"Developing grazing strategies as a new contribution to dairy cattle feeding in Ethiopia"

Grazing dairy cattle in Ethiopia

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Abstract

In Ethiopia, several socio-demographic developments - like rapid population growth, urbanization and rising incomes - are increasing the demand for high quality milk. Ethiopian dairy farmers cannot respond to this demand with their current farming strategies. DairyBISS aims to find out whether grazing is a suitable feeding strategy to increase the dairy production in Ethiopia and if so, how this can be implemented. By means of a literature review and interviews, an answer to this question is provided. This report offers an overview of advantages and disadvantages of different feeding strategies and presents the dairy sector in the Netherlands and Ethiopia. This information is used to see how the Dutch knowledge fits the context of Ethiopia and how different theories could help to implement feeding strategies in Ethiopia. A practical action list is provided for DairyBISS with steps to take into consideration for the continuation of their project. Multiple interesting elements can be derived from this report: These are relevant during the implementation of the DairyBISS project in Ethiopia: (1) The Ethiopian dairy sector can learn from Dutch dairy farming strategies, though this knowledge should be open and flexible to the existing Ethiopian technologies and context; (2) The Ethiopian culture, climate and dairy market influence the adoption of new technologies; (3) Ethiopian farmers should play an active role in the design of the project in order to bring the Ethiopian and Dutch knowledge together.

Key words: Ethiopia, feeding strategies, zero grazing, grazing, implementation theories, dairy farming
1. Introduction

Ethiopia finds itself confronted with rapid population growth, urbanization processes and rising incomes. These developments result in a rising demand for high quality milk. The number of small-scale milk processors has increased and the number of dairy products diversified. However, it seems that Ethiopian dairy farmers experience problems to meet the increasing demands from the market for high quality milk. On the one hand they struggle with getting high quality feed (they currently rely on fodder of unknown and disputable quality), and on the other hand they face managerial problems because of a lack of knowledge on specialized and efficient dairy farming. The project ‘Developing grazing strategies as a new contribution to dairy cattle feeding in Ethiopia’ is part of the Dairy Business Information Service and Support (DairyBISS) program. The general objective of DairyBISS, a project of Livestock Research group at Wageningen University and Research Centre, is to increase the number of profitable dairy farms and firms in the Ethiopian private dairy sector by improving business to business (B2B) relations, the availability and utilization of quality business information and advice. One component of this research focuses on how different feeding strategies influence dairy production in Ethiopia in terms of quality and quantity.

The focus of the DairyBISS project, amongst others, is located on the high plateau in the area of Sululta, approximately 40 kilometers North/North-West of the capital Addis Ababa. In Figure 1 the arrow points to the area of Sululta. DairyBISS identified that productivity and economic results of farms in this area are generally far below their potential and traces this back to the lack of knowledge, skills and competent farming staff. Current research in the Netherlands indicates that grazing could play an important role in improving the quality of cattle feed which can be useful for Ethiopian farmers that want to specialize in dairy production to ensure high quality and efficiency. The report on hand contributes to this

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1 For the purpose of this report, ‘lack of knowledge’ is referred to from a ‘Western’ point of view. We realize that the Ethiopian farmers have a different kind of knowledge on dairy farming strategies. One knowledge is not necessarily better or worse than the other, they are valued the same. Further elaboration on this can be found in Chapter 6.1.
research by elaborating on how grazing can be an answer to the current feeding problem of dairy cattle in Ethiopia. It seems particularly interesting to elaborate on how lessons learned from Dutch dairy farms – which are highly productive – may be applicable to the Ethiopian context. To answer the research question, whether grazing is an answer to the current feeding problem of dairy cattle in Ethiopia, the following sub-questions will be answered: (1) What knowledge is available about dairy cattle feeding strategies in the Netherlands and what can be learned from it? (2) What knowledge is available of Ethiopian farmers about dairy cattle feeding and which farming strategies are used at the moment? (3) To what extent can the knowledge gained in the Netherlands be applied to the Ethiopian context and which cultural, social and other context specific aspects need to be taken into account when implementing a sustainable and culturally sensitive project?

The paper on hand proceeds as following: in Chapter 3 we present and explain the different possible feeding strategies for dairy cattle in general and also touch upon advantages and disadvantages of each strategy. Furthermore, this section elaborates on which factors a farmer needs to take into account when deciding for a specific feeding strategy. Chapter 4 then goes into detail on the Dutch experience with dairy farming. Developments in the past as well as the status quo are covered and followed by specific examples of lessons learned concerning dairy farming in the Netherlands. In the next chapter - Chapter 5 - we present the specific context in Ethiopia in more detail. Chapter 6 provides both theory on the implementation of innovations and a cross-fertilization of Dutch and Ethiopian knowledge about dairy farming. This provides a better understanding of the theoretical and practical implications of transferring farming strategies to the Ethiopian context. The report ends with a practical advice for DairyBISS in the form of a concrete action plan to provide input on the further continuation of the DairyBISS project in Ethiopia.
2. Methodology
To provide an answer on whether grazing is the best strategy to increase efficiency of dairy farming in Ethiopia and how to implement these strategies a literature review was done and semi-structured interviews were conducted. This literature review and the interviews have a strong focus on merging the available knowledge about efficient dairy production and grazing in both the Netherlands and Ethiopia. Together the literature review and the interviews enable us to provide DairyBISS with a context-based advice on how to proceed with the grazing component of the implementation of the DairyBISS project.

2.1. Literature review
The literature review is used as the basis of the report and was mainly used to gain knowledge on the context of Ethiopia, feeding strategies in both Ethiopia and the Netherlands and to formulate implementation strategies. Therefore, the literature review was divided in several subtopics: general theories on feeding strategies for dairy cattle, Dutch dairy farming and Ethiopian dairy farming and implementation strategies. In order to gather sufficient and high quality knowledge we used a number of 15 articles per subtopic and used academic databases such as Google Scholar, Lexis Nexis, Scopus, Jstor and Web of Science to find the articles. The search criteria for the literature review were based on the meetings with the experts. However, the range of search criteria expanded while the interviews with specialists were conducted.

2.2. Interviews
Besides the literature review ten semi-structured interviews were conducted. The respondents were selected by snowball sampling. Snowball sampling is a non-probability sampling technique where the researcher asks the respondents for new participants. The sample group grows during the research, which makes it an appropriate method when specialists are required to provide answers (O'Reilly, 2012). This strategy was favorable in this project as specialists were necessary to provide specific information on feeding strategies of dairy cattle. The first contacts were provided by Adriaan Vernooij and Simon Oosting and these contacts suggested other respondents. Four professors, two PhD students and one master student of the Wageningen University and Research Center (WUR) were interviewed. The other respondents are a livestock scientist of the International Livestock Research Center (ILRI), an Ethiopian student and the project manager of the ‘Grazeland farm’.
The interviews that were conducted have all been recorded and transcribed in order to fully understand and process the knowledge of the specialists. Every interview was prepared by creating a topic list customized to the expertise of the interviewee. This topic list usually existed of the following topics: grazing strategies, feeding strategies, applicability in the Netherlands, applicability in Ethiopia, climate, innovations and advantages and disadvantages of different feeding strategies. The order and content of the topics were largely dependent on the focus of the specialist (O'Reilly, 2012).

2.3. Respondents

A. Duncan
Occupation: principal livestock scientist International Livestock Research Institute
Expertise: feeds, innovation systems and livestock systems

A. Hailu
Occupation: unemployed Ethiopian living in Addis Ababa
Expertise: environmental studies, flower farms in Ethiopia

P.G.M. Hebinck
Occupation: professor rural sociology WUR
Expertise: agrarian transformation processes in Africa with an emphasis on land reform, small scale farming and rural livelihoods

G. Mengistu
Occupation: Ethiopian PhD student working on animal nutrition in Ethiopia
Expertise: cattle feeding, dairy cattle nutrition

R. van der Meulen
Occupation: Dairy farmer in Westerhoven, the Netherlands who produces for FrieslandCampina
Expertise: dairy farming, grazing in the Netherlands

S.J. Oosting
Occupation: professor animal production systems at the WUR
Expertise: agricultural systems, animal husbandry, animal nutrition and feeding, animal production systems, tropical agriculture
**W.F. Pellikaan**
Occupation: professor animal nutrition at the WUR
Expertise: animal nutrition and feeding

**P.A. Tamas**
Occupation: professor research methodology
Expertise: fieldwork in developing countries, research methodology, development studies

**H. Teuben**
Occupation: project manager of the Grazeland farm
Expertise: biology, soil ecology, water boards in Ethiopia

**R. Wassink**
Occupation: master student international development studies
Expertise: thesis on farming strategies in the Sendaba valley, Ethiopia

**A.P. Wouters**
Occupation: professor livestock at the WUR
Expertise: agro-industrial chains, animal husbandry, animal nutrition and feeding, farm and captive animals, agriculture in the Netherlands, grasslands, tropical agriculture

**R. Zom**
Occupation: research ruminant nutrition at the WUR
Expertise: mathematics, farm and captive animals, animal nutrition and feeding, animal production systems

### 2.4. Possible contacts for future research

**B. Hailu**
Occupation: Ethiopian dairy scientist
Expertise: animal science, dairy science
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**Y. Zelalem**
Occupation: Ethiopian food production specialist
Expertise: dairy production, livestock technology, tropical livestock systems
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3. Dairy farming strategies

3.1. Decision-making

“Dairy farms are multifunctional systems producing food, providing environmental services (e.g. maintaining and enhancing wildlife habitats) and generating income for the farmer” (O’Brien et al., 2012, p.35). Dairy farms can be found everywhere in the world and seem to be more hazardous, more complex and less standardized than industrial production systems, because of the vast amount of uncontrollable variables (Cros, Duru, Garcia & Martin-Clouaire, 2004). It is up to every farmer to decide on the specific strategies and management styles and to choose how to implement these for the farm. The first choice to make is about where to focus the strategies on. R. Zom (personal communication, June 10, 2015) highlighted three different farm strategies that can be considered by a dairy farmer.

The first strategy is about optimizing the production of a single cow. The farmer designs the strategy in such a way that the intake of feed of an individual cow maximises the production of milk for that cow. Farmers will likely maximize the feed intake of a cow in the first phase of the lactation and reduce it in the last phase. Doing this will produce the most amount of milk per cow since the production is much higher in the beginning. In this strategy the energy intake of the diet will match the requirements of the cow.

The second strategy is about managing the available resources. Hence, the farmer is not trying to optimize the intake for an individual cow but attempts to optimize the available feed resources for the entire herd. This management strategy is twofold. The farmer is not only managing the feed intake of the group of cows but also the feed stocks need to be managed more actively.

The third strategy is about optimizing different groups within the herd. Different groups within a herd will require a slightly different energy intake. A farmer could for example give different feed resources to different groups that require another level of energy intake. High yielding cows and cows that are growing fast will benefit from feed that is of high quality. This feeding strategy will optimize their milk production. Cows that are dry or low yielding do not require that same level of energy intake and could be fed with less quality feed without losing much milk production.

After the focus of the farm has been decided on it is now important to look at which strategy to choose for attaining the feed necessary on the farm. The feeding of cows is the biggest expenditure for a farm that focuses on milk production (White, Benson, Washburn & Green, 2002). There are many different strategies for production or obtaining the feed that is
necessary on the farm and these strategies can differ a lot between farms. It is important to highlight that with cows “optimizing feed intake is more important rather than maximizing feed intake” (Muller, 2015, p.56). With optimizing feed intake it is important to take the gross feed efficiency into account. Gross feed efficiency is defined as the ratio between the amount of feed that is being fed to the cows and the amount of milk that is being produced by those cows (Muller, 2015).

In general we can distinguish between two strategies that can be used for attaining the feed on the farm, grazing and zero grazing. These strategies will be further explained in the following sections of this chapter.

3.2. Zero grazing

The first option that a farmer could choose for attaining the feed for his cows is called zero grazing. It can also be called stall feeding system or confined system (B. Wouters, personal communication, June 8, 2015). This is the most used feeding strategy in the world (R. Zom, personal communication, June 10, 2015). Meul, Passel, Fremaut and Heasaert (2012) highlighted some characteristics that are part of a zero grazing farm. Zero grazing farms are often said to be more intensive farms, handling more cows, having highly controlled diets of concentrates and stored forages (grass/maize silage) for the cattle, having high milk yields and increased inputs of nutrient and energy. However, whether these aspects are specific characteristics for zero grazing farms only is highly disputable and the debate on this will be touched upon in the final part of this chapter.

The definitions of zero grazing are not always clear on what exactly falls under this strategy but it is a system where cows are housed throughout the year (Meul et al., 2012). The cows might every now and then be able to go outside. The purpose of this is giving the cows some exercise and they will not graze during these periods (R. Zom, personal communication, June 10, 2015). There are two ways of attaining the feed within zero grazing. These two can overlap and be mixed but can also be used completely separate from each other. There is some debate about whether both strategies fall under zero grazing. In this report they will both be included within the zero grazing category.

