater pollution and dehydration of the soil).

Four criteria that were not found in literature were added to the questionnaire because of their relevance within this study: energy use, producing feed crops, milk production and attending study groups. These criteria were added to the questionnaire after consultation with experts and farmers to discuss the criteria from the literature.

A questionnaire was distributed among organic dairy farmers. Farmers were asked to value these on a 1 to 5 scale and to add criteria if they thought there were any missing. Next, they were asked to select the 5 most important criteria and to mention one or more example farm enterprises according to their top 5 criteria. Using the results of the questionnaire, a list of criteria that determine excellence, according to dairy farmers, was made. The questionnaire could be completed online and

[1] Kees van Veluw (Louis Bolk Institute and WUR), Gerard Oomen (WUR)

was distributed among organic farmers by e-mail and through an announcement in Ekoland (trade journal for organic farmers). For the complete questionnaire in Dutch, see Appendix 1.

2.1.2 Selection of positive deviants

The list of example farmers mentioned in the questionnaire was used as a starting point for the selection of the positive deviants. Three experts (Kees van Veluw and Jan de Wit of the Louis Bolk Institute, and Edith Finke of DLV) were consulted to give their opinion on this list and in collaboration with these experts a final selection of nine farms was made. The farms were evaluated anonymously in this thesis. Chapter 5 provides a short description of all farms.

2.2 Interviews

To find the farms that are most in line with the results of the questionnaire experts within the WUR and Louis Bolk Institute were addressed. Ten farms were selected with the help of expert judgement.

Questions were based on all criteria for excellence and special attention was given to the farmers' criteria. The selected farmers were interviewed. The interviews consisted of three parts: first a tour was done to understand the farm, to see the animals and to assess the landscape and pastures. Then a qualitative part with questions about the history of the farm, background of the farmer, goals and motivation was done followed by a quantitative part about farm management in order to obtain data as input for the model FarmDESIGN and to perform an environmental performance assessment (thesis Kawire Gosselink). The semi structured interviews lasted between 90 and 120 minutes and were recorded.

2.3 Evaluation visited farms (research question 2)

2.3.1 FarmDESIGN model

To evaluate the visited farms on biophysical characteristics, the FarmDESIGN model was used. This is a static model that can be used to process basic data of a whole farm system (Groot et al., 2012). The inputs for the model were provided by the farmers in interviews and can be categorized in biophysical environment, crops, crop products, animals and herd composition, animal products, manure produced on farm and imported fertilizers and manures. Detailed data concerning yields and feed value were found in *Kwantitatieve Informatie Akkerbouw en Vollegrondsgroenteteelt* by Schreuder et al., (2009) and adjusted according expert knowledge[2]. Because of privacy reasons and the complexity concerning farm economics, there is no detailed information about economic performance. Based on the impression gained during interviews on farm, we assume that all farms are economically sustainable. FarmDESIGN is developed for both diagnosis and redesign of the farm system. For this study, the tool was only used for diagnosis.

Nitrogen use efficiency and feed self-supply rate were calculated based on results from the model:

$$N\ efficiency\ (overall) = \frac{Total\ N\ output\ [crops + livestock]}{Total\ N\ input\ [import\ crop\ prod + fixation + deposition + non.symb.fixation + import\ manure]}$$

[2] Expert knowledge: Gerard Oomen (WUR), Jeroen Groot (WUR), Jan de Wit (Louis Bolk Institute)

$$Feed\ self\ supply = 1 - \frac{N\ import\ all\ crop\ products}{N\ supplied\ to\ animals} * 100$$

2.3.2 Fat and Protein Corrected Milk

All milk yields were corrected for fat and protein in order to compare production related performance within the survey. The following formula was used for correction to 4 percent fat and 3.3 percent protein (Remmelink et al., 2010):

$$FPCM = 0.337 + 0.116 * \%\ fat\ content + 0.06 * \%\ protein) * milk\ yield$$

Appendix 2 presents nutrient balances and individual flows as derived from FarmDESIGN, appendix 3 gives an overview of manureapplication by farmers.

2.3.3 Calculation external land

To give an overview of the land area needed to produce milk, external (off farm) hectares for fodder production were calculated based on the amounts of the different feedstuffs that were imported into the farms. The production of straw and manure also require land, but both have a double purpose and were therefore not taken into account. For simplicity reasons, land needed for fuel production has been neglected.

Organic crop yields were estimated according to average yields in KWIN Akkerbouw en Vollegrondsgroenteteelt (Schreuder et al., 2009). The proportional division of the ingredients of suppressed concentrates was provided by feed producer Van Gorp. Soy hulls were not taken into account since this is a by-product of soy beans.

Assumptions for calculations external hectares are presented in Appendix 4.

2.3.4 Multi-Criteria Analysis

The evaluation of visited farms provided quantitative information on six criteria for excellence. The performance of the farms was then compared using a Multi-Criteria Analysis. First, the impact on each criterion or performance indicator was normalized to be able to compare the farms (the best-performing farm received a 1 and the least-performing farm received a 0. The equation below describes how this was done.

$$s_{ix,norm} = \frac{s_{ix} - s_{x,min}}{s_{x,max} - s_{x,min}}$$

Where:

$s_{ix,norm}$ is the normalized impact score for farm i on criterion x,

s_{ix} is the performance of farm i on criterion x,

$s_{x,min}$ is the lowest impact of the nine farms on criterion x,

$s_{x,max}$ is the highest impact of the nine farms on criterion x.

The consistency of the normalized values was checked by computing the coefficient of variation.

$$Coefficient\ of\ variation\ (CV) = \frac{st\ deviation}{mean}$$

Three different weighting sets were made. The first gave equal weights to all criteria, the second used the values given to these weights derived from the questionnaire (on a 1 to 5 scale) and the third used the number of times each criterion was mentioned in the questionnaire as being most important (Table 1). The weights given to the criteria in weighting sets two and three were known after the results of the questionnaire were available.

The score of a farm for each of the three weighting sets was calculated by multiplying the score for each criterion with the weight for that criterion, as displayed in the equation below. The overall score of each farm (taking into account all three weighting sets) was calculated simply by adding up these scores for each of the three weighting sets.

$$S_{i,y} = \sum_{x=1}^{n} w_x . s_{ix,norm}$$

where:

$S_{i,y}$ is the score of farm i on weighting set y,

w_x is the weight for criterion x,

$s_{ix,norm}$ is the score of farm i on the corresponding criterion.

2.4 Farm typology (research question 3)

In addition to the data on biophysical farm characteristics (presented in Chapter 4), it was interesting to elaborate on motivation, goals and challenges of the farmers, since these personal characteristics also determine performance on farm (Van Veluw, WUR, pers. comm.). A typology was made inspired by the 'Farming Styles' approach developed by Van der Ploeg (1993) in order to group farmers with comparable goals, challenges and production related performance. Farms were plotted in a production related chart with scale (number of cows) and intensity (milk yield), since these parameters were most transparent. Farms were grouped based on position in the chart, and the goals and challenges defined by the farmers and interpreted from the interview. A general picture of farm practices was described for every group in a farm portrait.

3 Farmers' criteria for excellence

In this chapter, the first research question of the thesis will be answered: *What are criteria for excellence according to organic dairy farmers and literature, and which farms comply with these criteria?*

3.1 Results of the questionnaire

The questionnaire was filled out by 54 Dutch organic dairy farmers. In the following sections, the outcomes of the questionnaire are presented. The results of each question in the questionnaire are discussed separately.

3.1.1 Valuing criteria for excellence

The respondents were asked to score twelve criteria on a scale of 1 to 5, where 1 was 'not important' and 5 was 'very important' (Table 1). In general, the respondents valued the criteria highly, resulting in an average weight of 3.8, implying that all criteria were considered important. Production had a low score (2.7) compared to the average of the criteria; however, the majority of the respondents (63%) valued production with a 3 or 4 (but none with a 5). Since the average weights given to the criteria did not differ significantly from each other (as can be seen from the standard deviation), all criteria were valued as important.

Subsequently, the respondents were asked to give the five most important criteria for an excellent dairy farm. There was a large variation between the mentioned frequencies and a chi square test of independence confirmed that the frequencies were not uniformly distributed. Chi square tests of independence were subsequently done to determine statistically independent groups within the list of criteria. This analysis resulted in two groups ($p < 0.05$; see Table 1). The following six criteria form Group 1 were identified in this thesis as *farmers' criteria*: soil quality management, minimizing the use of antibiotics, farm income, maximizing pasture time, climate friendly farming and closing nutrient cycles. The second (less important) group was formed by the criteria: innovative attitude, landscape management, energy use, producing feed crops, production (litres/cow/year) and attending study groups.

Table 1: Survey results for the 12 criteria for excellence: average weights resulting from scoring on a 1 to 5 scale (±SD), the number of times criteria were mentioned (maximum 5 per respondent) and grouping based on a chi-squared test of the mentioning results. All criteria under group 1 are *farmers' criteria*.

Criterion	Weight (average ± standard deviation)	Number of times mentioned	Group
Enhance soil quality management	4.5 ± 0.7	26	1
Minimize the use of antibiotics	4.5 ± 0.8	25	1
Farm income	4.0 ± 0.7	24	1
Maximize pasture	4.4 ± 0.9	19	1
Climate friendly farming	3.9 ± 1	15	1
Closed nutrient cycles	3.8 ± 0.8	13	1
Innovative attitude	3.7 ± 0.9	10	2
Landscape management	3.9 ± 0.8	9	2
Energy use	3.9 ± 0.8	9	2
Producing feed crops	3.4 ± 1.2	4	2
Production (litres/cow/year)	2.7 ± 0.9	2	2
Attending study groups	3.2 ± 1	2	2

3.1.2 Missing criteria

In addition to the criteria incorporated in the questionnaire, the respondents were asked to add missing criteria. These criteria can be divided into three groups: 1) animal welfare, 2) social function of the farm and 3) balance between working and non-working time and working pleasure. Animal welfare is explained as among others biorhythm, behaviour concerning calves (e.g. calves by mother, management of bull calves) and stable type. The social function encompasses contact with consumers and regional embedding of the farm. For a complete list of the missing criteria we refer to Appendix 5. Again, it is interesting to see that the mentioned missing criteria do not necessarily relate to the productive performance of the farm, but suggest that the respondents have a more environmentally and socially concerned view that looks further than their own farm. The missing criteria were not analysed in the rest of the thesis for two reasons: firstly because they were too broad to assess within this study, and secondly because they were mentioned only a few times by the respondents as being one of the five most important criteria (less than 5 times).

3.1.3 Example farmers

The next question of the questionnaire was to mention farms that complied with the respondents' criteria for excellence. In total, 32 farmers were mentioned, 24 of which were named once and nine of which were named more than once. The distance of the respondents to the farmers they mentioned was calculated and varied between 8 and 195 kilometres (Figure 3). From this it can be derived that farmers know other farmers outside their own region.