The first strategy can be called cut and carry strategy. The cows are fed with either cut grass or with silage or hay. The farmer will have land where he grows grass. This grass will be cut by the farmer and be fed to the cows straight away or stored in a silage to feed the cows later. The cows are thus indoors when they are fed and the farmers will choose for growing feed that can be easily cut (B. Wouters, personal communication, June 8, 2015). In the cut and
carry systems farmers need to consider the grass growth system in order to feed the cows optimally. A silage plan has to be made in order to deal with the differences in grass growth but a lot of grass will be fed to the cows straight away (R. Zom, personal communication, June 10, 2015).

The second strategy implies farmers purchasing the feed for the cows. The cows still do not go outside to graze for their feed but the farmer will buy all the necessities on the market. Both strategies often use additional supplements to optimize the nutrient intake of the cows. This zero grazing system is highly used by farmers who want to focus on an individual cow basis (R. Zom, personal communication, June 10, 2015). It is a strategy where you can easily measure and control the feed intake of a cow and thus control their diet. Feed intake, in this system, is measured by weighing the amount of feed provided to the cows on a daily basis and deduct the refusal weight (feed provided but not consumed) (Muller, 2015). Calculations are also made about the additional supplements that are fed, next to the grass and silage, to the cows.

3.3. Grazing

Grazing is the second strategy that can be used for attaining the feed necessary for the cows. White et al. (2002, p.96) define grazing as “getting at least 25% of annual forage as pasture” in comparison to zero grazing systems “where greater than 95% of forage was mechanically harvested and stored before feeding”. This means the cows go outside on the pasture to graze their own feed.

However, there is no system in the world where cows can be managed with only grazing. There will always be some kind of combination between grazing and supplement feeding. Even in New Zealand, where the conditions for grazing are perfect because of the mild weather all year long and where it does not get too cold in coastal areas (New Zealand Weather, 2015), there is still supplemental feeding in the cows’ diets. This mostly has to do with the differences in grass growth and this can result in periods where the grass is insufficient to meet the cow’s energy requirements (R. Zom, personal communication, June 10, 2015). So, in order to maintain a high level of milk production it is important to feed the cows additional supplements next to grazing.

The term ‘pasture’ “serves as a general reference to plant communities that are harvested through the efforts of grazing animals. A dairy quality pasture is a grass, grass-legume or other forage combination utilized with a sufficient level of management to complement or meet the nutritionals requirements of dairy cattle” (Sullivan, DeClue &
Emmick, 2000, p.3). In other words: pastures are fields that are suitable for grazing. Farmers will choose for pasture that can be efficiently utilized. This means that it is good and easy to graze for the cows (B. Wouters, personal communication, June 8, 2015). Those pastures need to be managed to achieve four different goals: 1. quality of forage is high and consistent 2. optimize forage dry matter yield on a per acre basis. 3. high efficiency of harvest 4. high efficiency of forage conversion (Sullivan et al., 2000). When these elements are managed well the cows’ requirements can be met by grazing. Cows graze in grazing events, which is defined as the number of times a year cows are going outside to graze. It is very important that the grazing takes place regularly and intensely so that the herbage will keep its quality (Cros et al., 2004), which is called the ‘use it or lose it’ philosophy (Sullivan et al., 2000). The intensity of grazing during grazing events can be measured by calculating the amount of forage mass that is removed. For this strategy a good infrastructure is necessary, which includes fencing, watering systems and laneways (Sullivan et al., 2000). Within grazing there are three different subcategories which will be explained in the following sections of this chapter.

3.3.1 Continuous grazing

Continuous grazing, also referred to as set stock grazing, means that you match the grass growth or pasture allowance with the requirements of the cows. The farmer starts off with a large field and you put the first cows in the field in early spring. During this time it is possible to use the entire field for grazing since the grass growth rate is still low. The pasture will be grazed by a certain number of cows per hectare. When the grass growth rate increases it is possible to increase the numbers of cows per hectare. It would then also become beneficial to put a fence up and exclude one part of the pasture that is not being grazed for cutting. When grass growth rate goes down again the farmer decreases the number of cows per hectare and can cut a little less or nothing for silage. Another possible strategy would be to keep the cows on one large field but change the supplement feeding rates with the changes in the grass growth rates (R. Zom, personal communication, June 10, 2015).

3.3.2 Rotational grazing

This system is about moving cows from one pasture to the next. With rotational grazing the intervals between successive grazing is referred to as the rotational length (Sullivan et al., 2000). When the pasture is not sufficiently feeding the cows, they get either supplemented by conserved feed, maize silage or hay. The cows will always be fed concentrates during times of
winter, or when the grass growth rates are insufficient (Cros et al., 2004). There are two
different systems within rotational grazing (R. Zom, personal communication, June 10, 2015).

Firstly, there is the paddock system. The cows will spend 1 to n days of grazing on a
paddock and then move on to the next. The days are set and consistent, based on grass growth
rates. It will be easier for the farmer to match the nutrient intake with the energy requirements
of the herd. Secondly, there is the ration grazing or strip grazing. These strategies are similar
but differ in how they fence off the field. This will change the possible field that can be
grazed by the herd. In these systems the paddocks are divided into a certain number of sub
paddocks. It is about matching the grass growth rate with the pasture intake of the herd. The
farmer will calculate the growth rate so that it is clear how many days are necessary to fully
regrow a pasture field. The rotational length will be calculated to optimize the growth within
the different fields. When the grass growth rate goes up or down, the rotational length will be
adjusted accordingly. All the excess that is left will be cut for silage to later be used if the
grazing is not sufficient to meet the cow’s energy requirements. So the main difference
between the two strategies is that rationed grazing uses only a front fence and strip grazing
will involve both back and front fences (R. Zom, personal communication, June 10, 2015).

3.4. Debate – feeding strategies in comparison
For which feeding strategy a dairy farmer opts is strongly dependent on several economic,
ecological, social, legislative and other factors (see Figure 2). In the first place this is,
however, a highly personal decision as several interviewees have stressed (S. Oosting,
personal communication, June 3, 2015; W. Pellikaan, personal communication, June 1, 2015;
B. Wouters, personal communication, June 8, 2015). Some farmers just prefer having cows in
the field and seeing them graze whereas others prefer having the cows close by and choose for
zero grazing. Traditional patterns within a family, region or country also play an important
role.

Despite these individual preferences, there are some aspects that every farmer has to
take into account when deciding between grazing and zero grazing. First, the general
economic situation of the farmer, including availability of capital, land (and its location),
infrastructure, machines or technology (e.g. robotic milking) and labor (as in family labor
available for farm work but also capital to employ laborers), strongly influences the decision.
The market plays a role insofar as the farmer needs access to it, but more importantly there
needs to be a demand for (more) dairy products, otherwise it does not make sense for the
farmer to specialize in dairy production. Moreover, the herd size a farmer has or aims for
plays a role as well as the question whether the farmer wants to upscale or not. Farmers also have to take into account national and international legislation to see which feeding strategy is suitable for their specific region within the given legislative framework. This legislation concerns specific regulations on land but also on nutrients (e.g. maximum use of fertilizer or maximum amount of nutrients to be stored on a farm). The public opinion in general may as well play a role, as particularly Western countries’ populations have developed a preference for grazing cows which they can see in the fields outside. This makes ‘green’ milk more profitable and may influence the farmer’s decision to decide for grazing over zero grazing. Along the same line, concerns about animal welfare may determine the feeding strategy. Also farmers’ skills - or at least the possibility to gain further knowledge on the different strategies - play an important role. This is because some strategies require more knowledge and skills than others. In addition, all interviewees have stressed the importance of specific local conditions related to (dairy) farming. This includes taking into account the climatic conditions, soil capacity and grass quality, availability of water and irrigation possibilities, risks of parasites, condition of land in terms of trees, shade or shelter, animals’ safety when being outside and religious or cultural features influencing farming activities (W. Pellikaan, personal communication, June 1, 2015; R. Wassink, personal communication, June 3, 2015; B. Wouters, personal communication, June 8, 2015; R. Zom, personal communication, June 10, 2015).

As the choice for one of the feeding strategies is dependent on so many different factors, it becomes understandable why farmers as well as scientists are not unified when it comes to deciding on which feeding strategy is ‘the best’. Particularly in Western countries, the discussion about grazing and zero grazing has thus been characterized by an ongoing heated debate. Here, we want to present some of these discussions and research outcomes to get an overview of how the grazing vs. zero grazing debate is taking form and to be better able to decide whether grazing is a suitable option for feeding dairy cattle in Ethiopia.
3.4.1 Advantages of grazing strategies

Many farmers and researchers argue that grazing as the best feeding strategy just because grazing satisfies the natural behavior of dairy cows to be outside and walk around. They are “made for grazing” as B. Wouters puts it (personal communication, June 8, 2015). This leads to the widespread assumption that grazing is better for animal welfare and health compared to zero grazing strategies. Some studies could prove this by showing that pastured cows show lower rates of leg injuries, less incidences of lameness, mastitis and other maladies (Fontaneli, Sollenberger, Littell & Staples, 2005; Meul et al., 2012; W. Pellikaan, personal communication, June 1, 2015; White et al., 2002; B. Wouters, personal communication, June 8, 2015). As indicated before, this has become an important issue for consumers as many prefer milk from grazing cows over confined cows’ dairy. Grazing thus bears the advantage for farmers of a more positive image with the possibility of higher incomes due to consumers’ willingness to pay more for ‘green’ dairy products (Cros et al., 2004; Meul et al., 2012). That grazing is more natural than confinement is supported by evidence that through grazing the

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2 Own source.
farmer can offer a higher variety of plants than with concentrates and purchased fodder. According to some farmers and researchers, this leads to a highly balanced and in general better nutrition of the animals (Sullivan et al., 2000).

Second, as the animals graze for their feed and do not need to be fed several times per day, grazing systems are supposed to be less labor intensive than zero grazing. This will thus make dairy production cheaper and more efficient (S. Oosting, personal communication, June 3, 2015; W. Pellikaan, personal communication, June 1, 2015; B. Wouters, personal communication, June 8, 2015). Also, research shows that milking takes significantly longer in zero grazing systems than for pastured cattle (White et al., 2002). According to W. Pellikaan (personal communication, June 1, 2015), this can be explained by the fact that grazing cows can walk in one row to the robotic milking systems whereas indoor-kept cows need to be milked in their individual boxes. The latter takes more time as the milker needs to walk from one cow to the other whereas grazing cows come to the milker/milking machine. This implies that upscaling and increasing the livestock is easier and less expensive on grazing farms as more cows can be handle within the same time, but also that more labor is available for other farming activities as for example cropping. Like this, farmers can further increase their income and use their labor at a highly effective level (Meul et al., 2012; S. Oosting, personal communication, June 3, 2015). Meul et al. (2012) for instance showed in a study that grazing farms scored significantly higher on labor productivity than their zero grazing counterparts.

Several studies indicate that grazing in general is cheaper than confining the animals. On the one hand, this has to do with lower feed costs, as farmers need to buy less feeding supplements or concentrates and can just feed their cows with the pasture grass that is available anyways. On the other hand, grazing bears significantly lower asset cost as farmers have to invest less in housing, equipment or storage facilities, at least during summer periods. As these facilities are not used throughout the whole year but just for specific periods, for instance maintenance costs are a lot lower than for pure zero grazing farms (Cros et al., 2004; Fontaneli et al., 2005; Meul et al., 2012; White et al., 2002).

Another advantage of grazing over zero grazing concerns the ecological and environmental impact. Meul et al. (2012) conclude that due to less mineral fertilizer and concentrates use and lower energy consumption, grazing farms score higher for ecological sustainability indicators and thus show better energy productivity than zero grazing systems. O’Brien et al. (2012) support this finding by showing that grazing systems generally have a
lower impact on the environment than zero grazing systems, due to effective resource use and fewer pollutants from concentrate feeds.

3.4.2 Disadvantages of grazing strategies

Despite the clear advantages of letting dairy cattle graze, many researchers and farmers can prove that grazing also bears significant disadvantages and difficulties that have to be taken into account when deciding for the most suitable feeding strategy. First, and perhaps most importantly, there is a large loss of control over the cattle (concerning diet, health and behavior) when letting them graze. The farmer cannot know the exact amount the cattle consumes and whether this is sufficient to meet their nutritional and energy requirements (Cros et al., 2003; B. Wouters, personal communication, June 8, 2015). Measuring the intake through measuring the weight of the feed provided and deducting this with refusal weight is easier in zero grazing. Sullivan et al. (2000) describe the cows in these situations as a ‘black hole’ as it is not possible to measure their intake and what supplements they might need for the maximum dairy production. Particularly when the animals only eat small quantities per bite the feed intake tends to be very low and not sufficient to meet their demands (A. Duncan, personal communication, June 4, 2015; B. Wouters, personal communication, June 8, 2015).