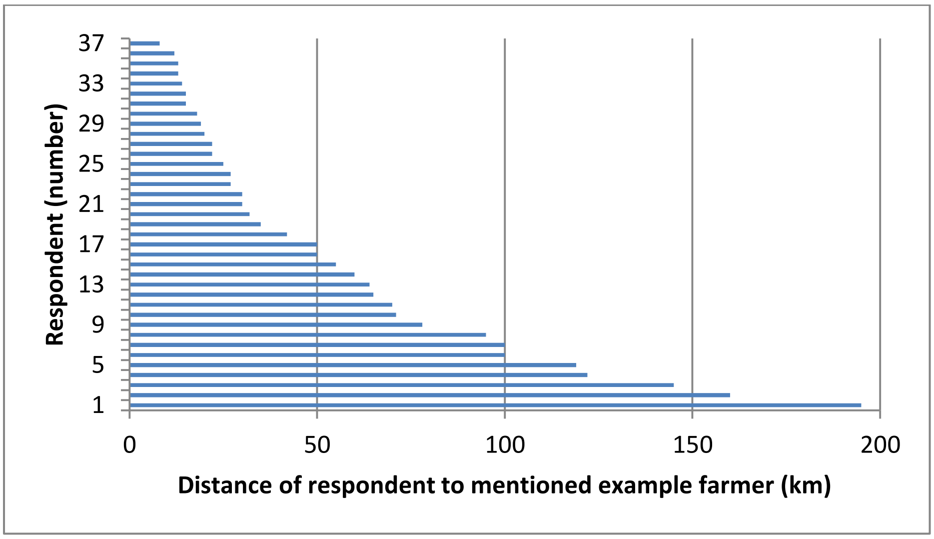

Figure 3: The distance of the respondents to the example farmers they mentioned. For each respondent, the distance between his/her postal code and that of the farmer(s) mentioned was calculated.

3.2 Use of criteria for excellence in this thesis

This thesis evaluates the (biophysical) criteria for excellence: enhancing soil quality, maximizing pasture time, closing nutrient cycles, minimizing the use of antibiotics, producing feed crops, milk production. The criteria climate friendly farming and energy use are assessed in the thesis of Kawire Gosselink (2013) *Environmental performance of positive deviants among organic dairy farmers*.

4 Results: Selected farms

Nine farmers were interviewed on farm. This chapter provides short descriptions of their farm situations. The farms are presented anonymous and are ordered based on herd size (number of dairy cows). Figure 4 shows all farms in a soil type map.

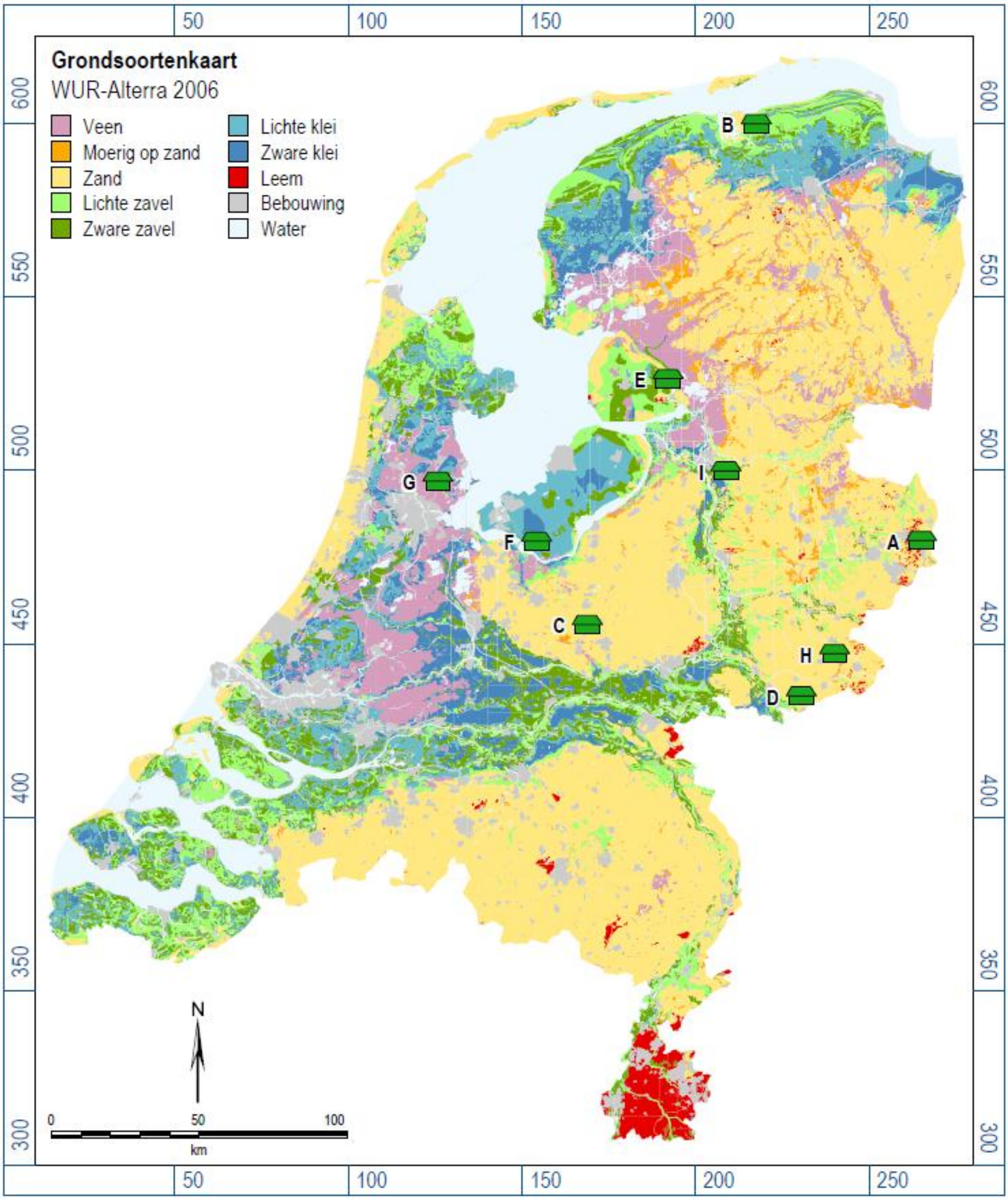

Figure 4: Location of the nine farms visited (source: Geodata Alterra, 2006).

Farm A

This is the largest farm in the survey. A modern stable has been built with a deep litter stable for the dairy cows and cubicles for the young stock. Advanced machinery (like a milk carrousel) makes it possible to sustain this number of animals with 2 persons.

Farm	A
Soil type	Dry sand with boulder clay
Dairy cows (nr + breed)	160 Mixed (Holstein Frisian, Brown Swiss, Jersey, Fleckvieh, Montebeliarde)
FPCM yield (kg/animal/year)	6968
Other livestock on farm	40 heifers, 40 calves
Grazing system	Rotational grazing system
Grassland (ha)	110
Farm yard (ha)	38
Arable land (ha)	20
Crops	Cereals (triticale, rye, barley)
Milk processing	Aurora

Animals are kept inside at night year round in order to be able to grow enough grass silage. Inputs to the farm are barley, triticale, rye and lucerne. There is a skybox in the stable and the farm is always open for visitors. A path through the pastures ('klompenpad') starts at the farm.

Farm B

This farm is situated in the very fertile Wadden area with clay on top of sandy soils. The farm is currently in a transition stage: the farmer's son joined the venture recently and will take over soon. In the past, some arable crops for human consumption were cultivated, but the farmer's son decided to focus on becoming a self-reliant dairy farm. Processed concentrates, straw and hay are the only input to the farm. A small amount of the milk is on farm processed into yoghurt and curd cheese (kwark). The products are sold in specialty shops in the region. The majority of the milk goes to a local processor.

Farm	B
Soil type	Moist clay
Dairy cows (nr + breed)	88, Whitehead + HF
FPCM yield (kg/animal/year)	7208
Other livestock on farm	20 heifers, 20 calves
Grazing system	Rotational grazing system
Grassland (ha)	72
Farm yard (ha)	80
Arable land (ha)	8
Crops	Cereals , maize, peas
Milk processing	Local processor

Farm C

This farm is a family farm since 1925. The Jersey cattle were introduced in 1967. In 1980 the current farmer joined the venture. In 1984 they converted to organic and started the on farm production of cheese. Nowadays all milk is converted into cheese on the farm; 60 Mg of cheese are sold yearly. The main objective is to produce as natural as possible, this means no synthetic minerals, no antibiotics, no vaccinations, not pasteurizing and keeping horns.

Farm	C
Soil type	Wet loamy sand
Dairy cows (nr + breed)	85, Jersey
FPCM yield (kg/animal/year)	6238
Other livestock on farm	27 heifers, 26 calves
Grazing system	Rotational grazing system
Grassland (ha)	47
Farm yard (ha)	47
Arable land (ha)	0
Milk processing	On farm processing

Inputs to the farm are mainly cereals. In the future they would like to become self-reliant by producing all roughage and concentrates themself. Soil quality management is remarkably good on farm, expressed by the increasing organic matter content (0.3%/year for the 0-15 cm layer). There are five people partner in the venture; all have a full time job on farm.

Farm D

Farm	D
Soil type	Wet loamy sand
Dairy cows (nr + breed)	75, Jersey
FPCM yield (kg/animal/year)	5450
Other livestock on farm	19 heifers, 19 calves
Grazing system	Pure graze
Grassland (ha)	41
Farm yard (ha)	39
Arable land (ha)	6
Crops	Cereals
Milk processing	Aurora

After studies in Dronten (agricultural education), farmer D decided in 1990 to join the conventional venture of his parents. In 1996 they had the opportunity to buy a farm nearby with a farm yard of 39 hectares where he started his own organic farm using half of the Jersey herd of his parents. In 2002 he became certified biodynamic.

The simplicity of the farm system is remarkable. The feed regime is sober with mainly grass clover and a limited amount of flattened cereals as source of concentrates during milking. Only silage and a small amount of cereals are imported. The replacement rate is rather low (15-20%) with the ideology that this is labour and costs efficient. Animal health is good, veterinary costs are low. For 20 hours a week there is a relatively independent care-employee, mainly to help milking. Furthermore, the farmer works alone.

Farm E

Farm	E
Soil type	Moist wind borne sand
Dairy cows (nr + breed)	61, Mixed (Holstein Frisian, Jersey, Brown Swiss, Dutch Frisian, Fleckvieh)
FPCM yield (kg/animal/year)	8507
Other livestock on farm	19 heifers, 18 calves, pigs, chicken
Grazing system	Rotational grazing system
Grassland (ha)	36
Farm yard (ha)	10
Arable land (ha)	29
Crops	Cabbage, lettuce, leek, parsnip, carrot, potato, fodder beet
Milk processing	85% On farm processing 15% to Ecomel

This farm is a mixed farm, with arable production both for human consumption (cabbage, lettuce, leek, parsnip, carrot, potato) as for concentrates (2 ha fodder beet), livestock and an on farm shop. There are five people partner in the venture. The farm contributes to landscape development through planting trees in hedgerows, planting willows and amphibian pools.

Inputs to the farm are compost for the compost stable, poor quality grass (which is composted on the farm) and lucerne. Products from the farm are sold in the on farm shop and on organic markets. Moreover, the farm has a delivery service. Milk is processed into cheese and yoghurt on farm.

Farm F

Farm	F
Soil type	Moist heavy sea clay
Dairy cows (nr + breed)	60, Mixed (Dutch Frisian, Holstein Frisian, Angler)
FPCM yield (kg/animal/year)	4179
Other livestock on farm	60 heifers, 60 calves, chicken, horses
Grazing system	Pure grazing system
Grassland (ha)	15
Farm yard (ha)	14
Arable land (ha)	26
Crops	Cereals, faba bean, carrot, potato
Milk processing	Campina

This farm has an antroposophical background and has been certified bio-dynamic from its establishment. Around 20 people live on-farm. These people work on farm but also foster families. The farm is in this way a social community.

Arable land is used to cultivate crops for human consumption (faba bean, carrot, potato, wheat) and there is a horticulture garden. Furthermore, there is a bakery on farm which uses the cultivated wheat. The farm aims to be self-reliant and keeps cows as part of the system to produce manure which is used on the arable land. Calves are relocated to a semi-natural grazing area at an age of 9 months and return right before delivering a calf at an age of 3 years. This structure is labour and resource extensive and fits in the farm philosophy.