Moreover, the ultimate precondition for grazing is good quality grass and a sufficient carrying capacity of the soil. This is highly dependent and very sensitive to climatic conditions and can thus fluctuate within but also between years. For farmers this means they cannot determine properly beforehand how much fertilizer, feeding supplements, water, area per cow etc. they need for a specific year which makes it a highly risky and less predictable feeding strategy. Grazing challenges the farmers insofar as that they have to balance these aspects and decide nearly every day whether they have to supplement or not and whether to use fertilizer or not. Particularly during dry periods but also during phases of heavy rainfalls, the quality of the grass can considerably vary and be of such a low quality that grazing alone does not satisfy the animal's needs (Cros, Duru, Garcia & Martin-Clouaire, 2003; Deak, Hall, Sanderson, Rotz & Corson, 2010; S. Oosting, personal communication, June 3, 2015; W. Pellikaan, personal communication, June 1, 2015; Sullivan et al., 2000; B. Wouters, personal communication, June 8, 2015). These seasonal differences also impact the health and welfare of the animals as specific climatic conditions may increase the risk for heat stress and sunburn, parasitic diseases and other maladies (Sullivan et al., 2000; B. Wouters, personal communication, June 8, 2015). To what extent these climatic fluctuations influence a farmer's ability to feed his cattle also highly depends on how much land he has available and if rotation...
for instance is possible to decrease the pressure on the land. Land availability is thus a significant influencing factor when it comes to deciding on feeding strategies and is a major disadvantage of grazing when land is scarce for a farmer or even a whole region (A. Duncan, personal communication, June 4, 2015; B. Wouters, personal communication, June 8, 2015). Here, it is also important to take into account the fact that grazing always brings a loss of biomass with it. As B. Wouters (personal communication, June 8, 2015) for instance states, this loss can make up to 20 percent of the available biomass which is a significant disadvantage of grazing in comparison to zero grazing systems, where up to 95 percent are used and only 5 percent wasted.

Despite the advantage of grazing due to lower use of energy and concentrates as identified before, other researchers also point to the higher possibility of environmental impact through grazing. Particularly because cows defecate and urinate everywhere on the pasture land but also because of fertilizer use for better grass quality, the environmental impact might be higher than in zero grazing systems. This also implies higher labor use because workers are needed for cleaning up the pastures or for dispensing fertilizer on the soil (A. Duncan, personal communication, June 4, 2015; W. Pellikaan, personal communication, June 1, 2015). In general, the argument made by some researchers that grazing requires less labor and thus less investment needs to be taken with a pinch of salt. For instance, if the quality of land and grass is too low for grazing, the costs for fertilizer and labor needed to treat the soil might be much higher than the costs for confinement of cattle, which would make zero grazing cheaper than grazing. Also the infrastructure costs might outweigh the costs farmers save because they do not need housing and storage facilities. Fences, lanes, watering systems, herdsmen and sprinklers or fans to cool down the animals in summer time are just some of the investments a farmer might have to make. All this does not only require capital but also more labor which thus increases the overall costs for a farmer (Fontanelli et al., 2005; S. Oosting, personal communication, June 3, 2015; Sullivan et al., 2000; White et al., 2002; B. Wouters, personal communication, June 8, 2015).

Most importantly, grazing requires high management skills and knowledge from the farmer – about his animals and their requirements, about the land and soil capacity, about rotation policy and how to use his land most efficiently without degrading it as well as about how to calculate the amounts of hay or silage needed for the animal and of nitrogen fertilizer for the soil. Farmers always need to make sure that they do not overgraaze or undergraaze to
keep their dairy production high enough to ensure steady income (Cros et al., 2004; Meul et al., 2012; S. Oosting, personal communication, June 3, 2015).

3.4.3 Advantages of zero grazing strategies
Most of the disadvantages of grazing presented in the previous section already points to the advantages of zero grazing. Zero grazing systems are said to be better in reaching the animals’ nutritional requirements as they are better looked after and their intake can be controlled more effectively (A. Duncan, personal communication, June 4, 2015; Meul et al., 2012). It is much easier for farmers and thus requires fewer skills to determine the animal’s needs and adapt the feed accordingly. Farmers are less affected by the fluctuations of grass and soil quality and in general less concerned by climatic conditions. Zero grazing makes it possible for the farmer to give high quality feed throughout the whole year which can boost dairy production. The land scarcity is not an issue in zero grazing systems, if we understand zero grazing in the sense of farmers using only purchased fodder. Zero grazing is the only way for smallholders without much land available to do intensive dairy and enables many farmers to upscale and increase their livestock significantly (S. Oosting, personal communication, June 3, 2015). Zero grazing farms show on average higher labor efficiency, energy use efficiency and make more efficient use of resources than pasture farms. Due to the absence of urine and dung patches the nitrate loss is reduced and the environmental damage on the land is lower as the animals do not trample on the grass (Meul et al., 2012; S. Oosting, personal communication, June 3, 2015). Also the loss of biomass is much lower as around 95 percent of it can be used when you cut the grass in comparison to letting cattle graze on it which implies optimizing the grass utilization (B. Wouters, personal communication, June 8, 2015). Most importantly, several studies have shown that confined animals produce on average more milk than grazing cattle. White et al. (2002) found a difference of about 11 percent between confined and pastured cows, whereas Fontaneli et al. (2005) even speak of 19 percent more milk produced by housed cattle than by grazing ones. W. Pellikaan (personal communication, June 1, 2015) as well as B. Wouters (personal communication, June 8, 2015) stated in the interviews that farmers would mostly chose for zero grazing strategies when they want to intensify dairy production and specialize in dairy farming. However, O’Brien et al. (2012) explain that these higher milk production rates and the higher income going along with it is partly compensated by the lower costs for feed and housing and the lower use of resources in grazing systems so that the overall difference from an economic perspective is rather insignificant.
3.4.4 Disadvantages of zero grazing strategies

As for the advantages of zero grazing, the disadvantages can also mostly be derived from the advantages of grazing displayed before. First, zero grazing can decrease the welfare and health of animals by letting them less room to move and be in their natural environment. Secondly, the environmental impact is much higher in zero grazing systems, particularly through higher emissions, eutrophication and acidification (to prevent acidification, much more manure input would be needed) (Meul et al., 2012). Moreover, zero grazing is labor intensive as someone is required to bring the feed to the cows and to clean the housing. However, whether this labor input is really higher than in grazing systems depends on the individual farm as explained before. Also, the investments to be made for housing, storage facilities and equipment needed for zero grazing feeding might not be significantly higher than the costs for grazing facilities but are in the first place a disadvantage of zero grazing farming (W. Pellikaan, personal communication, June 1, 2015; B. Wouters, personal communication, June 8, 2015).

3.5. Grazing or zero grazing?

The previous sections have shown that both grazing and zero grazing strategies have significant advantages and disadvantages (see Appendix 1 for an overview) that a farmer needs to take into account when deciding for a feeding strategy for his dairy cattle. As this project is primarily concerned with how to increase milk production of dairy cattle in Ethiopia, a reflection on the previous explanations shows that zero grazing is often the strategy used by farmers who want to increase their dairy production and specialize in dairy farming. However, as has been pointed out, many different aspects have to be taken into account when deciding for a feeding strategy and the desire to increase dairy production cannot be the only factor to consider when making this decision. There is no hard evidence that cows are ‘happier’ or that the milk is better when they are grazing and the evidence for differences in production is rather limited. An ultimate statement on which feeding strategy is the ‘best’ for dairy cattle cannot be made. It is a very personal decision in the first place and it highly depends on the context and the specific local circumstances and conditions. This means that we have to take a look at the specific contexts to decide whether grazing is a suitable strategy for Ethiopia and whether Dutch feeding strategies might be applicable for the Ethiopian context. The following sections will thus go into detail on the specific conditions in place in the Netherlands and in the project-region in Ethiopia.
4. Dairy farming in the Netherlands

4.1. The Dutch context

The Netherlands is inextricably linked to dairy. In general, cheese, yogurt and milk are consumed daily within the household. This makes the Dutch dairy sector an important contributor to the Dutch economy and export (NZO, 2015). Currently there are 18,000 Dutch dairy farms which comprise of 1.6 million dairy cows, together they produce 12.7 billion kilos of milk each year. This makes the Netherlands the fifth biggest milk producer of the European Union (EU). The high production of Dutch dairy cows enables the Dutch dairy sector to be competitive and export its dairy products to over 150 countries, but mostly to surrounding countries in the EU (71%). However, currently the export of Dutch dairy to countries outside the EU is expanding rapidly. Several aspects contribute to the flourishing of the Dutch dairy sector (NZO, 2015):

- The Dutch temperate climate, with its cool summers (17°C-20°C) and moderate winters (2°C-6°C), high rainfall, and good soil provide the perfect conditions for the dairy cattle and to grow the grass to feed dairy cattle;
- The Netherlands has a strategic location in Europe which creates plenty of sales opportunities;
- The logistics infrastructure in the Netherlands is excellent;
- The Netherlands has sufficient knowledge to build an efficient and sustainable dairy sector.

In comparison to other dairy-producing countries the Dutch dairy sector is intensifying with attention for the well-being of the cows and with environmental regulations in mind (NZO, 2015). In this chapter it is emphasized how Dutch laws ensure the land-based character of dairy production and other past and current developments contributed to the favorable dairy climate and how grazing techniques contributed to this intensive but regulated dairy production. The last part of the chapter elaborates on Dutch lessons learned from grazing and intensified dairy production.

4.2. Dairy production in the Netherlands

Over the years the agricultural sector, including the dairy sector, in the Netherlands has changed significantly. Grazing as the main feeding strategy only became a prevalent farming strategy in Europe after the first World War. In 1946, after the end of the second World War, Dutch farmers were also faced with shortages of concentrates. This forced the Dutch farmers to become efficient with the resources they had available. Consequently, continuous grazing
as the main feeding system expanded rapidly from two farms to 50,000 farms in the early fifties. However, in the late 1950s and the early 1960s, Dutch farmers got access to concentrates. The availability of concentrates increased the milk production of the Dutch farmers and diminished the necessity to look at grassland management (R. Zom, personal communication, June 10, 2015).

This renewed focus from grazing to concentrates is also clearly visible in the development of dairy farms in the Netherlands. The number of dairy-farming businesses has significantly decreased since the 1960s. In 1960 there were 150,000 dairy-farms comprising of 1.6 million dairy cows, which were put out to graze from spring to fall. From the 1960s onwards the dairy sector has further intensified leading to an increase in the number of dairy cows, resulting in 2.5 million dairy cows in 1983. However, due to the milk quota (see page 7 for extensive explanation) and increased milk production per cow the number of dairy cows fell back to 1.5 million in 2004. The same trend is noticeable in the number of dairy farms which has decreased to 24,332 in the Netherlands in 2004 (Bruijnis, 2006). The 18,000 dairy farms that still exist today (NZO, 2015) have grown in size, as the number of dairy farms with more than 70 dairy cows has grown to 33.3 percent in 2004. This growth of the herds and the focus on intensification goes hand in hand with higher production yields and a focus on efficiency (Bruijnis, 2006).

The intensification trend of Dutch dairy farms influences the time that dairy cows are kept inside. The grazing time is diminishing and an increasing number of dairy cows is kept in the shed year-round. In the period between 1994 - 2004 the number of grazing dairy cows has decreased from 92 to 83 percent. In 2012 25-30 percent of the dairy cows were kept inside (Bruijnis, 2006). This trend to keep the cattle inside is stimulated by decreasing milk prices, the milk quota, environmental regulations (for example the manure legislations), increased size of the herd, labor efficiency, increased production, milk robots and controllability (as further explained in paragraph 2.4).

In the last years this intensification trend is supported by a decline to 70% in pastured areas in the Netherlands (Linde, 2015). Despite this decline, grassland remains the main source of roughage for dairy cattle in the Netherlands. However, the types of grazing strategies are changing and continuous grazing loses ground (Visscher, Radersma & Pol-van Dasselaar, 2011). This is an ambiguous development since the Dutch government and the Dutch consumer prefer to see the image of a grazing cow. However for the growing number of extensive farms it is not self-evident to maintain grazing. Livestock farmers often indicate
that changing management systems and automatic milking robots are the reason to choose for zero grazing or to substantially reduce grazing methods (Linde, 2015). Despite the evident decline in grazing methods, Dutch farmers are still interested in grazing and therefore the current trend is to find alternatives for optimal grass utilization that both fit the extensive farmers, increase dairy production and meet the environmental regulations and animal welfare standards (Visscher et al., 2011).

4.3. Dutch dairy farming: current developments

Nowadays most Dutch farmers use rye grass for grazing. Grazing is always supplemented with different silages (maize and/or grass) during winter. These combined and balanced feeding strategies have led to very high production rates. Nowadays 40-60 liters of milk per Dutch cow per day is not exceptional (W. Pellikaan, personal communication, June 1, 2015).

In this paragraph we will touch upon the current grazing strategies in the Netherlands, the different reasoning behind the strategies and then elaborate on the Dutch laws and legislations that support the choices behind Dutch feeding strategies.

4.3.1 Current grazing strategies in the Netherlands

Nowadays a change in farm-management is visible. Together with the increased use of automatic milking robots this affects grassland utilization and gives rise to new variations of continuous and rotational grazing (Linde, 2015). The EU directives on water quality and nitrate levels in water highly affect the choices of Dutch farmers to return to feeding strategies with lower input of nitrogen and fertilizer (R. Zom, personal communication, June 10, 2015).

However, the individual choices for grassland management are often based on the farm’s business characteristics: allotment, layout of the parcel, the availability of grass and labor force, dairy intensity (liters milk per hectare), alternative growing possibilities for roughage, type of soil and the economic situation (Visscher et al., 2011).

Today, seven common feeding strategies can be distinguished in the Netherlands: continuous grazing/controlled grazing, rotational grazing, ration grazing, strip grazing, summer feeding and stall feeding. However, the main distinction can be made between continuous grazing, rotational grazing and zero grazing. Within these three categories all feeding strategies in the Netherlands can be placed (Galama et al., 2002; Remmelink, Middelkoop, Ouweltjes & Wemmenhove, 2014; Visscher et al., 2011). The strategies are not exclusively Dutch, but it is unique that in the Netherlands farmers switch between different
grazing strategies or use several or all grazing strategies interchangeably (R. Zom, personal communication, June 10, 2015).

4.3.2 Continuous and controlled grazing

Continuous grazing is a system in which the dairy cattle has unlimited access to the grazing land for 20 hours a day. The dairy cows are only kept inside when milked, cows receive concentrates, but no roughage. This continuous grazing strategy is used by 10% of the Dutch farmers, mostly by farmers who have robotic milking systems (R. Zom, personal communication, June 10, 2015). The main reasoning behind continuous grazing is that it is quite easy and convenient, because it is not labor intensive, no major investments are needed for extra fencing and the cows show their normal behavior and customs because they are used to grazing the same plot. Other advantages are the flexibility, the lack of grass losses, the possibility to skip plots and to mow grass when it gets too long or put the cattle on a plot with the right grass length and nutritional value (R. Zom, personal communication, June 10, 2015; Galama et al., 2002; Remmelink et al., 2014; Visscher et al., 2011). Despite the advantages, this grazing system requires a lot of planning. It is difficult to match the pasture allowance with the allowance of the cow and therefore Dutch farmers are often too late with adding the necessary feeding supplements to the ordinary diet or with increasing the grass severity leading to lower dry matter yield (R. Zom, personal communication, June 10, 2015). This late response has consequences for milk production, because the quality and the amount of grass available diminishes per day (Galama et al., 2002; Remmelink et al., 2014; Visscher et al., 2011). Thus, with the current intensification of dairy farms in the Netherlands, continuous grazing is not considered to be the most optimal grazing system.

Another variant within this category is controlled grazing which is used by 60% of all Dutch farmers (R. Zom, personal communication, June 10, 2015). Within this strategy the dairy cows can daily enter the grassland, but they only graze for 8-10 hours a day. During the night the cows are in the shed and get additional supplements and roughage. The dairy cattle is moved to another plot after 3-5 days (R. Zom, personal communication, June 10, 2015; Galama et al., 2002).

Some Dutch farmers choose to combine continuous and controlled grazing. In this scenario the cattle is put out to graze during the day when the weather is less optimal (mostly during spring and fall) and during summer the continuous grazing method is applied.
4.3.3 Rotational grazing

In the Netherlands rotational grazing is the most common strategy, however the paddocks are smaller than in other countries and often have a one-day grazing cycle (R. Zom, personal communication, June 10, 2015). In the Netherlands the grass growth varies per season due to weather conditions, therefore the quality of grass can differ. When the grass is growing slow, supplements can be fed.

Advantages of this kind of grazing in comparison to continuous grazing strategies are that it is less labor-intensive, less time spent on mowing, more rest for the dairy cattle and most importantly, a farmer can match the size of the field/paddock and the grazing allowance with the grass growth. However, this system also has disadvantages. The dairy cattle does need additional feeding supplements, a farmer has lower grass yields and picking up the cows from the meadow does take a lot of time (Remmelink et al., 2014; Galama et al., 2002). The ditches that are part and parcel of the Dutch pasture land create another obstacle for rotational grazing. The ditches pose a logistical challenge when a farmer needs to move the cattle from one plot to another (R. Zom, personal communication, June 10, 2015).

Although grazing is often the preferred feeding strategy for both farmers and the Dutch society, zero grazing is experiencing a revival in the Netherlands due to stricter manure legislation. The Dutch manure legislation forces farmers to minimize nitrogen and phosphorous use. A practical solution to meet the manure terms is to keep the dairy cattle indoors. Mainly intensive farmers use zero grazing as the main feeding strategy. Nowadays 30% of the Dutch dairy cows are kept indoors all year. These intensive farmers have large pasture areas available. However, due to efficiency and controllability they choose to mow the grass and feed it to the cows in the shed (S. Oosting, personal communication, June 3, 2015). When the farmer cuts it himself, the grass production is higher. Another reason for Dutch farmers to choose for zero grazing can be of environmental nature due to existing manure/nutrient legislations (S. Oosting, personal communication, June 3, 2015). According to Dutch manure legislation, 1.5 cow units are allowed per hectare of land, because a farmer is allowed to produce 170 kilograms of nitrogen in animal manure per hectare of land. One cow already produces 120 kilograms of nitrogen per year in manure. However, due to this legislation, many intensive farmers choose to keep the dairy cattle inside and bring the food to the cows in order to have a higher cow density and production (S. Oosting, personal communication, June 3, 2015).
To summarise, there are three main feeding strategies in the Netherlands: continuous grazing, rotational grazing and zero grazing. Within all three categories one can find several varieties and differing strategies. Most Dutch farmers combine several strategies, whereby some focus on the highest production per cow, others choose to focus on highest production of grass. Both focuses can pay-off in terms of dairy production.

4.4. Intensification and increased efficiency

Currently 67.2% of the Dutch land is used as farmland. This percentage has been decreasing for the last thirty years. The decreasing amount of land available for agriculture is partly due to increased urbanization. This scarcity of land in the Netherlands raises the prices of agricultural land, leading to prices that are extremely high in comparison to agricultural land in other milk producing countries in the European Union. This leaves Dutch dairy farmers with high capital utilization, because the availability of land is a necessity to be able to produce milk (Agriholland, 2015).

These rising land prices and the income of Dutch farmers are highly influenced by the current Dutch and European agricultural policy. One part of these highly influential policies is the manure legislation. Currently, this manure legislation determines, for a large part, which agricultural choices a Dutch farmer makes. According to the manure legislation dairy farmers are obliged to have a certain amount of land per animal to spread out the manure. The offset of manure on own pasture land is cheaper than when a farmer has to sell manure to other parties, so agricultural manure policy increases the demand for agricultural land (Agriholland, 2015).

Another example of an European agricultural policy that influences the dairy farm sector is the milk quota. In 1984 the milk quota was introduced to dispose the surpluses of dairy products in the EU. However, due to the world’s rising demand for dairy products and the fear to lose the Dutch market share, the Dutch government and the European Union decided to abolish the milk quota from April 2015 onwards. However, to avoid severe price fluctuations, a gradual prolonging of the milk quota between 2009-2015 was established. The Dutch farmers organization (Land- en Tuinbouw Organisatie, LTO) expects an increase in dairy production of 15 to 20 percent in the coming five or six years. The Dutch government is wary of the consequences of complete abolishment of the milk quota. The Dutch state Secretary wants, in response to the Dutch public opinion, to prevent increased industrialization and uncontrolled intensification by making dairy farming a land-related activity. Therefore, Dutch farmers are only allowed to buy additional dairy cows when
additional pasture land is purchased. With this law, ‘Wet verantwoorde groei melkveehouderij’, the state Secretary wants to ensure that the amount of dairy cows that are fed by grazing is increased to 80 percent in 2020. This is especially a challenge for dairy farms that have more than 160 dairy cows (EenVandaag Economie, 31 maart 2015). In practice this law means that the milk quota is replaced by a phosphate quota which will entail that the amount of pasture land owned by the farmer determines how much manure (phosphate) a farmer is allowed to produce.

The increased scarcity of agricultural land, the stricter manure legislations, the abolishment of the milk quota and growth of the average Dutch dairy farm sizes enforce a trend towards efficient and intensified dairy production. To keep dairy production profitable Dutch farmers are forced to increase their productivity and standard output. This creates a change in the planning of the Dutch average farm. In 2013 the average Dutch dairy farm comprised 49 hectares of agricultural land and 151 dairy animals. This is an increase in both size and dairy cattle from over 40% from 2000-2013. This intensification also increased the labor factor input with 4.1% (CBS, 2015). According to the LTO, the Dutch farmer association, the average Dutch dairy farm in 2020 will be a family-owned business with more than 200 dairy cows (LTO, May 18, 2011).

All these trends and developments together teach us that intensified dairy farming is possible if provided on a sustainable basis. Both the suitable Dutch climate and the law, on the land-based character of Dutch dairy production, ensure that developing efficient grazing strategies are worthwhile to intensify dairy production. However, the question remains whether this is also the case for other countries with other legislations and climatic conditions.

4.5. Knowledge exchange
Most Dutch dairy farmers are members of farmer cooperatives, within which milk is sold to milk-processing plants owned by that specific cooperation. Such memberships guarantee security, ensure that a good price is paid for the milk and are an investment for next generations (NZO, 2015). Besides these cooperatives there is one large Dutch overarching farmer association, the ‘Land- en Tuinbouw Organisatie’ (LTO). The LTO is concerned with knowledge transfer from knowledge institutes to farmers via entrepreneurial networks (LTO, 2011). As for each sector in the Netherlands, the dairy farm sector also has several lobby and advocacy networks for Dutch dairy farmers, of which the largest is the ‘Nederlandse Melkveehouders Vakbond’ (NVM). The NVM ensures an environment in which dairy
farmers earn enough to sustain their families by advocating the rights of the Dutch dairy farmers.

The Dutch dairy sector also contains a lot of knowledge. The Dutch dairy sector exports not only dairy products, but also this knowledge and the technology. Dutch dairy farmers take this knowledge and technology abroad by starting up farms in different countries (NZO, 2015). This knowledge is often used to implement and boost agricultural projects in developing countries, like Ethiopia. This strong emphasis on knowledge exchange among Dutch dairy farmers gives room for debates about feeding strategies and provides a learning environment for adapting grazing strategies in such a way that it increases efficient dairy production. In the next paragraph these Dutch debates and lessons are discussed.

4.6. Dutch dairy farming: towards a grazing future

4.6.1 Zero grazing or grazing: the Dutch debate

In the Netherlands - as in other countries worldwide - there is a debate going on about whether it is better to keep dairy cattle outside to graze or to use zero grazing and keep cows indoors. Nowadays the debate in the Netherlands is provided with new impetus, due to the abolishment of the milk quota, stricter environmental legislations and the trend towards intensified dairy farms, as described above. The advantages and disadvantages of the different feeding strategies have already been touched upon; most arguments in favor of grazing are based on animal wellbeing and the natural situation, while shed feeding seems to be more efficient considering nutritional intake and dairy production (S. Oosting, personal communication, June 3, 2015; B. Wouters, personal communication, June 8, 2015).

Both grazing and zero grazing in the Netherlands are developing towards more efficient dairy production. However, there are also movements to counter the trend in favor of zero grazing. Dutch researchers, the Dutch government and Dutch dairy farmers together are creating practical tools to make grazing as efficient as possible, in such a way that grazing is of additional value for dairy production. Whether any farmer in general decides in favor of grazing or zero grazing to increase their dairy production is based on several economic, ecological, social, legislative and other factors (see Figure 2 in Chapter 3). However, Dutch farmers specifically tend to base their decision on: economy, labor, civil society values, personal values, animal wellbeing and dairy production (B. Wouters, personal communication, June 8, 2015; Koe en Wij, 2007b).
4.6.2 Lessons learned from adapting grazing strategies on Dutch dairy farms

One of the projects that aims to create awareness about the possibilities for efficient grazing on farms in the Netherlands is the ‘Koe en Wij’ project. The project provides practical knowledge on how grazing can support the efficiency of Dutch dairy farms. ‘Koe en Wij’ shows the different possibilities and difficulties for grazing occurring on different farms with different management strategies. The difficulties faced in the ‘Koe en Wij’ experiments are discussed to assess whether grazing is an option on high production farms (more than 9500 kilos of milk per cow) and farms with small plots. Additionally the effects of grazing for farms with Automatic Milking Systems (AMS) and large herds (more than 100 cows) are discussed.

In their evaluation, the group ‘high production’ mostly faced difficulties in keeping the production constant and of high quality, maintaining the quality of the grass and the irregular digestion and nutritional values because of changing weather conditions (Koe en Wij, 2007a). To keep the production high, extra feeding of silage or roughage is needed. However, there are extra costs for this and they might rise to such levels that it is more profitable to accept that the production is decreasing. Therefore, a possible solution for a high production farmer that practices grazing, would be to use occasional or ration grazing. This would keep the grass of the same quality and it would ensure that the plot remains in a good condition.