The farm manages 300 hectares of community land. The majority is nature conservation area, but it also contains road verges. These road verges are dominated by grass-clover vegetation, and are not fertilized with manure. Most silage comes from these verges. It can be discussed weather these road verges 'belong' to the farm or not, therefore this farm is evaluated twice in this study: Farm F considers all roughage from road verges as imported feed stuff, farm F* evaluates the roughage from road verges as part of the farm. Grass clover and silage are the only sources of feed for the cattle.

Farm G

Farm	G
Soil type	Peat soil
Dairy cows (nr + breed)	55, Brown Swiss+HF
FPCM yield (kg/animal/year)	4210
Other livestock on farm	40 heifers, 40 calves
Grazing system	Rotational grazing system
Grassland (ha)	78
Farm yard	28
Arable land (ha)	0
Milk processing	Eko-Holland

The farm is situated on peat soil. The farm family moved from another peat area in The Netherlands to this farm in 2001. They started working organic there in 1995 and were able to convert this new farm before moving in. The main motivation to work organic was the vision to balance instead of optimize on milk production and awareness of the importance of reducing nutrient surpluses that result from manure production. Alternative medicines are not used since this costs too much effort and the benefits are not visible enough. Inputs to the farm are solid goat manure and processed concentrates.

All 78 hectares of the farm are pasture; this includes maintenance of 15 hectares nature conservation area owned by Staatsbosbeheer. The farmer is active in landscape management and is responsible for the cattle. His wife manages the meeting centre which can be rented for several purposes (e.g. meetings or workshops). Furthermore they do farm education which they both like.

Farm H

Farm	H
Soil type	Moist sand
Dairy cows (nr + breed)	55, Frisian Dutch
FPCM yield (kg/animal/year)	6604
Other livestock on farm	55 heifers + calves, 40 beef cattle
Grazing system	Rotational grazing system
Grassland (ha)	38+18
Farm yard (ha)	24
Arable land (ha)	20
Crops	Cereals, maize, alfalfa
Milk processing	Aurora

This farm is certified organic since 1991, the motivation to start producing organic was initiated by personal interest to produce more (environmental) friendly. Heifers are in semi-natural grazing areas during the summer.
The 20 hectares of arable land are all used to produce feed crops. There is interest to become a mixed farm in the future with arable production for human consumption. External inputs to the farm are rye, sugar corn (leftovers), roughage and liquid cow manure.

The farm also performs a social function: farm education is given and there are often interns. There is a small farm shop where the home made French cheese is sold. Both the farmer as his wife are working on farm.

Farm I

Farm	I
Soil type	Wet loamy sand
Dairy cows (nr + breed)	40
FPCM yield (kg/animal/year)	4179
Other livestock on farm	11 heifers, 8 calves, 10 beef cattle
Grazing system	Pure Graze
Farm yard (ha)	40
Grassland (ha)	40
Arable land (ha)	0
Milk processing	Eko-holland

This farm is in an insecure situation since they have to move soon to make place for a highway. Although the transition is coming closer, the farmers are very positive and actively optimizing the production of raw milk kefir. Brown Swiss cows are kept and no antibiotics are used which guarantees good milk quality according to the farmer. There is only permanent pasture on farm, inputs to the farm are barley, beet pulp and roughage and liquid pig manure.

There is a small farm shop in which dairy products (10% of production) as well as non-perishable organic products are sold. Farmer and his wife are both working full time on farm.

5 Evaluation of visited farms

In this chapter, the second research question of the thesis will be answered: *How do positive deviants perform at farm level?*

All selected positive deviants were interviewed about their farm management, in particular with respect to the farmers' criteria mentioned in the questionnaire. Data obtained during these interviews was analysed using the FarmDESIGN model.

This chapter provides background information about the farms and gives an overview of the performance on the farmers' criteria for excellence. The chapter is divided in three sections: section 6.1 gives insight in structural farm characteristics, section 6.2 elaborates on quantitative managerial characteristics and section 6.3 presents the results from a Multi Criteria Analysis.

5.1 Structural farm characteristics

Table 2 gives some basic characteristics of the features of the farm. The farms were sorted on the basis of the number of cows in a descending order from 160 to 40, and labelled from A to I. Farm F is mentioned twice: F considers nature land for silage as external resource, F* counts these hectares as part of the farm.

All farms were dairy farms with the focus on milk production rather than on side activities. The majority of the land was used as permanent pasture to graze and for the production of roughage. The land use for imported feed is included as 'external hectares'.

Two farmers kept the Jersey breed with a typical low volume of milk produced, with a high fat and protein content. One farmer had a Brown Swiss herd. All other herds were mixed, in order to create a breed adapted to the circumstances on the particular farm. Milk production per cow corrected for fat and protein (fat and protein corrected milk, FPCM) varied throughout the group: farm F had the milk production with 5433 kg FPCM /cow/year, the highest yield was 8507 kg FPCM/cow/year, which is well above average organic production (6390 kg FPCM/cow/year (Thomassen et al., 2008). The farms were based on soils with variable productivity (grassland yields ranging from 8500 to 11000 kg DM/ha/year).

Table 2. Productivity and intensity related characteristics of visited farms. The external area was estimated on the basis of the amount of imported feeds.

			Farm Size (ha)				FPCM yield per year			
Farm	**Number of cows**	**Cows/ ha**	**Farm**	**External**	**Total**	**Breed**	**Per animal** (kg/cow)	**Per total area** (kg/ha total)	**Per farm area** (kg/ha on farm)	**Soil type**
A	160	1.2	130	72	202	Mixed[1]	6968	5519	8576	Sand
B	88	1.1	80	17	97	White head+ HF	7945	7208	7945	Clay + sand
C	85	1.8	47	30	77	Jersey	6238	6886	11.281	Sand
D	75	1.6	48	4	52	Jersey	5450	7861	8515	Sand
E	61	0.9	65	13	78	Mixed[2]	8507	6569	7983	Sand
F	60	1.3	45	33	78	Mixed[3]	5433	4179	7244	Clay
F*	60	1.3	45	0	78	Mixed[3]	5433	4179	7244	Clay
G	55	0.7	78	18	96	Brown Swiss + HF	7425	4210	5235	Peat
H	55	0.8	73	3	76	FH	6604	4779	4975	Sand
I	40	1.0	40	8	48	Brown Swiss	6153	5128	6153	Sand
AVER ± SD	74 ±34	1.2 ± 0.4	65± 27	19 ±21	88± 43		6615 ± 1087	5651 ± 1379	6388 ± 2577	

1: Holstein Frisian, Brown Swiss, Jersey, Fleckvieh, Montebeliarde

2: Holstein Frisian, Jersey, Brown Swiss, Dutch Frisian, Fleckvieh

3: Dutch Frisian, Holstein Frisian, Angler

5.2 Managerial farm characteristics

The criteria 'maximal use of antibiotics' (daily dose of antibiotics), 'maximal pasture time' (pasture time), 'soil quality management' (OM accumulation) and 'closing nutrient cycles' (N, P, K balances, N self-supply, N-efficiency N loss/ha) were determined as managerial farm characteristics. Table 3 shows the quantitative data on these criteria.

Table 3 Criteria mentioned by farmers

Farm	**Daily dose of antibiotics**	**Pasture time (hours)**	**OM accumulation (kg/ha)**	**N self-supply (%)**	**Overall N efficiency (%)**	**N loss (kg/ ha/yr)**	**N balance (kg/ha/ yr)**	**P balance (kg/ha/ yr)**	**K balance (kg/ha/ yr)**
A	0	1600	1970	83	46	57	57	-1	19
B	0.02	4080	2168	93	37	70	71	-6	14
C	0	3360	2581	83	47	71	71	-2	37
D	0.01	3720	1684	92	42	54	59	-6	8
E	0.3	4131	2795	88	61	50	51	2	16
F	0	3240	4573	35	44	165	166	9	216
F*	0	3240	3236	95	92	6	6	-11	-13
G	2.0	3465	2593	89	68	16	16	-1	17
H	0	4032	1637	97	57	32	32	-7	1
I	0	4050	1575	91	37	42	64	-4	10
AVERAGE ± SD	0.23 ± 0.6	3491± 755	2481 ± 918	84 ± 18	53 ± 17	1.1 ± 1	59 ± 44	-3 ± 5	33 ± 65

5.2.1 Farmers‘ criteria

Antibiotics

The daily dose of antibiotics is the amount (mg) of active ingredients in the antibiotics expressed per kilogram of cow weight per year (mg/kg/year). The average applied to livestock on organic dairy farms was 1.75 mg/kg/year in 2009 (Smolders et al., 2013). All farmers except farmer G used less. Five farmers were totally free of antibiotics (A, C, F, H and I) and two farms (B and D) were approaching 0 with a daily dose of 0.01 and 0.02 mg/kg/year respectively. Farm E only used antibiotics in case of severe mastitis; the daily dose was fairly low (0.3) compared to average organic. Farm G had daily dose of 2 mg/kg/year which is the highest dose within this subset of farmers and is higher than average.

Pasture time

The yearly average pasture time for organic farms is 3300 hours/cow/year (Smolders and Plomp, 2012). Only the largest herd (of farm A) grazed substantially less that this average duration with 1600 hours/cow/year of grazing. The variety of the other farms is almost 900 hours/cow/year, which corresponds to a difference of approximately 44 days grazing between farm F (3240 hours grazing/year) and farm E (4131 hours grazing/year). No relation was found with farm size or intensity.

The motivation for maximum pasture time unanimous was: ‘that is how it should be’. Farmers explicitly mentioned the relation they see with animal health: there are less leg and hoof problems. Especially the herds with horns are behaving better in the pasture: they are calmer and there are fewer injuries compared with the indoor winter season. Soil and weather conditions are often limiting factors to pasture time.

Organic matter supply and nutrient balances

The organic matter supply to the soil shows the amount of accumulated organic matter. Farm F had most accumulation of organic matter (4573 (F), 3236 kg/ha (F*)) and farm I has the least (1575 kg/ha). The N self-supply depends highly on the amount of imported feed as can be seen in the values for F and F*. All farms (except from F) produced the majority of the animal feed themselves. The overall N efficiency did not relate to the N self-supply or to the N loss. More nitrogen entered the system than disappeared via (animal) products.

Balances for N, P and K were quite consistent within the subset of farms, with exception for farm F and F*. The balances for F are higher and for F* lower. Especially the high value for K is remarkable since it is higher than the value for N, which is an exception in this group. Values for P are slightly negative for most farms, expressing a bigger loss than gain of phosphorus.

5.2.2 Herd management

Table 4. Characteristics of herd management by the 9 selected excellent dairy farmers.

Farm	Concentrates in the diet (%)	Maize in the diet (%)	Type of stable	Replacement rate (%)	Spring calves	Horns
A	30	0.3	Deep litter	20	no	no
B	3	3	Deep litter + cubicle	15	no	yes
C	20	0	Deep litter	30	yes	yes
D	5	0	Cubicle	20	yes	yes
E	12	4	Compost	20	no	no
F	0	0	Deep litter	25	no	yes
G	12	1	Cubicle	20	no	no
H	27	13	Deep litter + cubicle	25	yes	yes
I	10	0	Cubicle	25	yes	yes
AVE + SD	13.2 $\pm$ 10.4	2.2 $\pm$ 4.3	-	22 $\pm$ 4	-	-

Feeding regime

As presented in Table 4, there were rather big differences in the amount of concentrates fed, but none of the farmers came close to the maximum allowed 40% concentrates in the diet given by SKAL (SKAL, 2013). Diets were based on "feeding the rumen", and concentrates were based on cereals rather than on maize. There is awareness of the positive effects of herbs. All farmers used the herbal mixtures from the German company Hubert Cremer. The exact ingredients of these mixtures are not known (secret recipe), but the farmers observe more responsive cows with less health problems.

Fresh grass and roughage were considered as the most important sources of feed. The motivations given varied from awareness about competition with human resources, to that this is the cheapest way to feed livestock.

Housing, replacement rate, spring calves and horns

Six out of the nine farms have a free range deep litter stable. The farmers with cubicles did have the desire to change the housing type, but investment costs were mentioned as a limiting factor. The advantages of a deep litter stable mentioned by the farmer are the solid manure and less leg problems and mastitis.

Main selection criteria for replacement of dairy cows were fertility and health conditions. Four out of the nine farms were in favour of (elements of) the pure graze system: Farms C, D, H and I had a system with spring calving, with the idea that the peak in milk production is parallel with the peak production of the grassland. Farm D, F and I also used the corresponding grass strip grazing method: the pasture shifted three times a day in order to keep the animals active and to feed fresh grass tops. All other farms used the rotational grazing system. The majority of the farms kept cows with horns. This was seen as the most natural way.

5.3 Multi Criteria Analysis

In order to gain insight on the overall performance on several criteria a Multi Criteria Analysis (MCA) was performed with a selection of criteria based on feasibility and expert judgment.

The normalized values in Table 5 showed the performance on the criteria of the farms: almost all farms were scoring maximum and minimum values, expressing the heterogeneity in performance within the selected farms. To rank the overall performance of the farms on the criteria different weighting approaches were used. This did not lead to changes in the ordering of the farms.

The normalized values were strongly correlated as shown in Figure 5. Three groups can be distinguished, farms A, D, F, and I showed least consistency (highest CV, Figure 5) and scored lowest on the criteria; B, C, F*, G and H showed more consistency and better performance, farm E had the largest consistency and performs best, in all weighting methods this farm had the highest overall score.

Table 5 Normalized scores and weighing results (in *italic*) of the Multi Criteria Analysis.

Normalized value	**A**	**B**	**C**	**D**	**E**	**F**	**F***	**G**	**H**	**I**
OM accumulation	0.15	0.22	0.35	0.06	0.43	1	1	0.36	0.04	0
Use of antibiotics	1	0.99	1	1	0.9	1	1	0	1	1
Pasture days	0	0.98	0.7	0.84	1	0.65	0.65	0.74	0.96	0.97
N efficiency	0.29	0	0.32	0.16	0.77	0.26	0.23	1	0.65	0
Feed N SSR	0.77	0.94	0.77	0.92	0.85	0	0.97	0.87	1	0.9
Production per cow	0.5	0.82	0.26	0.01	1	0	0	0.65	0.38	0.23
No weight	*2.7* ***(10)***	*3.9* ***(3)***	*3.4* ***(6)***	*3* ***(8)***	*5* ***(1)***	*2.9* ***(9)***	*3.8* ***(4)***	*3.6* ***(5)***	*4* ***(2)***	*3.1* ***(7)***
1-5 ranking	*10.3* ***(10)***	*15.1* ***(4)***	*13.7* ***(5)***	*12.2* ***(9)***	*18.9* ***(1)***	*12.8* ***(7)***	*16* ***(2)***	*13.4* ***(6)***	*15.8* ***(3)***	*12.5* ***(8)***
Times mentioned	*65.3* ***(10)***	*88* ***(4)***	*80.1* ***(6)***	*69.6* ***(9)***	*113.1* ***(1)***	*70* ***(8)***	*93.4* ***(2)***	*83.4* ***(5)***	*93.3* ***(3)***	*70.4* ***(7)***
SUM	*78.3* ***(10)***	*107* ***(4)***	*93.8* ***(6)***	*84.8* ***(9)***	*137* ***(1)***	*85.7* ***(8)***	*113.2* ***(2)***	*100.4* ***(5)***	*113.1* ***(3)***	*86* ***(7)***

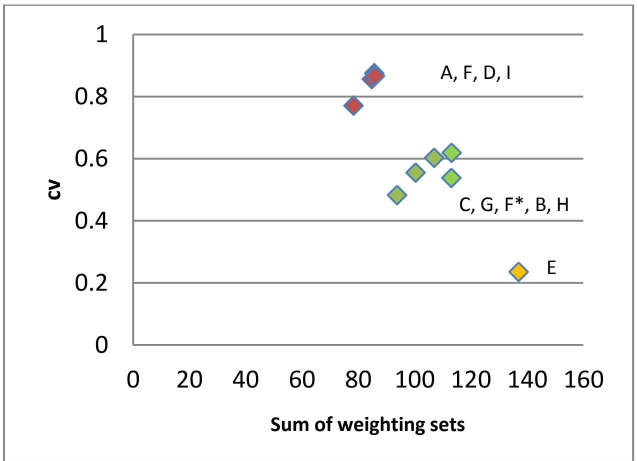

Figure 5. Relation between overall performance, using weighting based on sum of weighting approaches, and the coefficient of variation (CV) in normalized performance indicators. Farms were grouped based on CV >0.7, 0.3-0.7 and <0.3.

6 Towards a farm typology

As shown in Chapters 4 and 5, the selected farms in the survey are highly divers. During farm visits, it was clear that personal characteristics influenced the farm management. This chapter provides a qualitative description of differences and similarities between the answers farmers gave on questions related to background, mission, challenges and success. These answers in combination with quantitative production related features were used to set up a farm typology inspired by the 'styles of farming' approach of Van der Ploeg (1999). This typology groups individual farmers with comparable socio-cultural dynamics and structural characteristics.

6.1 Goals and challenges

Farmers were asked to introduce themselves through a short story of the farm history, their life on farm and the goals they want to achieve as farmer. At last, questions farmers were asked for their challenges and how they see their own success. Table 6 presents the answers to these questions. The following paragraphs elaborate on the information shown in the table and expressed in the interview.

Table 6: Incentives, goals, challenges and success factors defined by the farmers.

Farm	Incentive for farming	Goal	Challenge for future	Defined success factor	Corresponding criteria for excellence
A	Raised on farm	Keeping healthy animals	To increase earnings through added value via other processing cooperation	Realistic expectation from the cows, does not over ask. Strong animals, good breed.	Farm income
B	Raised on farm	Extensive farming: anti-intensification	-To create a closed nutrient cycle - To farm without concentrates	Lucky with division of parcels, good soil. Good dairy farmers	Soil quality management, closing nutrient cycles
C	Raised on farm (husband)	Natural farming and processing	-To improve processing of cheese with own natural rennet - To add arable feed crops to the system	Through added value via excellent cheese reasonable income/profit	Farm income, producing feed crops
D	Raised on farm	Working as self-sufficient as possible: closing nutrient cycles, using less external inputs	To be able to sustain a family farm	Keep it simple, no difficult machinery or theories	Producing feed crops, closing nutrient cycles
E	Raised on farm, passion for farming	Extensive farming, animal and human friendly farming	To create a cycle with society	Everybody can walk their own path. Divers entity, a bit of everything and therefore dynamic. Soil organic matter is of most important.	Soil quality management
F	Creating a holistic system	Following own thoughts instead of rules	To improve farmer-consumer contact	View from wholeness, system approach, long term vision	Closing nutrient cycles
G	Raised on farm	Being part of niche market	To improve the integration of nature and farming	The farm is not so special, does not deviate so much from others. Strong combination with nature conservation.	Landscape management
H	Raised on farm	To produce in a way I find sustainable	-To optimize energy use efficiency -To become a climate neutral farm -To enlarge arable production	It might be something non-measurable. The good expectations and positivism	Climate friendly farming, producing feed crops
I	Raised on farm	Extensive farming	-To improve soil quality -To diminish manure surplus	Eager to learn, innovative attitude	Innovative attitude, Soil quality management

Incentive
All farmers grew up on conventional farms. Most left the farm for (agriculture related) studies and came back to join the farm venture. The fact that most farmers had been away from the farm and came back gives the impression that all farmers made a conscious choice for farming. Also the conversion to organic, done by all farmers in the late 1980s or '90s, indicated a decision in favour of this occupation. The motivation to convert to organic was for most farmers triggered by interests in nutrient levels. Farmer G described his choice for organic: "In 1986 I calculated the first nutrient balance of my farm. The results were shocking. I did not know that we were farming so intensive and applied so much manure. It gave insight and new energy to change: we started diminishing the application of artificial fertilizers and concentrates in order to reduce the nitrogen flow. With this we were already heading towards organic. Conversion to produce certified organic was a logic step".

Goal
Farmer B: "It was all about intensification, big, bigger, and biggest. The majority of the farms have over 200 cows and import concentrates. That is not how I want to have it." The goals can be interpreted as 'extrinsic' since the incentives come from a bigger movement outside the farm: most goals defined were related to resistance to the intensification trend in conventional agriculture. All goals were rather idealistic and none of the goals was in particular focused on production or profit.

Challenge
The challenges were related on farm level and influence the management more direct. Profit related challenges were given (farms A, C and D), as well as the desire to reduce external inputs and to optimize at nutrient/soil level (farms B, C, H and I) and closer contact with consumers (E, F).

Success
It was clear that farmers do not see practical skills or equipment as source of their success, but a vision, which is expressed in the farm management. Answers to the question "What do you define as the success of your farm" were frequently related to the goals and/or challenges given. Farmer E for example stated that personal development ("Everybody can walk their own path") is part of the success of the farm. This is in agreement with the goal to be an animal- and human friendly farm and the challenge to create a cycle with society.

Criteria for excellence

Table 6 shows that the mentioned goals, challenges and success factors are related to criteria for excellence. Most mentioned were the criteria soil quality management, closing nutrient cycles and producing feed crops. Farmers were aware of soil quality and aim to improve this. Most farmers had the desire to reduce the external inputs and produced feed crops on farm. Nevertheless, farmers also mentioned that the nutrient cycle should be closed within the region and not per definition on farm.

6.2 Farm typology

Farms in this survey choose a similar style of farming by working organic. This was represented by a comparable worldview where principles of health, ecology, fairness and care were integrated in the farm management. Van der Ploeg (1999) developed the 'styles of farming' approach, a sociocultural conceptualization of farming. Every style refers to a set of comparable ideas, motivation and ideals. The farmers in this survey match best in the style defined as 'economical farmer'.

This style is also known as the 'low external input agriculture'. According to the description of Van der Ploeg, farmers in this style have low costs for energy, concentrates, machinery and animal care. The milk production is usually lower than attainable, due to a focus on resilience rather than on production resulting in less typical milk cows and the low amount of concentrates fed. The resources use efficiency is high which indicates expertise (Van der Ploeg, 1999). Compared to conventional farming, all farms had small herds, low or average production per animal and a focus on animal health rather than on high production.

The farming style can be seen as umbrella in which different farm types can be distinguished due to physical and managerial variation. Figure 3 gives a production oriented picture of the farms with on the X axis scale of farming (number of cows) and on the Y axis farming intensity (kg FPCM/cow/year). Axes cross at the average for organic farming (56 cows and 6390 kg FPCM/cow/year (Thomassen et al., 2008)) meaning that farms below the X axe produce less than average and farms left from the Y axe keep smaller herds than average. Farms E, F, G and H were comparable in scale, but varied in intensity. Farm A was clearly distinguished from the other case study farms due to its larger scale of farming.