The second group, the farmers with a small plot, faced several challenges that also appeared with the other groups and which can be summarized as labor-/management- and economics-related issues. Furthermore, they faced difficulties due to the weather. The weather influences the mowing possibilities and the nutritional value of the grass. When rainfall rates are high the nutritional value of the grass decreases and the plot is easier trampled. The weather also influences the amount and kind of additional feeding required to supplement the grazing diet. When the weather gets warmer and/or the grass wetter the importance of structured feed increases, since the quality then decreases. Another difficulty faced by the group with a smaller plot was the fact that the land was easily trampled. This issue can be solved by creating better drainage, so the plots will become less muddy and vulnerable when it rains. Another solution is to create a bigger plot through trading or exchanging land. An unexpected consequence of this kind of grazing was a high amount of urea in the milk, which could be cured by additional feeding of maize and by spreading the chemical fertilizer in two shifts (Koe en Wij, 2007b).
The spokesman of the third group, the farmers with a large herd, states that the farmers invented several solutions for the problems they encountered with grazing. To solve the problem of trampling of the land, a first solution the farmers decided upon was to harden the dikes and widen the entrance to the field. Another solution were to use mobile water troughs, so that cows do not constantly gather on the same spot. The participating farmers in this group valued a well-conditioned plot higher than keeping cows outside day and night. Therefore, decreasing the amount of hours outside was found as a solution for trampled land as well, especially in wet periods. The second problem, land availability, was dealt with in several ways. One solution was draining of ditches between parcels. However, this is not always allowed or possible. Another solution was opening up more parcels at the same time and thus give cows more freedom. A problem with this solution is that there needs to be enough land available. A third solution was found in lesser hours of grazing and more additional feeding. The disadvantage of increased amounts of additional feeding is, as discussed above, that it costs more.

The fourth group, with an Automatic Milking System, was mostly curious whether or not grazing would be economically beneficial for them. In the Dutch situation, it turns out that it indeed is. Another focus of this group was the labor intensity. However they could not really find a significant difference, some aspects take more time, others less. In general, grazing seemed to take a little more time than zero grazing. Farmers with an AMS system value regulated milk times and therefore sheds needs to be easily accessible. Structured additional feeding is thus necessary to keep them moving, as well as a constant quality of grass. This can be provided through stand grazing or strip grazing. However, to maintain the grass quality, regular mowing is and remains necessary (Koe en Wij, 2007c).

4.6.3 Practical tools

The experiments in the ‘Koe en Wij’ project show that grazing, with some additional adaptations, can increase the dairy production, the economic efficiency and still meets the needs of both the farmers and the wishes of civil society. However, in practice, only a few farmers seem to reach this, so to put these lessons into practice a completely new adapted management system is needed (Pol-van Dasselaar et al., 2013). To make a start with this, nine variables that influence efficiency need to be taken into consideration:

1. Grass intake
2. Additional feeding
3. Parcelling
To achieve an efficient, profitable farm by using grazing techniques, all these aspects should be taken into account and taken care of. However, the grass intake and management are most emphasized, because when the grass intake is not optimal and the cows are fed too much, there are unnecessary extra costs for additional feeding. This on its turn is connected to the way the land, the cows, the grazing is managed (WUR, 2012; WUR, 2013; Pol-van Dasselaar et al., 2013). So in short, to make grazing more profitable than zero grazing, a lot of adaptations should be made. The nine influences on efficiency need to be taken into account and a precise management and planning is necessary.

Besides practical tools that enhance the economic efficiency of grazing, the Dutch civil society also plays a significant role in the success of grazing. FrieslandCampina, a Dutch company that produces dairy products, highly values grazing and decided to pay a little extra per liter of milk produced by a cow that has been grazing. This extra money is meant to compensate and stimulate farmers to let their cows graze during the grazing season, despite the lower milk production (R. van der Meulen, personal communication, June 14, 2015). The lower production rates and the economic consequences it has for the farmer can be taken care of by the entire dairy production chain. For example, whereas first FrieslandCampina (or another dairy company) pays extra money to the farmer, they then deliver for more money to supermarkets and supermarkets can ask their customers a higher price. Another actor in the chain, as mentioned before, is the Dutch government which - by environmental legislations, subsidies and laws - can ensure that the land-based character of the Dutch dairy sector is maintained and/or stimulated. Civil society organizations and the different farmer organizations, advocacy networks and lobby groups have an important role in supporting policies and creating awareness (Koe zoekt Wei, 2005).

4.7. Conclusion
Although, it is generally assumed that dairy production decreases in a grazing system, compared to a system in which cows are kept indoors, there are plenty of solutions to keep the production at high and sustainable levels. One new strategy, drawn from the lessons learned,
to ensure same levels of total production is siesta grazing. Van Duinkerken (2002) conducted a two year research in which siesta grazing was compared to traditional grazing by looking at the differences on a farm, the Waiboerhoeve in the Netherlands. It turned out that both the grass intake of cows and the milk proteins increased leading to an increased milk production of almost a liter per day per cow.

In order to use grazing as a strategy to enhance dairy production in the Netherlands, some adaptations need to be made, both on the farm and the management level. Grazing can be an efficient and cheap solution to increase the dairy production, however only if there is enough land available and a good management system. If not, it becomes expensive, inefficient and farmers would lose a lot of grass (B. Wouters, personal communication, June 8, 2015).
5. Dairy farming in Ethiopia

5.1. The Ethiopian context

The Federal Democratic Republic of Ethiopia (FDRE) is a country in the Horn of Africa. A key characteristic of Ethiopia is the wide variety of altitudes. These altitudes strongly determine the distribution of the country in different climatic zones and thus the crop availability, growth, natural vegetation and rainfall which in turn influences the land suitability for different farming activities. Middle and higher altitudes (>1500m) receive greater rainfalls than the lowland areas (up to 900mm per year) resulting in a multitude of agro-ecological zones suitable for varying farming systems. Ethiopia’s agricultural sector plays a central role in its economy, as 80-85 percent of the Ethiopian population is employed in agriculture (FAO country profile, 2015).

5.2. Dairy production in Ethiopia

Demand for milk is increasing in Ethiopia. USAID (2010) states that the current demand for dairy products is 17 liters per capita/per year and projects that this demand will grow to approximately 27 liters by 2027. According to the CIA’s World Factbook (2015), Ethiopia displays a population growth rate of nearly 3 percent per year, which places the country on the 14th position on the world ranking list. As mentioned in the introduction, Ethiopian dairy farmers experience problems to meet the demands from the market for high quality milk. On the one hand they struggle with getting high quality fodder (and currently rely on fodder of unknown and disputable quality), and on the other hand they face managerial problems because of a lack of knowledge on specialized dairy farming.

Three milk production systems can be identified in Ethiopia; urban, peri-urban, and rural systems. The urban and peri-urban system are found near Addis Ababa and surrounding towns, which allows the farmers participating in these systems to take advantage of the urban markets (Yilma, Guernebleich & Sebsibe, 2011). Together, these systems produce 35 million liters of milk annually. In these systems, large and small scale (usually privately owned) farms can be found. Often grade and/or crossbred cattle are used, which can produce between 4 and 9 liters of milk (measured over a 279-day lactation period) (Ahmed, Ehui & Assefa, 2004). Most of the milk from this production (73%) is sold to the formal and informal markets. Of the rest, 10% is consumed within the household, 9.4% is used to feed calves and 7.6% is processed to butter and cheese (Ahmed et al., 2004). A great majority of the producers sells the milk directly to the consumers (Yilma et al., 2011). In the area of Sululta the urban, peri-urban and rural system exist next to each other. However, the urban system is
intensifying to respond to the increased demand of milk in Addis Ababa (G. Mengistu, personal communication, June 17, 2015). The rural systems, on the contrary, are more focused on subsistence farming. These rural systems include pastoralists, agro-pastoralists and mixed crop/livestock producers, and are mainly found in the highlands (Yilma et al., 2011). This system is not oriented towards the market and most of the milk is consumed at home or spread between neighbors, since it is not customary to sell the milk. This practice is mostly influenced by religion and tradition. A possible surplus is processed into Egro, butter, ghee and/or Ayib using traditional technologies and marketed through the informal market (Ahmed et al., 2004). The progress that the milk sector has made in the past century is mainly due to technological intervention, policy reforms, population growth and expected growth in incomes (Ahmed et al., 2004). Data suggests that the demand for milk will increase in the near future, at least in urban centers and among people with high purchasing power in the lowlands. In these areas, all segments of the population consume dairy products. This is in contrast with the highlands, where the main consumers are children and some vulnerable groups of women (Ahmed et al., 2004). However, milk is not consumed every day of the year. Large, orthodox, parts of the population fast for up to 200 days per year. During these periods, milk is not consumed. In order not to let the milk perish, it is processed into butter and cheese (A. Duncan, personal communication, June 4, 2015). Next to the impact on the levels of consumption, this extended fasting period also has an impact on market prices (H. Teuben, personal communication, May 29, 2015). The market prices are thus very unstable and therefore can negatively affect the income of the farmer.

It is expected that predominantly the urban sector will respond to the increased demand for milk and other dairy products. However, according to Ahmed et al. (2004), the small scale household farms in the highlands hold most of the potential for dairy development.

5.2.1 Developments in the dairy sector
The Ethiopian government has made a shift towards market economy and liberalization policies in the last 50-60 years, which had a great impact on the dairy market (Ahmed et al., 2004). Starting with the imperial regime, that lasted from 1960 to 1974, an almost free market economic system was maintained. Within this, the emergence of 'modern commercial dairying' was possible. The start of this ‘modern commercial dairying’ was possible because the country received an amount of dairy cattle from the United Nations Relief and Rehabilitation Administration (UNRRA). At the same time, the government established
various milk processing and market facilities to help develop increased dairy production. There was especially rapid development in and around Addis Ababa during the second half of the 1960s, which was mainly a result of both expansions in large private dairy farms and the inclusion of smallholder producers. Additional reasons for the increase in milk production can be found in policies implemented during this regime, like (scale production), marketing, subsidies in transport to the market, secured land tenure and an active free market for feed and other inputs needed by dairy farmers. In 1966, the Ethiopian government established the Addis Ababa Dairy Industry to control and organize the collection, processing and distribution of locally produced milk. Few years later, the Dairy Development Agency (DDA) took over these tasks (Ahmed et al., 2004).

During the Dergue regime, from 1974 to 1991, the central economy was emphasized. State farms were the focus of the government policies. In 1979, just 8 years after its establishment, the DDA was merged with some dairy farms into the Dairy Development Enterprise (DDE). The main goal of the DDE was to shift the focus from the urban towards the rural producers. Tasks to reach this goal included the operation of state farms that had been nationalized, establishing several milk collection networks, to process and market these collected dairy products, providing advice and technical services to farmers and lastly sell veterinary medicine and feed to farmers (Ahmed et al., 2004).

Since 1991, the government aims at market liberalization, with the help of structural adjustment programs. It is focused on creating more and better access to markets for smallholder farmers, which in turn could stimulate them to increase their production (Yilma et al., 2011). The private sector has gotten a bigger role during this phase, taking over some activities from the government. Milk marketing and processing services are now controlled by dairy marketing cooperatives. They buy milk from both members and non-members of the cooperative, process it and sell the products to traders or local consumers (SNV, 2008).

Remarkably, during each of the phases described above, the focus of the government was on the improvement of the milk production. By introducing improved feeding and breeding and health programs, the government tried to increase the income of dairy farmers. Not much attention was given to the marketing and processing of the dairy products. The government focused their efforts on input (Ahmed et al., 2004). These policies did (directly and indirectly) influence the dairy sector, with changes in macroeconomics and the orientation of development efforts, but also household income, tenure and land policy (Ahmed et al., 2004).
5.2.2 Livelihoods and resources

Households in Ethiopia are often described as mixed crop-livestock farming systems. In this system, the household both has livestock and produces crops. The focus in Ethiopia is on crops, but they mostly own cattle to plough the land. The liters of milk that the cattle does produce, is mostly consumed at home or given to neighbors. It is hardly seen as a source of extra income (Tegegne, Gebremedhin, Hoekstra, Belay & Mekasha, 2013). A benefit of this mixed farming system is that the forages to feed the animals can be grown on the farm, so there is no need to go to the market to purchase feed (Ahmed et al., 2004). The total cattle population in Ethiopia is estimated around 49.3 million, highest for the entire of Africa (Gebremedhin, Pender & Tefsay, 2002), despite the decrease in livestock between 1972 and 2006 due to limited fodder resource (Assefa & Hans-Rudolf, 2015). However, the amount of milk produced by these households is limited because they are largely dependent on indigenous breeds, who produce far less compared to non-native or crossbreeds. This native Zebu produces about 400-680 liters of milk/cow per lactation period.

Most often, household resources include family labor, a limited piece of farmland and some livestock assets (Gunte, 2015). Livestock and its products are important sources of daily consumption - both in milk and meat - for these local farmers and their families (Melesse & Jemal, 2012). But that is not all, the animals can also be seen as cash income, draught power, insurance or store of wealth for the household. The animals’ production is in rare cases sold, but often they are used for work on the land. When needed, the animals themselves can also be sold. So the livestock can also be seen as a piece of wealth or insurance policy for when the family no longer has another source of income.