Farm types were defined based on position in Figure 6, the interpretation of the goals, challenges, success factor defined in Table 6, and the farmer philosophy and values expressed in the interview. Within one type farmers had a comparable work approach, the focus of the farmer. This was among others expressed in the type of breed, the medical care given to the herd, the importance of high production and the way of processing. Farm portraits for the types defined are given in box 1. One farmer can fit in more types, but for simplicity reasons the most outstanding features were leading.

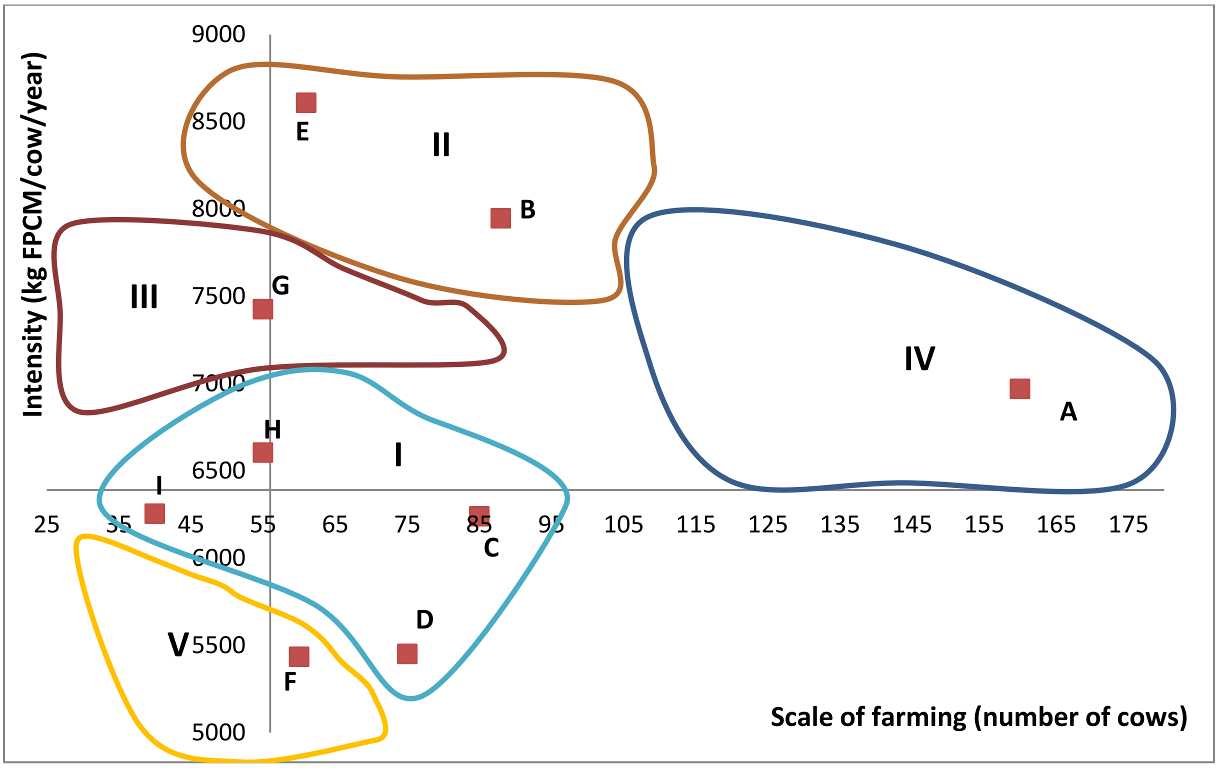

Figure 6: Relation between indicators of the scale (number cows) and the intensity (milk production per cow; kg FPCM/ cow/year) of the case study farms. Axes cross at the average for organic (67 cows and 6390 kg FPCM/cow/year).

Box 1 Farm portraits

I *Fine tuners.* These farmers are close tho the average in terms of scale and productivity but deviate through their overall fine tuned management. High quality milk is produced for exclusive dairy products. The farmers are strong in system thinking and are optimizing at the farm level as well as on regional level in terms of environmental impact. Pure breeds are kept to guarantee consistent milk quality. No antibiotics are used on these farms, which can be seen as proof that the system is in sophisticated balance. The success of this type of farmer is a combination of perfectionism and well balanced decisions concerning herd size. Farmers C, D, H and I were identified as fine tuners.

II *Intuitive dairy farmers*. The system is well established. Animals are adjusted to the local circumstances. Production is high, replacement rate is low, animal health is good. Antibiotics are given when needed. More people are working on the farm and everybody can express their own quality. Extra value is added through the production of dairy products. The intuitive farmer is strongly value driven and less mechanistic and rule bound. Experience, intuition and enthusiasm are an important part of the success of this type of farmer. Farmers B and E were assigned as intuitive farmers.

lll *Steady farmer*. The daily routine with a dairy herd has been like this already for a long time. Challenges are for example in nature conservation or diversifying the farm. This farmer deviates because of its soberness and efficient time management. Its success lies in setting priorities and diversification. Farmer G was assigned as a steady farmer.

lV Entrepreneurial *farmer*. Breeds are robust and resilient and there is a technical view on farming. Attention to the livestock is on herd level. There are more people involved than the family only. The farm is as a company with sophisticated, technical, mechanistic management practices. The success of this farm lies in the management capacity to stay tuned with the large herd. Farmer A was identified as entrepreneurial farmer.

V *Integrated farmer*. Keeps cows as part of the system, milk is a by-product of manure: a deep litter stable provides good quality manure which is used for the arable part of the farm. Calves and heifers are in nature to reduce the workload and to make them robust and resilient. People are an important part of the system, the farm is often also used with a social purpose. The system needs to be transparent and easy in order to let it work. There are a lot of people involved in the farm enterprise. This style of farming is rough and resilient. The system view and a strong ideology are characteristic for the success of this style. Farmer F was assigned as integrated farmer.

7 Discussion

This thesis aimed to identify positive deviant farms and to evaluate these farms with respect to criteria for excellence. Nine perceived positive deviant dairy farms were visited and analysed. A heterogeneous subset of farms was studied: farms were varying on both structural characteristics as managerial characteristics and all farms were driven by the personal philosophy of the farmers. Farm management was focused on balancing the whole farm system rather than on optimization of one component.

Farmers showed awareness of the impact of farming on the broader environment. This was for example expressed through active participation in landscape management, well thought use of machinery and solar panels or wind turbines on farm. This awareness had also a social component: all farmers were used to have visitors on a regular basis and most farmers sold at least part of the production in an on farm shop. McCann and Sullivan (1997) wrote that farmers in general have “the feeling that their decisions can have an important effect on the environment” (p. 753) and that organic farmers have a higher degree of concern about environmental topics than conventional farmers. This fits with the thought that organic agriculture is a production system that sustains the health of soils, ecosystems and people (IFOAM, 2013).

This chapter aims to give a critical reflection of the findings in this study.

7.1 Farmer selection

This thesis started with a questionnaire among the whole population of organic dairy farmers in The Netherlands to get insight in farmers’ view on criteria for excellence and to identify positive deviants among organic dairy farmers in the Netherlands. The criteria included in the questionnaire were based on a literature research and were discussed with farmers before the questionnaire was distributed. Literature research was quite concise: only two articles could be found that described criteria for excellence or positive deviants (Calker et al., 2005; Gassons, 1973). It can thus be questioned whether the criteria for excellence listed in the questionnaire were complete and accurate. The discussions with farmers also proved that it was difficult to compose a comprehensive list of criteria. To overcome this, the possibility to mention missing criteria was incorporated in the questionnaire. Although there were missing criteria given by the respondents[3], these were only mentioned a few times. These criteria had been encountered in the literature, but were not included in the questionnaire since they were seen as comprehensive umbrella concepts, which are difficult to assess. For this reason, and because they were not mentioned much, the missing criteria were not analysed in detail. A strong point of the questionnaire is the amount of respondents: 54 organic dairy farmers filled out the questionnaire. This can be seen as a robust result upon which the selection of positive deviants is based.

The respondents of the questionnaire were asked to identify example farmers according to the five criteria they found most important. Nevertheless, it is very well possible that the respondents already had a view of an example farmer before they filled out the questionnaire. This implies that the criteria from the questionnaire will have had little or no effect on this predefined view. Therefore, the selected farms might not perform better than average on the criteria that were assessed in this study. Other, more visible aspects, such as the type of cows, making cheese on the

[3] The respondents mentioned animal welfare, social function of the farm and working pleasure as missing criteria.

farm, running a farm shop or using little or no antibiotics, might have played a role in the selection of positive deviants by the respondents of the questionnaire as well as by experts consulted for selection of positive deviants. It is likely that 'invisible' aspects such as nutrient cycles or emissions of greenhouse gases will have had less influence on the choice of example farmers. Although the criteria for excellence as included in the questionnaire will have affected the results of the questionnaire and the subsequent analysis of positive deviants, the goals, challenges and success factors mentioned by the farmers (Table 7) corresponded to the pre-set criteria for excellence. It can therefore be presumed that the criteria for excellence are indeed of importance.

7.2 On farm management

7.2.1 Resource use at farm level

The composition of the inputs determines to a high extent the external hectares, the N self-supply and the nutrient balances. Farms A, C and F had the largest ratio external to own land and as a result, also a lower N self-supply than other farms. The high inflow of N is mostly due to fixation by the clover in the grass. This also explains the low values for farm G since this is the only farm without a grass-clover pasture.

Organic matter accumulation was used to assess the criterion soil quality management. Degradation was not taken into account since this was difficult to estimate. On permanent grasslands it can be expected that the organic matter contents increases in the topsoil, until an equilibrium has been reached (degradation=accumulation (McLauchlan et al., 2006). Grassland management (intensity and timing of grazing) can influence the accumulation of organic matter. Optimally grazed grasslands show often higher organic matter build up than under-or overgrazed lands (Smith et al., 2008). To create a comprehensive overview for comparison of the organic matter contents on the different farms, the ratio permanent pasture/arable crops needs to be taken into account: soil disturbance from tillage in arable lands is a cause of organic matter depletion (Six et al., 2000). Besides, among others availability of manure for fertilization, rainfall, soil type, temperature, harvested products and crop residue management can influence the degradation rate.

The organic matter accumulation for farm F and F* was remarkable high. The data shown in Table 3 expressed a system with high nutrient inflow (for farm F due to import of fodder) and limited outflow (manure stays on site) resulting in a nutrient stock on farm. Clay soils are less vulnerable for nutrient losses and have a naturally higher soil fertility compared to sandy soils (Van Eekeren, 2010) and Burke et al. (1989) found that relative organic C losses were lowest in clay soils. Therefore, high accumulation and low degradation rates can be expected for farm F on the heavy clay. However, it can be questioned how accurate the values are since a mixture of horse and cow manure (900 tonnes) was exported to arable farms which was not taken into account in the model. The amount of cow manure in this mixture varies in time and the farmer was not able to estimate the amount exported.

7.2.2 System view

A system without antibiotics (farm A, C, F, H and I) or with minimum use (as farm B and D) provides a strong indication that the system is optimized in terms of animal management (Van Veluw 2013 pers. comm.). Farmers pointed recurrently out that soil maintenance, breed choice, feed regime, housing and pasture management are all key in order to keep healthy and resilient herds. All farmers used the herbal mixtures from company Hubert Cremer and observed better animal health. According to Pool and Van de Voort (pers. comm. 2013) these herbal mixtures and divers grasslands solve potential selenium and cupper shortages that occur in roughage based diets, besides the garlic in the mixtures functions as natural antibiotic.