Different (new) dairy technologies and policies can have significant impact on the livelihoods of these local farmers. Consider household income, nutrition, food security, health care and access to education (Melesse & Jemal, 2012). On the other hand, it is very difficult for smallholders to gain access to and participate in the dairy market. This is due to bad infrastructure and because it entails investments, that not every farmer can make. Duguma, Tegegne & Hegde (2012) found during research in the Ethiopian highlands that farmers saw feed shortages, the prevalence of diseases, labor scarcity and lack of capital as their major constraints. Possibilities to improve these limitations could be found in the introduction of milk collection points, milk groups and/or cooperatives. These have already been started in some regions, like in Debre Zeit. However, they are often still hours away for many milk producing households (Ahmed et al., 2004).
5.3. Climate & Land

5.3.1 Climate

Different actors argue that Ethiopia holds great potential for dairy production due to the favorable climate and a disease-free environment, mainly in the highlands (H. Teuben, personal communication, May 29, 2015; B. Wouters, personal communication, June 8, 2015; Ahmed et al., 2004; Yilma et al., 2011). The climate in the highlands is good for indigenous breeds of cattle, but also for imported or crossbreeds. The climatic conditions also offer possibilities for the cultivation of feed for dairy cattle, however there is a lot of fluctuation in the weather conditions (Melesse & Jemal, 2012). Ethiopia is annually faced with a long rainy period, which starts around June/July and ends when November nears. The following dry period sometimes extends up to 6 months (A. Duncan, personal communication, June 4, 2015). Due to the fluctuating weather conditions there is not always sufficient quantities or nutritional quality feed, which is not good for dairy cattle because they need a constant daily supply of feed (A. Duncan, personal communication, June 4, 2015). If the supply of feed and/or the quality of the feed is low, the dairy production is also limited. When feeding is mostly based on fodder and grass, the amount and quality of feed is dependent on the weather conditions (Ahmed et al., 2004).

Overall, there is still a lot of room for improvement of the livestock productivity, mainly on improvement of the nutritional value of the intake of the dairy cattle. Ahmed et al. (2004) argue that this improvements can mainly be found in the adoption of sown forage and improved forages and better crop residue management.

5.3.2 Availability of land and tenure systems

Different scholars argue that the volume of pasture lands is decreasing in Ethiopia as a result of the increasing population (A. Duncan, personal communication, June 4, 2015; Yigezu, 2003). Another reason for the increased scarcity of land is the leasing of land by (foreign) investors (Abbinck, 2011). In 1975, as part of the 'new' constitution, all land was nationalized and redistributed. The present government's' constitution of 1994 continued this and added that land cannot be sold or exchanged by any other party than the government itself. Land can be leased from the government, also for long periods of time for commercial farming purposes (FAO, 2004; Ahmed et al., 2004). When this land is leased it becomes heritable. Within this policy, the farmers are also allowed to rent plots of land, hire labor and make sharecropping arrangements.
The average landholding per household is 2.5 hectares, but this varies per region. The biggest part of this land (63%) is used for crop production, and smaller parts for grazing land (28%) and hay- and pasture land (17.6%) (Duguma et al., 2012). Usually the better parts of this land is used for cropping, and the other parts for grazing (S. Oosting, personal communication, June 3, 2015). Due to the growing of staple and/or cash crops there is already a lot of pressure on the land, therefore, the livestock herders tend to depend on natural pastures and common grazing areas for the feeding of their cattle (Ahmed et al., 2004). The livestock herders do not lease the land, as they see it as communal grazing land. The cattle of different farmers graze together during the day and by night the farmers bring their own cattle inside (R. Wassink, personal communication, June 3, 2015). The FAO (2004) argues that the communal grazing policies lead to households keeping livestock beyond the carrying capacity of the grazing land, which in turn damages the pasture land and contributes to a dairy production.

5.3.3 Land degradation

As shown above, communal grazing lands are important sources of feed for dairy cattle in Ethiopia. There is collective action that aims at managing these lands in a sustainable manner, most of which is locally initiated and organized at the village level. Despite these efforts, grazing lands are facing severe degradation, especially in the northern parts of Ethiopia (Gebremedhin et al., 2002). Low agricultural production together with population growth have resulted in the conversion of forest and grazing land to cultivated land on great scale. In the past, farmers used to irrigate the grazing lands, but this practice ceased completely when the grassland was converted into cultivated land.

Nowadays, the use and management of grazing lands is based on rainfall patterns. During the dry period most dairy cattle graze along the lake shores. During the rainy period the dairy cattle is fed at the farm, because the shores often flood. In the highlands farmers face more problems with degradation of the grazing land. The common practice is to allow dairy cattle to graze the forestlands when there other options are no longer available. Both at the end of the dry season and at the end of the main rainy period, elders of the communities close the communal grazing lands. After the rainy period it is strictly forbidden to either cut the grass or to let the cattle graze on it. At the end of September, the grazing lands are reopened. In the meantime, these regulations allow regrowth of sufficient grass and protects somewhat against deterioration of the land. The regulations show that the Ethiopian people are aware of
land degradation and seek for ways to efficiently manage the available land in order to prevent a tragedy of the commons (Assefa & Hans-Rudolf, 2015).

5.4. Feeding strategies in Ethiopia – grazing
The majority of Ethiopian farmers are smallholders who cultivate 95 percent of the total grazing and browsing land in Ethiopia, which is estimated to be 61,000,000 – 65,000,000 hectares. Smallholders are farmers who produce relatively small volumes on small plots of land, usually family oriented (ETI, 2005). To feed their cattle, Ethiopian smallholders do not only resort to grazing, some also rely on purchased fodder only (zero grazing strategy) or use mixed forms of farming (crops and cattle) (FAO country profile, 2015; S. Oosting, personal communication, June 3, 2015; Mekonnen, Dehnine et al., 2010). These farmers possess approximately five cows which leads to low outputs of milk.

An advantage of grazing as a feeding strategy in Ethiopia is that it is relatively cheap compared to zero grazing because farmers need to buy only few additional feeding supplements and they have access to communal grazing lands. On the other hand, a disadvantage of grazing as a feeding strategy is that the amount and quality of feed intakes of the cattle are low as the quality of the grass heavily depends on the amount of rainfall. In some periods of the year the amount of nutrients are quite low which results in a lower quality of the milk. Grazing might cause environmental degradation in case the use is not regulated between the farmers. Especially on communal lands the cows can put a lot of pressure on the land. Furthermore, farmers are dependent on the rain season as in some periods of the year the cattle cannot graze outside due to the rain (A. Duncan, personal communication, June 4, 2015).

In the proceeding of this paragraph two farms will be described on which grazing is applied on a large scale. The first farm described is the Dutch ‘Grazeland’ farm in Ethiopia and the second is the farm of Gadisa, an Ethiopian farmer. These examples illustrate grazing in Ethiopia and the differences between a Dutch and an Ethiopian farm.

5.4.2 Grazeland farm
The Grazeland farm is a Dutch owned dairy farm in the Sendaba valley, which is located forty kilometers west of Addis Ababa and eight kilometers from the city Ginchi. The farm has been established in 2013 by Geert. and Marleen Wassink in cooperation with Harry Teuben, manager and owner of Okekoe a company specialized in cattle breeding, natural farming and natural grazing in the Netherlands, and Hendrik Troost, financer of the project. The Wassink
family runs the farm in Ethiopia. An important aim of Grazeland is the application of modern dairy/ecosystem knowledge and this shows in the restoring of the natural cycle of soil fertility. This will be done by maintaining a dense vegetative cover on the soil, improving the distribution of nutrients on fields, and improving the water supply for plant production. Another aim of Grazeland is to become a model farm for local farmers by creating a Farm Business Center. This Farm Business Center is going to provide trainings and loan farming material to local farmers (H. Teuben, personal communication, May 29, 2015). The Grazeland farm will also establish a milk collection point which is aimed at connecting the local farmers to the market by collecting their milk and selling it to Holland Dairy (Teuben, Wassink & Troost, 2013). Grazeland works together with Holland Dairy, a Dutch company located in Debre Zeit which collects milk of farms and sells it to the market.

In 2013 the Grazeland farm received permission from the Ethiopian government to lease 128 hectares of land in the Sendaba valley. At the moment the Grazeland farm comprises of 75 Holstein Friesian cows which have been imported from the Netherlands. Wassink aims to increase the amount of cows to 200 in the coming years. At this stage, the stables of the Grazeland farm are partially completed and 25 local employees are hired (H. Teuben, personal communication, May 29, 2015). The project received a Private Sector Investment grant from the Dutch Ministry of Foreign Affairs.

According to the Private Sector Proposal of Grazeland their strategy applied is a combination of ‘back to basics’ (natural system, small scale farmers) and modern dairy/ecosystem knowledge (Teuben et al., 2013). This strategy entails large scale free grazing and improving the grassland by restoring the soil fertility. The establishers of Grazeland value the advantages of free grazing over the disadvantages. According to Wassink, Teuben and Troost this feeding strategy fits better to the Ethiopian context compared to zero grazing. This because it is the traditional feeding strategy and many smallholders still use grazing (H. Teuben, personal communication, May 29, 2015). According to them grazing increases the quality of the milk as the cows are healthier. When grazing is applied cows tend to get less diseases compared to zero grazing. Furthermore Wassink, Teuben and Troost consider grazing as a cheaper possibility compared to zero grazing as less supplements need to be bought (H. Teuben, personal communication, May 29, 2015).

The response of local farmers to this project varies enormously. Some of the local farmers see opportunities for connecting with the Grazeland farm while others respond
negatively. The opportunities seen by local farmers are mostly focused on employment possibilities and knowledge exchange. The Grazeland farm already has 34 local employees, and this number is likely to increase in the coming years. Some local farmers are curious what new technologies Grazeland has to offer and are eager to learn from them. They visit the farm to see which techniques they like and whether they can implement these on their own farms. On the contrary, there are also farmers who responded suspiciously to the establishment of the Grazeland farm (R. Wassink, personal communication, June 3, 2015). Some local farmers destroyed the fences and one farmer sued the farm. These farmers were not content with Grazeland leasing an huge part of their communal grounds. According to Teuben, the attitude of the local population towards Grazeland is improving as local farmers are regularly invited to the farm and meetings are often held with the elderly of villages nearby, thus establishing closer relationships (H. Teuben, personal communication, May 29, 2015).

5.4.3 Gadisa’s farm
Gadisa is an Ethiopian farmer in Ambo, west of Ginchi, who is one example of a farmer that has a progressive attitude towards change and development. For several years Gadisa has been using Holstein Friesian cows and mainly uses grazing as a feeding strategy. He supplements concentrates, additional straw and different cereals. The cows of Gadisa do graze more compared to zero grazing but less compared to local smallholders. The cows of Gadisa produce 12-16 liters milk per day (R. Wassink, personal communication, June 3, 2015).

5.5. Feeding strategies in Ethiopia – zero grazing
An increasing amount of Ethiopian farmers intensify their farms and choose to apply zero grazing as feeding strategy for their cattle. According to Duncan (ILRI) advantages of zero grazing in Ethiopia are that the productivity tends to be higher because food intakes are better controlled by the farmer. Furthermore, zero grazing is less labor-intensive which enables household members to engage in other activities or to follow education. Duncan thinks that zero grazing is the way forward for the dairy industry in Ethiopia. This because due to the extensive rainy period in Ethiopia the soil is not suitable to keep the dairy cattle outside. However, if dairy cattle is kept inside, improvements in feed conservation during the rainy period are required (personal communication, June 4, 2015).
To illustrate how zero grazing is used to increase dairy production in Ethiopia two case studies will be described. The first is a Dutch farm in Ethiopia, the Alfa Fodder and Dairy farm and the second is an Ethiopian cooperative farm in Ginchi.
5.5.1 Alfa Fodder and Dairy farm

The Alfa farm is a dairy farm established in 2008 by Bert Flier in Debre Zeit, Ethiopia. The aim behind the establishment of the Alfa farm is that the farm could contribute to economic development in Ethiopia by doing business in an underdeveloped sector. At the moment the Alfa farm has 115 Holstein Friesian cows, imported from the Netherlands. Together these dairy cows produce 2760 liters of milk per day, which is sold to Holland Dairy. The establishers of the Alfa farm lease 85 hectares of land from the Ethiopian government and have 34 Ethiopian and 4 Dutch employees. The Alfa farm produces corn silage, which they use to feed their dairy cattle. Besides their own use of corn silage, about 7000 kilograms of corn silage is provided to the local farmers in the surroundings.

To reach the goal of supporting the local population the Alfa farm desires to be a model farm for the farmers in the area. They aim to realize this by provision of trainings. Until now, Alfa has provided two trainings to discuss the hygiene, milk quality, breeding and management (Alfa Fodder and Dairy Farm, 2012). Further research on this farm could be helpful to understand the reasons behind the choices they have made.

5.5.2 The Ginchi cooperative

In the area of Ginchi, as in many parts of Ethiopia, the dairy market is not very well developed yet. There are milk companies that collect the milk, such as Holland Dairy, but these only collect large amounts of milk. If farmers cooperate and collect their milk together the accessibility to the dairy market is increased. In order to get and maintain this access the Ginchi cooperative was created. The farmers of the Ginchi cooperative believe that dairy production can be increased by farmers and that this production can turn out to be very profitable in the future. Ginchi cooperative recognizes that there is enough demand to sell milk. The cooperative consists of 46 Ethiopian farmers. By cooperating the farmers can discuss techniques, lower their expenditures, improve their market position, increase revenues and stabilize milk production. Currently, the techniques to increase dairy production implemented by the farmers mainly emphasize the straw supply and the increased use of concentrates. Therefore, the Ginchi cooperative also provides concentrates, trainings, a milk collection point and an assurance of milk marketing.

All the farmers of the Ginchi cooperative apply zero grazing, because this is considered to be more efficient and thus resulting in higher incomes. According to these farmers it is more efficient to keep the cattle in the compound as they can control their intakes and learn how to increase the output. The disadvantages of grazing are, in their opinion, the
increased risk of diseases and the low quality of the grass. The leader of the Ginchi cooperative stresses that farmers need to cooperate in order to have a strong market position. This strong market position is necessary to increase their knowledge base and to increase their milk production (R. Wassink, personal communication, June 3, 2015).