The variety in concentrates fed was remarkable (Table 4). Similar, but rare in dairy production, is the low amount of maize in the diets. Most farmers believe that no or limited amount of maize is key in remaining good animal health since they observe less active behaviour when maize is fed. The difference in amounts of concentrates fed and the low ratios of maize in the diet were expected to be expressed in milk yields (Kennedy et al., 2003), but this was not identifiable in the results. Farms A and H for example feed substantially more concentrates, but there was no recognizable difference found in milk yield per animal compared to the other farms. A relation between milk yields per animal and ratio maize in the diet was not found either. It is presumed that other factors, in specific breed, are more important for milk production.

Despite the fact that all farmers stated that pasture time is of utmost importance, there is much variation within the group. This can partly be explained by the soil type which is often a limiting factor due to vulnerability of clay and peat soils for compaction during periods with excessive rainfall that frequently occur in spring and autumn. Moreover, it can be discussed to what extent farm A and F are meeting the SKAL regulations since the animals are kept inside until the first cut in spring in order to be able to use the grassland for fodder production.

7.2.3 Replacement rate and breed

Jager (2006) developed a categorization for replacement rates in which replacement <25% was marked as low, 25-30% as intermediate, and higher than 30% as high. He stated that a low replacement rate results in the most efficient system with lowest overall costs: in this way feed costs for calves and heifers are kept low. Fat content in milk decreases in consecutive lactations, but this is compensated by the increased lifetime of the production. The average replacement rate for organic farming was calculated 34% in a study with 74 organic dairy farmers (Nauta, 2005). It can therefore be assumed that replacement rate in organic agriculture is high. All farmers in the survey selected animals for replacement on fertility and health, not on age, and production was seen as a minor issue. Only farm C had a ‘high’ replacement rate of 30%, according to the categorization by Jager (2006). All other farms have low or intermediate replacement rates (Table 4).

Remarkable was the low fraction of the Holstein Frisian breed in the herds: this is the dominant breed in both organic and conventional farming (Nauta et al., 2006). All farmers were clear that they prefer less productive but more resilient cows. Milk yields per animal were varying; the average of the subset of farms (6615 kg FPCM/cow/year) exceeded the organic average of 6390 kg FPCM/cow/year (Thomassen et al., 2008). The FPCM yields did not show a strong relation with breed nor with concentrate use. The yields per animal are slightly higher for the mixed breeds compared to the pure breeds. The pure breeds from the other side had higher fat to protein ratios and were used for production of cheese and other dairy products.

7.3 Methodological discussion

7.3.1 Farm visits

Farm visits were conducted in February. This month had the benefit that farmers were willing to receive us; however the farm environment was not representative since the soils were frozen and the grassland was most of the times covered by snow. This influenced especially the opportunity to assess soil, grassland and biodiversity. The duration of the interviews was on average 1 hour and 45 minutes which seemed to be the maximum time for the farmers to concentrate, but was not enough to collect the desired data.

The interviews were the starting point to evaluate the farmers’ criteria and the remaining criteria for excellence. The semi structured part of the interview turned out to be ambiguous. Farmers were routinized in their management and therefore not complete in their answers. The structured part of the interviews was based on the inputs required to use the model FarmDESIGN. Detailed information especially on finances and labour was often not available. Furthermore, yields and fertilizer use were estimated.

7.3.2 FarmDESIGN

The model FarmDESIGN provided an incentive for further elaboration of the data collection effort. The model was not used to its full extent since not enough data was collected to include analysis on finances and labour. Therefore multi objective optimization was not carried out. The input data was to a large extent estimated based on information provided by the farmer and extracted from secondary data sources, which makes the output an indication of the current situation. Especially feed balances were initially unreliable and farmers' estimations on grassland yields needed to be adjusted in order to process realistic outputs from the model.

7.3.3 Multi criteria analysis

A Multi Criteria Analysis was carried out to provide an overview of the overall performance at farm level. Quantifying all criteria from the questionnaire was not possible, hence only organic matter accumulation, use of antibiotics, pasture days, N efficiency, Nitrogen feed self-supply rate and the production per animal were assessed. For example, farm income was given a high score by the respondents of the questionnaire, but not assessed. Furthermore farm performance is also influenced by quantitative criteria which were neglected. The ranking provided in Table 5 gives an indication of the performance of the farms on assessed criteria, but for an encompassing analysis of positive deviants further research needs to be conducted.

7.3.4 Farm typology

Chapter 6 gives insight in goals, challenges and success factors defined by the farmers. All questions related to this were open and non-structured. A wide range of answers were given. This is a weakness since the typology made is therefore partly based on on-farm observations and interpretation. The value of the typology would increase by a more participatory approach; for example by asking farmers to assign themselves in one of the categories or ask their opinion about the positioning. A larger subset of farms within the typology would be interesting.

7.4 Comparison with previous studies

This thesis evaluates farms on a wide range of criteria. Studies with comparable set up were not found. There was chosen to compare this study with literature on the criteria for excellence and on nutrient management.

7.4.1 Criteria for excellence from literature

In a study by Gasson (1973), the motivation, goals and values of English farmers are explored. As part of the research, farmers were asked to choose which statement (from a list of ten) most resembled their idea of a 'good' farmer. This study is comparable to Gasson's study because of the input of farmers in defining what a 'good' farmer is. The results of her study showed that farmers valued performance as a farmer, more than social or economic criteria (performance being explained as: product quality, land management and landscape preservation). Social criteria were a progressive attitude, satisfaction with life, caring about the well-being of workers and being well-established in the farming community. Lastly, economic criteria were making most money, owning the land and not being indebted. Table 7 below summarizes criteria for a good farmer as identified in Gasson's study.

A study by Van Calker et al. (2005) determined a number of 'attributes for sustainability' by means of questionnaires among experts and stakeholders. Sustainability was subdivided into the categories economy, internal social, external social and ecology. The stakeholder groups included in the study were consumer and farmer organizations, industrial producers and policy makers. These groups determined the attributes for external social sustainability only. Experts defined the other attributes because of the required in-depth knowledge on the subject. Our study focused on positive deviants from a farmer's perspective and therefore the input of farmers was larger in our research. In the study of Van Calker et al. (2005), economic sustainability was explained by one attribute: profitability. Internal social sustainability was explained by one attribute as well: working conditions. The most important attributes for external social sustainability and ecological sustainability are shown in Table 7 below.

Table 7: Results of the literature study: the criteria for a good farmer according to farmers in a study by Gasson (1973); the most important attributes for external social and ecological sustainability according to respondents in a study by Van Calker et al. (2005).

Criteria for a good farmer according to the study by Gasson (1973)		
Criteria for performance	*Social criteria*	*Economic criteria*
Product quality	Progressive attitude	Making most money
Land management	Satisfaction with life	Owning your land
Landscape preservation	Well-being of workers	Not being indebted
	Well-established in farming community	

Attributes for sustainability according to the study by Van Calker et al. (2005)	
Attributes for external social sustainability (determined by stakeholders)	*Attributes for ecological sustainability (determined by experts)*
Food safety	Eutrophication
Animal health	Groundwater pollution
Animal welfare	Dehydration of the soil
Landscape quality	Acidification
Cattle grazing	Biodiversity
Use of undisputed products	Global warming

7.4.2 Robust versus trendy criteria

Differences and similarities between previous studies (Calker et al., 2005; Gassons, 1973) and this study were found. Time bound popularity can be the cause of these differences and similarities. During the past decade, much attention is given to climate change and can be seen as trendy criterion. This might be a plausible reason that global warming was found important in both this study as the study conducted by Van Calker et al. (2005) but was not a criteria identified by Gasson in 1973. The criteria 'pasture time' and 'minimal use of antibiotics' (Table 1) can also be interpreted as trendy criteria for excellence (Van Veluw, WUR, pers. comm). During farm interviews farmers recurrently emphasized the importance of soil maintenance. This often also encompassed awareness of nutrient cycles. This would probably have been different during the implementation of the Mineral Accounting System (MINAS) in the period 1998-2003 and might therefore also be called a trendy criterion. Farm income can be seen as a more robust criterion; this has been important over the years and will most probably always be important for farmers.

However, the group that defined the attributes (farmers or experts) and the approach of the questions (technical or social) can also influence the results. The survey done by Gasson (1973) was embedded in social research whereas Van Calker et al. (2005) had a more technical approach.

7.4.3 Farmers' performance on nutrient management

The average performance concerning nutrient management of the subset of farms in this study, were compared to four studies (Groot et al., 2006; Steinshamn et al., 2004; Thomassen et al., 2008; Werff et al., 1995) which included farm gate balances in their studies. Groot et al., (2006) studied conventional farmers, all others assessed organic farms.

Table 8 Farm gate balances from this study and form literature (standard deviations were mentioned if available)

	This study (2013)			Groot et al., (2006)			Thomassen et al., (2008)			Steinshamn et al., (2004)			Werff et al., (1995)		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
Inputs (kg ha/yr)	119+ 67	9 + 9.8	57+ 81	224-249	-	-	186+ 56.8	14+ 6.0	-	58	3.8	-	20.9	9.2	60.5
Outputs (kg/ha/yr)	59 + 30	12 + 5	26 + 22	69-80	-	-	82 + 38.6	15+ 7.7	-	17.2**	3.2**	-	38	7.6	13.6
Input-output (kg/ha/yr)	59+ 44	-3 + 5	33+65	148-182	-	-	103+59.6	3+ 4.1	-	40.7**	0.6**	-	82.9	1.6	44.2

*Groot et al.,(2006) provided a range instead of a standard deviation and an average.

**Steinshamn et al., (2004) did not take fixation and deposition into account; outputs were defined as 'produced'.

Assuming a desired nutrient balance of 0 kg, most farms in this thesis performed well compared to the other studies (Table 3). However, the standard deviations are rather high, this is mostly due to the high nutrient losses of farm F*.

The setups and goals for this thesis and the studies for comparison were different but provide an indication of the performance of the nutrient use of the positive deviant farms. Groot et al. (2006) showed that nutrient situations are dynamic and can change by adaptation of management style and working approach. The studies from Steinshamn and Werff might therefore be outdated and not suitable for comparison. The most recent study on organic farms was done by Thomassen et al., (2008) and carried out at farms which were part of to Bioveem, a demonstration project of Dutch organic dairy farmers. It can be assumed that farmers participating in this project have the intention to perform well on nutrient management. Since the positive deviant farms in this study, show lower nutrient surpluses, it can be stated that they deviate from the norm. However, it is important to mention that FarmDESIGN, the model used to investigate on nutrient balances, gives an indication of the nutrient cycles and relies on assumptions made by the farmer.

7.5 Research improvements

A point of concern in this study is the selection of farms. Before conducting the interviews, little information about performance on the criteria for excellence was available and experts did the final selection of farms. The decisive role of expert knowledge can be diminished by an explorative research on the criteria for excellence for a large subset of farms mentioned by experts and/or in a questionnaire among the farm population. Insight in performance on the criteria for excellence in this stage gives the opportunity to select farmers which actually perform better on farmers' criteria, instead of farmers who are perceived as positive deviants by experts and farmers. Without the opportunity to do a preliminary study, expert knowledge is more important.

As indicated previously, the interviews were too long and too detailed to obtain the required data. This could be improved by testing the questions more extensively in advance. Also the semi-structured part of the questionnaire could have been improved through testing. Furthermore, sending the questions beforehand and asking the farmer to prepare the interview could have been beneficial as well. In order to have least uncertainties in the outputs, a second farm visit would give the opportunity to share findings and discuss the preliminary results. Another opportunity is to organize a meeting with all farmers to share and discuss the results in the form of a focus group discussion. However, farmers are usually busy and more commitment would not always be desired.

The evaluation of farms can be improved by adjusting the interviews and tools in order to provide similar data for comparison with average numbers (for organic and/or conventional) provided by for example 'Binternet' (farm venture information network) or LEI (Agricultural Economical Institute). Through comparison the deviating character can be assessed. Especially assessment of soil quality can be improved using an appropriate standardized method, and for the desired results, the season for fieldwork needs to be taken into account. In order to provide a comprehensive evaluation of the farm performance, a more standardized method to investigate on the social side of farming is desired.

7.6 Recommendations for further research

To our knowledge, this is the first study in the Netherlands using the concept of positive deviance to select farms that were evaluated. Moreover, the selection of these positive deviants was carried out by their peers: other organic dairy farms in the Netherlands. The respondents of the questionnaire identified criteria for positive deviance and chose positive deviant farmers accordingly. The involvement of farmers aimed to bridge the gap between science and practice.

With this subset of positive deviant farms, it turned out to be difficult to derive critical success factors. Every farm was unique and they were not all comparable with each other. The typology made in chapter 6 combines biophysical characteristics with social characteristics. Insight in the different farm types can be starting point for development strategic plans to develop not the sector as a whole, but investigate on the different types. The typology presented in this thesis was based on basic data from the interviews. Reflection from farmers and a larger group of farms is desired to develop a more thorough typology in which every organic dairy farmer can be recognized.

It is recommended to further investigate on defining criteria for excellence and to evaluate and compare more farms in order to identify well defined positive deviants. A larger subset of farms will also allow statistical analysis. Furthermore, it would be interesting to combine the quantitative criteria with more in-depth research on farmer characteristics and the relation to the herd. In order to analyse the managerial capacity of the farmers, it is recommended to focus on a more homogeneous group farmers (e.g. same breed, all free of antibiotics, same area, and same soil type).

8 Conclusions

This thesis is entitled “*analysis of positive deviants among organic dairy farmers*”. A frequently asked question throughout the process of writing was “Do the farmers indeed deviate?”. This question cannot be answered with a simple ‘yes’ or ‘no’ but the research questions are starting point to elaborate on this question.

The first research question of this thesis was: *What are criteria for excellence according to organic dairy farmers and literature and which farms can be identified as positive deviants using these criteria?* After a literature research, the following twelve criteria for excellence were identified: enhancing soil quality, farm income, maximizing pasture time, closing nutrient cycles, minimizing the use of antibiotics, climate friendly farming, landscape management, innovative attitude, energy use, producing feed crops, milk production and attending study groups. The results of an online questionnaire among farmers showed that the respondents found the first six criteria most important, and these were identified as ‘farmers’ criteria’. Nine positive deviant farms were selected based on the questionnaire results and analysed in further depth on both structural as on managerial farm characteristics.

The second research question *How do positive deviants perform on criteria for excellence*? was answered after conducting interviews. A diverse subset of farms was studied: farms were varying on both structural characteristics as managerial characteristics and all farms were driven by the personal philosophy of the farmers. Farm management was focused on balancing the whole farm system rather than on optimization of one component. Farmers performed on average well on most studied criteria for excellence, but not exceptional compared to the averages for organic farming found in literature. None of the farmers was evaluated as a frontrunner or innovator.

The third research question was: *How can farms be grouped in a typology based on characteristics related to intensity and scale of farming and qualitative farmer features?* All farmers worked according to the principles of organic farming, but their personal interests and character led to specific attention within the same focus. Investigation on non-physical criteria showed that farmers were aware of their position in society. Most goals defined started with resistance to or dissatisfaction with movements in conventional agriculture. The typology, consisting of five types of farmer (the fine tuner, intuitive farmer, steady farmer, entrepreneurial farmer and integrated farmer) showed similarities and differences in approaches and how farmers were able to translate goals and challenges into practice.

The results from the evaluation of the criteria for excellence show that for each criterion, most of the evaluated farmers scored higher than average. This is in line with expectations as these farmers were identified as positive deviants by their peers. However, for most criteria there were also farms that scored below average. No farm stood out through excellent scores on all criteria. However, all farmers deviated through their ideals and social function as farmer. Balancing the farm system and integrating different farm components in order to keep healthy animals turned out to be a key concept for the farmers in this study. The low use of antibiotics can be seen as proof that the systems are optimized in terms of animal management. The goals and challenges mentioned in interviews clearly showed that these farmers do more than meeting the SKAL rules. They all contributed in their own way to the image of the sector by fulfilling an example function.

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Appendix 1 – Questionnaire

Vragenlijst Excellente Biologische Boeren

Voor het project Excellente Biologische Boeren zijn we op zoek naar biologische melkveehouders die door hun manier van werken een voorbeeldfunctie en inspiratiebron vormen voor andere boeren. Door middel van deze vragenlijst achterhalen we 'criteria voor excellentie'. Met deze gegevens zoeken we 10 bedrijven die we analyseren om te kijken wat doorslaggevende succesfactoren zijn, waar kansen liggen en waar praktijk en theorie beter op elkaar aan kunnen sluiten. Het invullen duurt ongeveer 5 minuten. Alle gegevens worden anoniem verwerkt.

1. Hoe belangrijk vindt u de volgende aspecten? (1 = onbelangrijk, 2 = niet erg belangrijk, 3 = gemiddeld, 4 = redelijk belangrijk, 5 = heel belangrijk)

Bedrijfsinkomen	1	2	3	4	5
Melkproductie (liter/koe/jaar)	1	2	3	4	5
Sluiten van nutriëntenkringlopen	1	2	3	4	5
Beheer bodemkwaliteit	1	2	3	4	5
Zelf telen van voedergewassen	1	2	3	4	5
Energiegebruik	1	2	3	4	5
Landschapsbeheer	1	2	3	4	5
Zoveel mogelijk weidegang	1	2	3	4	5
Minimaliseren antibioticagebruik	1	2	3	4	5
Klimaatbewust handelen	1	2	3	4	5
Deelname aan studiegroepen	1	2	3	4	5
Innovatieve houding (o.a. toepassen nieuwe technologieën)	1	2	3	4	5

2. Zijn er aspecten die u belangrijk vindt, maar die niet in de lijst hierboven zijn genoemd? Zo ja, dan kunt u deze hier invullen en aangeven hoe belangrijk u deze vindt. (1 = onbelangrijk, 2 = niet erg belangrijk, 3 = gemiddeld, 4 = redelijk belangrijk, 5 = heel belangrijk)

___________________________________	1	2	3	4	5
___________________________________	1	2	3	4	5
___________________________________	1	2	3	4	5

3. Welke 5 aspecten (uit de vorige twee vragen) vindt u het belangrijkst voor een excellente melkveehouder?

____
____
____
____
____

4. Wie zijn uw voorbeeldboeren die voldoen aan uw 5 belangrijkste aspecten met betrekking tot excellentie? (Wanneer u een (bedrijfs)naam noemt, maakt u onze zoektocht gemakkelijker)

____
____

5. Zou u tot slot een aantal (bedrijfs)gegevens willen invullen?

Bent u EKO of BD? ____________

Wat is uw leeftijd? ______

Wat is de omvang van uw bedrijf (in hectare)? ___________

Hoeveel melkkoeien heeft u? ___________

Wat is uw melkquotum? ____________

Wat zijn de vier cijfers van uw postcode? ___________________

'Wanneer u op de hoogte gehouden wil worden van de resultaten van de enquête en ons onderzoek, kunt u hier uw e-mailadres achterlaten. (Er zullen maximaal twee e-mails verzonden worden.)
____

Hartelijk dank voor uw medewerking!

Appendix 2 – Nutrient balance and individual flows

Farm A		C	N	P	K
Inputs					
	Import crop prods	1253	40	8	30
	Fixation	0	45	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Import manure	0	0	0	0
Outputs					
	Export crop prods	35	1	0	1
	Export animal prods	363	47	10	13
	Export with manure	0	0	0	0
Balance					
	Inputs	1253	105	9	33
	Outputs	398	48	10	14
	Balance	856	57	-1	19

All flows					
	Import crop prods	1253	40	8	30
	Uptake in crops	3667	156	27	217
	Fixation	0	45	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Green manures	534	0	0	0
	Supplied to animals	4352	240	35	246
	Animal intake	3728	225	33	221
	Animal respiration	2441	0	0	0
	Manure produced	1547	193	25	233
	Bedding to manure	624	15	2	25
	Manure to soil	1054	155	25	233
	Import manure	0	0	0	0
	Available manure	1054	155	25	233
	Soil losses	603	19	-1	19
	Volatilization	494	38	0	0
	Erosion losses	0	0	0	0
	Export crop prods	35	1	0	1
	Export animal prods	363	47	10	13
	Export with manure	0	0	0	0
	Immobilization	985	0	0	0
	Total nutrient losses	75	57	-1	19

Farm B		C	N	P	K
Inputs					
	Import crop prods	461	14	3	25
	Fixation	0	79	0	0
	Deposition	0	15	0	1
	Non-symb. fixation	0	5	0	0
	Import manure	0	0	0	0
Outputs					
	Export crop prods	0	0	0	0
	Export animal prods	325	42	9	11
	Export with manure	0	0	0	0
Balance					
	Inputs	461	113	3	26
	Outputs	325	42	9	11
	Balance	136	71	-6	14

All flows					
	Import crop prods	461	14	3	25
	Uptake in crops	3667	114	26	230
	Fixation	0	79	0	0
	Deposition	0	15	0	1
	Non-symb. fixation	0	5	0	0
	Green manures	745	1	0	1
	Supplied to animals	3383	206	28	254
	Animal intake	2907	190	26	231
	Animal respiration	1698	0	0	0
	Manure produced	1356	164	19	242
	Bedding to manure	481	17	2	23
	Manure to soil	911	142	19	242
	Import manure	0	0	0	0
	Available manure	911	142	19	242
	Soil losses	572	48	-6	14
	Volatilization	446	22	0	0
	Erosion losses	0	0	0	0
	Export crop prods	0	0	0	0
	Export animal prods	325	42	9	11
	Export with manure	0	0	0	0
	Immobilization	1084	0	0	0
	Total nutrient losses	78	70	-6	14

Farm C		C	N	P	K
Inputs					
	Import crop prods	2016	52	11	50
	Fixation	0	63	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Import manure	0	0	0	0
Outputs					
	Export crop prods	0	0	0	0
	Export animal prods	458	64	14	16
	Export with manure	0	0	0	0
Balance					
	Inputs	2016	135	12	53
	Outputs	458	64	14	16
	Balance	1557	71	-2	37

All flows					
	Import crop prods	2016	52	11	50
	Uptake in crops	4673	199	35	326
	Fixation	0	63	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Green manures	546	0	0	0
	Supplied to animals	6143	313	46	376
	Animal intake	5088	290	43	336
	Animal respiration	3464	0	0	0
	Manure produced	2219	249	32	360
	Bedding to manure	1058	23	4	40
	Manure to soil	1428	204	32	360
	Import manure	0	0	0	0
	Available manure	1428	204	32	360
	Soil losses	683	25	-2	37
	Volatilization	791	46	0	0
	Erosion losses	0	0	0	0
	Export crop prods	0	0	0	0
	Export animal prods	458	64	14	16
	Export with manure	0	0	0	0
	Immobilization	1290	0	0	0
	Total nutrient losses	106	71	-2	37

Farm D		C	N	P	K
Inputs					
	Import crop prods	274	17	2	16
	Fixation	0	66	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Import manure	0	0	0	0
Outputs					
	Export crop prods	0	0	0	0
	Export animal prods	312	43	9	11
	Export with manure	0	0	0	0
Balance					
	Inputs	274	102	3	19
	Outputs	312	43	9	11
	Balance	-37	59	-6	8