5.6. Local knowledge

5.6.1 Knowledge construction

In the Ethiopian culture, ‘seeing is believing’ is an important aspect in gaining trust in new technologies (H. Teuben, personal communication, May 29, 2015). Most local farmers do not perceive knowledge as valid till they see with their own eyes how it works and if they like the way it works (A. Hailu, personal communication, June 16, 2015). The traditional way of knowledge construction of local Ethiopian farmers took place by sharing experiences with other farmers (R. Wassink, personal communication, June 3, 2015). One way to enhance this process of knowledge construction of new technologies might be to invite local farmers and show them the new technologies, as was done on the Grazeland farm. Which resulted in an increased understanding of the local farmers and a more open attitude towards these interventions (H. Teuben, personal communication, May 29, 2015).

According to Duncan, Ethiopian farmers have limited knowledge on improved dairy farming techniques. There is not much planned feeding of the cattle and not much conserving of feed for times of scarcity. Local farmers state they require training in animal husbandry, animal housing and animal feeding (A. Duncan, personal communication, June 4, 2015). In order for these trainings to be successful, the new techniques and theories need to be shown to the local farmers to increase their trust.

5.6.2 Response to interventions

Factors that influence the response of Ethiopians can be divided into three categories: social, economic and cultural. Smallholder farmers living in the rural areas are often illiterate and have not been trained and/or educated. In general, they have a conservative attitude and do not see the need to change as their way of farming works for them. However, a new generation of young, educated farmers emerges in Ethiopia (G. Mengistu, personal communication, June 17, 2015). An increased level of education leads to a more open attitude towards interventions and educated farmers tend to respond more positive compared to illiterate farmers (Mekonnen et al., 2015). Another cultural aspect is that it is culturally not accepted to sell milk. A smallholder only produces a small amount of milk, the rest of the produced milk is given to
their neighbors. This milk is seen as a favor and does not require payment. Furthermore, religion plays an important role in the Ethiopian culture, as was mentioned earlier in the chapter. During the fasting period the orthodox Christians are not allowed to drink milk which leads to a fluctuating demand and an unstable dairy market. This instability of the market influences the conservative attitude of some Ethiopian farmers towards interventions in the dairy sector (R. Wassink, personal communication, June 3, 2015). Ethiopians that have a conservative attitude towards intervention state that it is caused by a lack of a proper functioning institutions. A solution for these fears of the farmers can be found in creating dairy collection points. This could provide an answer to the fluctuating demand, because these collection points enable milk to be conserved for a longer period of time. In this way the milk can be sold when the demand rises again.

Another aspect that influences the response to interventions by external factors is the language barrier (G. Mengistu, June 17, 2015). The farmers of international farms, such as Grazeland and Alfa cannot directly speak to the local farmers and require a translator. This language barrier can create distance between local farmers and the international farmers, which in turn may lead to a lack of trust and a more suspicious attitude towards interventions. The problems with the language and the rate of illiteracy do not enhance the dissemination of knowledge regarding interventions. When this language barrier is not taken care of it can lead to situations in which local Ethiopians are not aware of interventions and therefore are not able to respond to them.

The response of local farmers to interventions is also influenced by their accessibility to resources such as capital and labor. Farmers who have less access to resources will probably be less open towards interventions and new technologies. This access to land and property rights are significantly influence the attitude towards interventions. Farmers who do not have assured access to their land will be less open towards interventions in dairy farming (A. Hailu, personal communication, June 16, 2015).
6. Implementation

This chapter provides information on implementation by touching upon both theoretical and more practical aspects of implementing a dairy-related project in Ethiopia. The first part of the chapter consists of theories on technology, adoption, niche management and boundary work. It can be very helpful for innovators to have an overview of those different theories and keep them in mind when further developing their innovation strategies. The second part of this chapter develops a cross-fertilization between the information from the research on Dutch and Ethiopian dairy farming and ends with a practical advice on possibilities for using Dutch farming knowledge in the Ethiopian context.

6.1. Theory

6.1.1 Technology and knowledge

When people plan to implement an innovation, it is often accompanied by a technology. To be able to say something about the implementation of those innovations and the strategies that can be used, it is important to first understand what a technology exactly is. “If definitions of the term ‘technology’ are collected from different disciplines, it is immediately apparent that they differ significantly in the elements that comprise them” (Fleck & Howells, 2001, p.543). Fleck and Howells (2001) have looked into the different elements that can be found in the definitions and developed a technology complex. From this they developed the most overarching definition of technology namely: “knowledge and activities related to artefact” (p.525). This means that technology is not only about the material aspects but also includes the knowledge and activities that actors have in relation to the material part. Technology thus consists of both hard (material) and soft (knowledge/activities) aspects. It is especially important that the soft aspects are understood and valued as much as the hard aspects, if they should not be valued even higher. Akrich (1992, p.205) explains this well by stating that “machines and devices are obviously composite, heterogeneous, and physically localized. Although they point to an end, the use for which they have been conceived, they also form part of a long chain of people, products, tools, machines, money and so forth”.

The human aspect becomes even more visible if you describe the material aspects as also being able to consist of knowledge combined with the real physical material. Technologies can also exist of knowledge that has been built and expanded over time. When people have been doing something for a long time and have developed a lot of knowledge on how to do something, it also becomes a form of technology. This can for example be knowledge about how to feed a cow fitting the local circumstances. It is about a way of doing...
things, it is “the human capacity to make” (Jansen & Vellema, 2011, p.169). This would result in knowledge being one of the most important parts of a technology and the material only has to be one aspect in the whole definition. It is therefore important to focus part of this chapter on theories about knowledge in technology implementation.

Knowledge is often understood as being different between local and global. However, all knowledge should be seen as local. Because the technical knowledge from the implementers is often seen as of higher value it is also seen as a more general or global knowledge. It is good to keep in mind that all knowledge are local but that it depends on the size of the network in how generalizable the knowledge seems to be (Belt, 2001). The bigger the network that is involved with the knowledge the more universal the knowledge is perceived. Carr and Wilkinson (2005) stated about this that “in the past, farmers and scientists were seen as culturally different… knowledge was seen as either particular and local or universal and generalizable (ready-made-science model)” (p.257). The differentiation between local and global knowledge is still visible in the way some implementations are executed. This differentiation is exacerbated by the linear extension model which will be explained in the following section.

Technology implementers could feel that they have found the right answer for a certain problem. However, one has to question on what that feeling is based since the knowledge from these different groups can be seen as based on different grounds or be valued differently. Where the professionals are perceived as specialists in their knowledge field and seem to make sure that their research and solutions are verified, local ‘knowledge’ would be perceived as less professional by not having the ‘right’ type of verified knowledge. Van den Belt (2001) refers to technology development as something that should not be based on the level of ‘sophistication’ the different stakeholders have. All stakeholders can have knowledge, which can sometimes also be seen as a technology, and they all should be valued equally. The concept of knowledge should also not “carry with it the implication of ‘discovering the real facts’, as if they lay ‘out there’ ready for uncovering. Such a view is based upon an ‘objectivism’ which assumes ‘the world is composed of facts and that the goal of knowledge is to provide a literal account of what the world is like” (Knorr-Cetina as cited in Arce & Long, 1992, p.211). Knowledge is more context influenced and different kinds of knowledge can all have a truth in them.

Because of the, sometimes differently perceived values of knowledge it is important to look at the origins of the knowledge. Arce and Long (1992) explain that knowledge is based
upon different life-worlds and bodies of knowledge. “It is the result of a great number of decisions and selective incorporations of previous ideas, beliefs and images, but at the same time destructive of other possible frames of conceptualization and understanding. Thus it is not an accumulation of facts but involves ways of construing the world” (p.211). The authors explain that for implementations, different types of knowledge should be brought together because the knowledge of the peasant and the innovation implementers are inherently different.

DairyBISS could use this information in their innovation design and for better the communication with the locals in Ethiopia, because it puts the different actors on a level playing field. Understanding that their knowledge on feeding strategies is also a technology that can increase the relevance of that information in the developing phase and therefore better fit the project to the local context. Both the hard and soft aspects of technology should thus be included and it should be kept in mind that the local farmers knowledge is as much a technology as DairyBISS’ technologies/feeding strategies.

6.1.2 Complexity of extension models
In the past decades many attempts have been made to introduce innovations into different contexts. Innovations are mostly based on a linear extension model. In this model a technology would be packaged and brought to the people who would open the package and use it according to the instructions that are provided. Here it is visible that the general knowledge was considered to be the best knowledge and could be implemented in the local context without many problems (P. Hebinck, personal communication, June 12, 2015). The approach on implementing technologies can also be called technical determinism. “Technology can follow only one course, a single nonlinear path of development, which is dictated by its characteristic quest for maximum efficiency” (Belt, 2001, p.3). When looking at how technical determinism is valued it becomes visible that there are two opposite opinions on this. The first group is very optimistic about this view on technology implementation because they see that technological development is progress. When implementing a technology based on the ‘best knowledge’, the outcome will be better because it will improve the local situation. There is also a more pessimistic view, in which implementing technology can be seen as very dominant. Giving a certain package of technology with instructions of how to use it could be a way to control culture and does not leave any space for the locals to live their own lives (Belt, 2001; Robbins, 2007). P. Hebinck (personal communication, June 12, 2015) explained this by showing two different types of water bottles (for example a glass
and a plastic bottle). Even though the water bottles have the same purpose they are different because people have different values on specific parts of the technology. Trying to enforce one single water bottle to everybody because that is the ‘best’ version would not work because it would be seen as controlling what we use to drink our water.

It is important to understand both perceptions on technology implementation. Two important lessons can be learned from it that should be considered for DairyBISS trying to implement a technology (Robbins, 2007). First, new technologies often are created to improve efficiency. But efficiency is not something that can be seen as neutral, context-free and universal. It is important to always look at the context of where the technology will be implemented, the efficiency might be differently interpreted in that context. Secondly, technologies do not always follow a fixed path that can be decided upon beforehand. There will be different and alternative pathways for development that will interfere with the implementation strategy. The path that ultimately is chosen will not always be based on the highest efficiency or the best results. It is therefore important to understand that a linear implementation schedule might be more complex than thought when only looking at the end result, alternative courses or adaption could be very possible. The relation between the social and the technical plays a role in this. It is therefore good to look into the interactions between the technical and the social sides of technologies.

For DairyBISS it is important to keep considering other feeding strategies, especially the strategies used in Ethiopia are important because they might be based on a different idea of what is most efficient. The Ethiopian strategies are coping mechanisms for the local circumstances, these have to be acknowledged and valued highly in the plans of DairyBISS. It can be helpful if DairyBISS finds out how the local Ethiopian farmers view efficiency in their local strategies. Since farmers have their own reasons for choosing certain farming technologies those have to be taken into consideration throughout the development of the innovation technology. DairyBISS should thus also be careful to not develop a set package of innovation and keep the strategy more in the form of ideas instead of set manuals.

6.1.3 Relation between the social and the technical
Social construction of technology (SCOT) and actor network theory (ANT) are theories about the interaction between the technical and the social aspects of technology. Both theories will be shortly introduced and the important elements to consider when implementing a technology in a different context will be highlighted more extensively.
Social construction of technology

SCOT is one of many ways to look at the interaction between the technical and the social aspects of technology. This theory is critical towards technological determinism and gives explanation to how facts and the workings of technologies are constructed and not solely properties belonging to the technologies. Technologies are often understood as having set properties that can only be interpreted in that specific way by the actors working with the technique. There are different severities on how to include the constructed properties in this theory. The fist severity is about that it is necessary to include the context. The second severity can go as far as understanding the content of science and technology as socially constructed (Bijker, 2009). This explanation of SCOT will go mostly into the second severity about the content being socially constructed.

There are four key concepts in this theory. They could be viewed as the different phases within the implementation and dissemination of a technology. The first concept is about the relevant social groups. Different groups will be able to look at a technology differently and thus also give various meanings to the same thing. Secondly, the concept of interpretive flexibility comes into play. Because of these different meanings given to the same thing there is not one technology, but many different ones. For example, a bike might be about exercise for one and about transportation for the other. Thirdly, there is the concept of stabilization. This is where the different meanings converge. Lastly is the closure concept, where all the different meanings have become one and there is only one understanding of the technology.

Closure could have been different. This different closure connects with the criticism on linear expansion models as explained before. Pinch and Bijker (1987) explain this well by saying that “in SCOT the developmental process of a technological artefact is described as an alternation of variation and selection. This results in a ‘multidirectional’ model, in contrast with the linear models used explicitly in many innovation studies and implicitly in much history of technology” [...] “Of course, with historical hindsight, it is possible to collapse the multidirectional model on to a simpler linear model; but this misses the thrust of our argument that the ‘successful’ stages in the development are not the only possible ones” (p.28). What has been successful in the past might not be successful in the future and different constructions might change the pathways of the implementation.

For developing new technical implementation strategies it is important to keep in mind that a technology implementation is not a linear process (see previous section) but reflexivity
and understanding of the different meanings that can be given to a technology might increase the flexibility and ease the implementation process, possibly decreasing frustration when things do not go as planned (Robbins, 2007).