All flows					
	Import crop prods	274	17	2	16
	Uptake in crops	4130	157	30	267
	Fixation	0	66	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Green manures	521	0	0	0
	Supplied to animals	3883	239	33	283
	Animal intake	3619	230	31	269
	Animal respiration	2377	0	0	0
	Manure produced	1194	196	23	272
	Bedding to manure	265	10	1	14
	Manure to soil	888	153	23	272
	Import manure	0	0	0	0
	Available manure	888	153	23	272
	Soil losses	567	16	-6	8
	Volatilization	306	43	0	0
	Erosion losses	0	0	0	0
	Export crop prods	0	0	0	0
	Export animal prods	312	43	9	11
	Export with manure	0	0	0	0
	Immobilization	842	0	0	0
	Total nutrient losses	61	59	-6	8

Farm E		C	N	P	K
Inputs					
	Import crop prods	594	23	5	32
	Fixation	0	30	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Import manure	1212	60	12	46
Outputs					
	Export crop prods	940	39	7	53
	Export animal prods	339	44	9	12
	Export with manure	0	0	0	0
Balance					
	Inputs	1806	134	18	81
	Outputs	1279	83	16	65
	Balance	527	51	2	16

All flows					
	Import crop prods	594	23	5	32
	Uptake in crops	3950	188	29	253
	Fixation	0	30	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Green manures	445	0	0	0
	Supplied to animals	3159	202	27	232
	Animal intake	3122	199	27	229
	Animal respiration	2036	0	0	0
	Manure produced	784	158	18	220
	Bedding to manure	38	3	0	3
	Manure to soil	588	142	18	220
	Import manure	1212	60	12	46
	Available manure	1799	202	30	266
	Soil losses	847	34	2	16
	Volatilization	196	16	0	0
	Erosion losses	0	0	0	0
	Export crop prods	940	39	7	53
	Export animal prods	339	44	9	12
	Export with manure	0	0	0	0
	Immobilization	1397	0	0	0
	Total nutrient losses	68	50	2	16

Farm F		C	N	P	K
Inputs					
	Import crop prods	4287	237	32	278
	Fixation	0	41	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Import manure	0	0	0	0
Outputs					
	Export crop prods	1769	82	13	53
	Export animal prods	352	50	11	12
	Export with manure	0	0	0	0
Balance					
	Inputs	4287	298	33	281
	Outputs	2122	132	24	66
	Balance	2165	166	9	216

All flows					
	Import crop prods	4287	237	32	278
	Uptake in crops	4548	172	29	201
	Fixation	0	41	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Green manures	654	0	0	0
	Supplied to animals	6412	368	48	425
	Animal intake	4727	332	43	364
	Animal respiration	2776	0	0	0
	Manure produced	3279	317	37	413
	Bedding to manure	1689	37	5	62
	Manure to soil	2100	255	37	413
	Import manure	0	0	0	0
	Available manure	2100	255	37	413
	Soil losses	467	103	9	215
	Volatilization	1179	62	0	0
	Erosion losses	0	0	0	0
	Export crop prods	1769	82	13	53
	Export animal prods	352	50	11	12
	Export with manure	0	0	0	0
	Immobilization	2287	0	0	0
	Total nutrient losses	389	165	9	215

Farm G		C	N	P	K
Inputs					
	Import crop prods	503	25	4	17
	Fixation	0	0	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Import manure	49	6	1	6
Outputs					
	Export crop prods	0	0	0	0
	Export animal prods	245	35	8	8
	Export with manure	0	0	0	0
Balance					
	Inputs	552	51	6	25
	Outputs	245	35	8	8
	Balance	306	16	-1	17

All flows					
	Import crop prods	503	25	4	17
	Uptake in crops	3974	210	28	251
	Fixation	0	0	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Green manures	818	0	0	0
	Supplied to animals	3659	236	32	268
	Animal intake	3509	229	31	259
	Animal respiration	2128	0	0	0
	Manure produced	1285	201	25	260
	Bedding to manure	151	7	1	10
	Manure to soil	986	155	25	260
	Import manure	49	6	1	6
	Available manure	1035	160	26	265
	Soil losses	557	-30	-1	17
	Volatilization	299	46	0	0
	Erosion losses	0	0	0	0
	Export crop prods	0	0	0	0
	Export animal prods	245	35	8	8
	Export with manure	0	0	0	0
	Immobilization	1296	0	0	0
	Total nutrient losses	31	16	-1	17

Farm H		C	N	P	K
Inputs					
	Import crop prods	167	7	1	6
	Fixation	0	45	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Import manure	14	2	0	2
Outputs					
	Export crop prods	0	0	0	0
	Export animal prods	286	42	9	10
	Export with manure	0	0	0	0
Balance					
	Inputs	182	74	2	11
	Outputs	286	42	9	10
	Balance	-104	32	-7	1

All flows					
	Import crop prods	167	7	1	6
	Uptake in crops	4291	169	30	231
	Fixation	0	45	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Green manures	511	0	0	0
	Supplied to animals	3948	221	31	236
	Animal intake	3680	211	29	223
	Animal respiration	2440	0	0	0
	Manure produced	1220	179	21	226
	Bedding to manure	270	10	1	13
	Manure to soil	921	152	21	226
	Import manure	14	2	0	2
	Available manure	935	154	22	228
	Soil losses	627	5	-7	1
	Volatilization	299	27	0	0
	Erosion losses	0	0	0	0
	Export crop prods	0	0	0	0
	Export animal prods	286	42	9	10
	Export with manure	0	0	0	0
	Immobilization	819	0	0	0
	Total nutrient losses	26	32	-7	1

Farm I		C	N	P	K
Inputs					
	Import crop prods	598	23	3	15
	Fixation	0	56	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Import manure	8	3	0	2
Outputs					
	Export crop prods	0	0	0	0
	Export animal prods	277	38	8	10
	Export with manure	0	0	0	0
Balance					
	Inputs	606	102	4	19
	Outputs	277	38	8	10
	Balance	329	64	-4	10

All flows					
	Import crop prods	598	23	3	15
	Uptake in crops	3945	187	31	266
	Fixation	0	56	0	0
	Deposition	0	15	1	3
	Non-symb. fixation	0	5	0	0
	Green manures	539	0	0	0
	Supplied to animals	4004	266	34	281
	Animal intake	3905	260	33	273
	Animal respiration	2562	0	0	0
	Manure produced	1153	226	26	271
	Bedding to manure	113	8	1	8
	Manure to soil	773	158	23	247
	Import manure	8	3	0	2
	Available manure	781	161	23	249
	Soil losses	532	-6	-7	-14
	Volatilization	207	48	0	0
	Erosion losses	0	0	0	0
	Export crop prods	0	0	0	0
	Export animal prods	277	38	8	10
	Export with manure	0	0	0	0
	Immobilization	788	0	0	0
	Total nutrient losses	22	42	-7	-14

Manure application

Appendix 3 – Manure application

This appendix gives the manure application of the studied farms in kilograms, as obtained through the interviews with the farmers. This data was used to fill out the FarmDESIGN model. The composition of manure (dry matter content, organic matter, N-P-K- contents) was derived from (Kennisakker, 2011)

A - Manure balance			
Name	Production	Balance	Applied
Pasture manure	36419	0	36419
Slurry manure	97597	0	97597
Farm yard manure	174341	0	174341
Rock phosphate	0	0	0
Kali vinasse	0	0	0

B- Manure balance			
Name	Production	Balance	Applied
Pasture manure	47141	0	47141
Slurry manure	38051	0	38051
Farm yard manure	99396	0	99396
Slurry manure P	11519	0	11519

C - Manure balance			
Name	Production	Balance	Applied
Pasture manure	27108	0	27108
Slurry manure	18853	0	18853
Farm yard manure	89773	0	89773
Rock phosphate	0	0	0
Kali vinasse	0	0	0

D - Manure balance			
Name	Production	Balance	Applied
Pasture manure	26067	0	26067
Slurry manure	48990	0	48990
Farm yard manure	20754	0	20754
Rock phosphate	0	0	0
Kali vinasse	0	0	0

E - Manure balance			
Name	Production	Balance	Applied
Pasture manure	35662	0	35662
Slurry manure	15159	0	15159
Farm yard manure	36770	0	36770
Rock phosphate	0	0	0
Kali vinasse	0	0	0
Compost	0	525000	525000

F - Manure balance			
Name	Production	Balance	Applied
Pasture manure	38345	0	38345
Slurry manure	24778	0	24778
Farm yard manure	131253	31482	162735
Rock phosphate	0	0	0
Kali vinasse	0	0	0

G - Manure balance			
Name	Production	Balance	Applied
Pasture manure	47804	0	47804
Slurry manure	101452	0	101452
Farm yard manure	23407	0	23407
Rock phosphate	0	0	0
Kali vinasse	0	0	0
FYM Goat	0	12702	12702

H - Manure balance			
Name	Production	Balance	Applied
Pasture manure	26592	0	26592
Slurry manure	66441	0	66441
Farm Yard Manure	25830	0	25830
Rock phosphate	0	0	0
Kali vinasse	0	0	0
Imported Slurry Manure	0	2168	2168

I - Manure balance			
Name	Production	Balance	Applied
Pasture manure	25897	0	25897
Slurry manure	44713	0	44713
Rock phosphate	0	0	0
Kali vinasse	0	0	0
Pig slurry manure	0	1339	1339

Appendix 4 – External hectares

A		*kg*	*ha*	***Input***	***yield/ha dm***	
	GPS	67200	10.3	GPS	6550	
	concentrates	30000	6.6	Barley	2700	
	Barley grain	150000	55.6	Rye	2700	
		tota	72.4	Oats	2700	
B	Concentrates	30360	6.7	Lupine	4000	
	Hay	35000	10	Maize	5400	
		total	16.7	Triticale pea mixture	4000	
C	GPS	28470	4.35	CCM	7800	
	Barley	33142	12.27	Hay	3500	
	Rye	2800	1.04	Silage	9000	
	Maize	1400	0.26			
	Oats	25845	9.57	**Concentrates (brokvoer)**	kg/ha	*percentage*
	Lupine	11850	2.96	'tarwegries'	6000	0.175
		total	30.45	maize	5400	0.1
D	Triticale peas mixture	5000	1.25	barley	2700	0.135
	Silage	22000	2.4	rye	2700	0.055
		total	3.69	lupine seed	4000	0.1
E	concentrates	18000	3.9	Soy hulls		0.08
	maize	18000	3.33	oats	2700	0.1
	Silage	50000	5.56	triticale	5000	0.2
		Total	12.79			
F	Silage	300000	33.33			
G	Concentrates	80000	17.60			
H	Graskuil	7500	0.83			
	MKS	14000	1.80			
		total	2.63			
I	Beet pulp					
	Silage	11250	1.25			
	Barley grain	18000	6.67			
		total	7.92			

Organic crop yields were estimated according to average yields in KWIN Akkerbouw en Vollegrondsgroenteteelt (Schreuder et al., 2009). The proportional division of the ingredients of suppressed concentrates was provided by feed producer Van Gorp. Soy hulls were not taken into account since this is a by-product of soy beans.

Appendix 5 – Missing criteria

Table 9: Criteria that were mentioned by the respondents of the questionnaire, when asked to name their five most important criteria for excellence. These criteria were not on the list of the 12 predefined criteria. The number of times each criterion is mentioned is shown in the second column of the table.

Criterion	Number of times mentioned
Social function / contact with citizens	2
Animal welfare	2
Representative appearance	1
Relations with the surroundings	1
Broadening (of functions)	1
Living environment of animals	1
Food quality	1
Solar energy	1
Biodiversity	1
Work enjoyment	1
Leisure time	1
Vision	1