Another thing that SCOT puts on the map is that technology is not only socially but also politically constructed. This connects with the expertise of different social groups. Questions should be asked about which knowledges are involved and how they are valued and what influence this has on the implementation trajectory of the technology (Bijker, 2009). Because DairyBISS is working in Ethiopia they have to be especially conscious about the political construction of their technology implementation. Reflecting about the input and role of different people in the process and valuing all knowledge the same can help keep DairyBISS aware of this. For DairyBISS it is thus important to keep in mind that people give different meanings to grazing as a strategy. Remaining flexible about those different meanings in the extension of the project decreases the linear extension of the innovation and decreases frustration when implementation does not go as planned.

*Actor network theory*

The actor network theory focusses for a large part on the agency of technology. As stated before, technology is often understood as being value free and completely neutral. The technology focusses on the material, physical aspects of technology. ANT counters that view by explaining that ‘things’ can have agency. In the article of Joerges (1999) agency is explained by looking at the developments of bridges in Brooklyn, New York. They were built in such a way that the black population, traveling by busses, would not be able to go under the bridges but the white population, driving in cars, would be able to go under the bridges. This resulted in the exclusion of the black and/or poor population from going to the more excluded areas. It gave the bridge a form of agency. The bridge was enabling and disabling people to go to a certain area and with this allowing and enforcing certain behavior. The example shows that DairyBISS, who implements technologies, has to be careful about the different influences and power that could be embedded in certain aspects of the technology or the technology as a whole. These elements could be both intentional but also unexpected.

Even more interesting to keep in mind, besides the technology being capable to have agency, is the script of technology. Script has to do with translation of the technology. The people involved in designing the technology have to make a guide or description about how to use the technology. However, this guide or description will also have to be translated again by the people that are going to use the technology. It is an active role that different actors take
They engage with technologies and they keep interacting with it. In these interactions, these actors reshape artefacts and transform the understanding of their significance for society and how they can be used (Williams, Stewart & Slack, 2005). As it is implemented and used, the innovation continues. Williams et al. (2005) call this ‘innofusion’. A technology then becomes ‘domesticated’ when it is entirely adopted and incorporated within local practices, purposes and culture. Both ‘innofusion’ and ‘domestication’ are needed in order for technologies to be adapted to the local contexts (Williams et al., 2005). This counters the idea of technology as a black box where all the different people interacting with the technology see the same box. Translation will thus not always result in the exact same description of the technology (P. Hebinck, personal communication, June 12, 2015).

For DairyBISS it is important to understand that their strategies and ideas on feeding strategies will be unpacked and repacked by different actors. A technology manual will change over time many times. It could be seen that this decreases the efficiency but it should be kept in mind that this repackaging is done for a reason. It will take a long time before innovations are domesticated in the local context and this will not always be the way it was originally designed. The innovations are also capable to have agency and this should be considered when implementing them in Ethiopia. DairyBISS should also be reflected upon this and continue learning during the implementation.

The following section will go into the adoption theories and thus looks into how implementation strategies are adopted by the target group.

6.1.4 Adoption of technology

What is also especially important to consider is that people do not always easily adopt new things in their life. It is necessary to also focus on this social side of adoption next to the technical one. The process, construction of knowledge and other social aspects are just as important as the technical aspects (B. Philipsen, personal communication, June 17, 2015).

Adoption theorists argue that the adoption of technologies is an inherently social and developmental process. Individuals construct perceptions of technology that influence their decisions on whether or not to adopt this technology. The theory examines the individual and the choices he or she makes to accept or reject an innovation and the extent to which that innovation is integrated into the context (Straub, 2009).

During the decision process leading up to adoption, individuals go through five stages. Stage one: when an individual becomes aware of an innovation. This is influenced by personal characteristics, socioeconomic factors, and access to the agents that can produce
change. Stage two: persuasion, the individual gains enough knowledge about the innovations’ characteristics to enable him or herself to make a personal judgment on whether or not to adopt it. The result of this judgment can be either in favor or not in favor of the innovation. Stage three: the individual makes a decision based on the outcome of the adoption or rejection in the stage before. Stage four: acting on the decision, implementation of the innovation. Stage five: where the individual reflects on the decision and implementation process and evaluates whether to continue with the adoption; confirmation (Rogers, 1995 in Straub, 2009).

This theory on adaption thus shows that the process of considering to adopt can be quite extensive and finding the right strategies to navigate the innovation through this process can be very helpful.

But there is another theory that helps to understand whether the innovation will be more easily adopted or not. This theory is the innovation diffusion theory. In this theory five factors are described that can influence the adoption of an innovation. The first, the ‘relative advantage’, is the perception of an individual that the innovation will be better or worse compared to existing similar ideas. Those ideas perceived as better than the others, will be adopted faster than the ones perceived as worse. Secondly, ‘compatibility’, describes the perception that a particular innovation is similar to existing or past ideas. Innovations that are understandable to an individual are adopted more easily. Innovations cannot be too radical in their differences from existing technologies, since then there will be no adoption (Schot & Geels, 2008). Thirdly, the ‘complexity’ of an innovation, is the difficulty to comprehend an innovation. This is possibly negatively related to the rate of adoption. When an innovation is difficult to comprehend, it will not soon be adopted. Fourthly, ‘triability’, is the accessibility of an innovation. When there are possibilities to experiment with the innovation, it gives the adopter more to base his or her decision on. Lastly, ‘observability’, is referred to as how available and visible an innovation is. When observing others adopting an innovation - be it successfully or unsuccessfully - the observer can be more inclined to consider a similar adoption. However, observability can also lead to social pressure; if everyone else has a certain innovation, those who would normally not adopt can be pressured into considering it anyway (Straub, 2009).

Taking these five elements into consideration when designing a project implementation strategy makes it easier to see how the innovation might be taking too big of a step for the adopters to still want to implement it. The elements of triability and observability are very important to keep in mind, especially for DairyBISS and the context of Ethiopia. It
has been said before that many Ethiopian farmers learn through observation. They like to learn from the experiences from people around them, ‘seeing it before they believe it’. A focus on making technologies visible, observable, can then be beneficial to the implementation process.

The observational learning process has four sub functions, argues Straub. Firstly, there is the attentional process, which asks if the behavior is important and accessible to the individual in question. The second function is the retention process, in which the question is if the information is salient enough to remember. Thirdly, the production process. The person here can ask him/herself if he thinks he can reproduce the action. Lastly, the motivational process; is the individual encouraged to repeat the action? (Straub, 2009). Philipsen also refers to this (intrinsic) motivation, arguing that only when this comes together with the social pressure, knowledge and skills, changes will be really made (B. Philipsen, personal communication, June 17). It is important to keep in mind that the motivation cannot just come from the outside. Intrinsic motivation is a key factor for change to happen in a sustainable manner. Knowing all this, DairyBISS can consider allowing room for observation and experimentation within their innovation plans in Ethiopia, for instance by establishing ‘model farms’ (for further elaboration see Chapter 6.2).

6.1.5 Secure implementation

Strategic niche management

Besides thinking about the way people adopt technologies it is also important to protect the innovation in the initial phase of introduction. What often happens when new innovations are brought to another context is that they fail to produce the desired results and are removed from the ‘market’. Many different factors influence this, mostly the amount of competition from other innovations, and a safe surrounding for these new innovations to experiment would be preferred. This safe environment would ensure that the innovation has time to learn from experience and gain momentum before losing ground because of the many pressures.

The strategic niche management (SNM) approach is one of the possibilities for ensuring a more secure beginning and implementation of the innovation. Within the SNM approach, it is argued that sustainable innovation can be facilitated by creating technological niches. The technological niche is a place where it is possible to experiment with the applications of new technologies (Kemp, Schot & Hoogma, 1998). To be more precise, these niches are “protected spaces that allow nurturing and experimentation with the co-evolution
of technology, user practices, and regulatory structures” (Schot & Geels, 2008, p.538). Within the protected spaces, there is no direct competition from other projects.

What is important to understand is that those niches are not only created in a top-down fashion but are created with a range of different actors, that also includes the local actors. It is thus that the niches emerge through collective action. It is not a push-approach, but an accumulation of different actors with different issues that come together and start to interact. This interaction forces the innovation to also consider the social aspects of the technology next to the technical aspects, as was described before in the theory of SCOT. SNM scholars argue that sustainable development needs this interrelation between the different actors (Schot & Geels, 2008). Hence, it tries to bring knowledge and expertise of users and other actors into the development process and to generate interactive learning processes. An advantage of this is that when all actors are invited to participate during the entire process, there will be more sense of shared ownership (Claussen, Haga & Ennals, 2008). This in turn will help make the project more sustainable.

However, it is not just about experimentation with new technology. SNM also aims at making connections and adaptations on the institutional level. This is focussed on stimulating the learning process that is necessary for further development, and on the actual use of the new technology (Kemp et al., 1998). It will make the new environment for the innovation less dangerous and the adoption easier.

This focus on learning is an important aspect of SNM. The importance of real-life experiences in demonstration projects is therefore stressed by SNM scholars. Actual implementation and specification in experimental settings would be most conducive for niche development. Visioning before experimentation can then help broaden networks and learning processes (Schot & Geels, 2008). For DairyBISS this would be a good strategy because it would increase the time they can spend on experimenting and fitting the innovation to the local context before it can be introduced by many pressures from the outside.

Building networks

Building social networks is an important part of SNM theory. Network theory argues that knowledge is generated by interactions between actors. These interactions in turn are based on communication. One of the major reasons to establish a network relationship is the willingness to gain access to the knowledge that other actors in the network have (Zieliński & Takemura, 2012). But the building of a network is also needed to create a platform for the new technology, to facilitate interactions between stakeholders and to provide the necessary
resources - money, people, expertise. The social networks also determine the depth and breadth of the learning processes during the adoption. Broad networks, especially the ones containing outsiders argue Schot and Geels (2008), provoked more learning. A lesson that can be learned from this is that a broad network can increase the safe environment for an innovation. Learning can be enhanced and the innovation better adjusted to the local circumstances.

6.1.6 The connecting factor – boundary work

When considering all the different elements that have influence on the implementation process of new innovations in other contexts it becomes visible that there needs to be something that can bridge the technological side and the social side.

It is important that the different knowledges involved are well communicated. In order to have effective communication, the different parties involved need a “common purpose, a common standard, and a common language”, argues Berry (2000, p.60). But this is difficult to obtain, which leads Carr and Wilkinson (2005) to suggest that more conversational spaces, with less restrictions on what is communicated within these spaces, allows greater diversity in the forms of interaction. Negotiation and contestation of competing knowledge claims happens on the boundary between different actors. Here, organizations can provide a space in which groups can retain their own cultural perspective, while coming to understand that of others. This would be considered as boundary work, bridging the gap. Within this space, relations between the two groups can develop. ‘Boundary organization’ can describe the increased interaction between groups, specifically when working together with scientists and farmers (Carr & Wilkinson, 2005). Projects are most sustainable when knowledge obtained from research is integrated with the context in which they are being implemented. When an impermeable boundary emerges at this interface, it is no longer possible to have meaningful communication between the two parties. This impermeable boundary can arise when there are problems or tensions due to communication or translation, for example when there are different views on what is reliable or useful knowledge (Clark et al., 2011). It will benefit the DairyBISS project if they ensure that in their implementation strategies the boundaries will not become impermeable but communication lines will be open and that this communication is always two-way.

During the implementation of new innovations into foreign countries it is often assumed that language is the main cultural barrier to overcome. When DairyBISS wants to help facilitate Ethiopian farmers in using grazing as a strategy to increase dairy production,
they will have to hire a translator. This translator can help get the message across to the farmers and ensure that the different knowledges are communicated well to prevent the occurrence of an impermeable boundary. However, as mentioned in the case of Grazeland, the usage of a translator can create distance and distrust between the local Ethiopian farmers and the person who comes to explain the advantages of the innovative feeding strategy (G. Mengistu, personal communication, June 17, 2015). So, although it seems that language is the most important hurdle to overcome, this is not the case. As P. Tamas (personal communication, June 22, 2015) argues, translation and language barriers are part of more fundamental differences in how the two parties conceive the objects in question. Only hiring a translator is not the way to ‘convince’ a local farmer that a new innovation needs to be adopted, the innovator needs to be very context-sensitive and sense whether and how the innovation might fit into the local Ethiopian context. Only when the innovator, in this case DairyBISS, totally grasps how local Ethiopian farmers work and why they do this the way they do, then a translator is able to overcome a language barrier. If not, then the innovations will fail to be adopted by the local Ethiopian farmers and an impermeable boundary occurs.

6.1.7 Elements to take into consideration

The previous sections in this chapter have provided a lot of information about things to take into consideration when implementing a technology in a different context. This section will combine those different theory based advices to give a short summary and overview of the most important elements.

- Technologies are hard (material) and soft (knowledge, skills) and both aspects should be taken into account in innovation strategies.
- All knowledge is local but based on different life-worlds, because of this they should be valued the same.
- Implementation of innovations is a complex process, being open to alternatives and changes will improve implementation.
- Different meanings can be given to the same technology.
- Technologies can be both socially and politically constructed, they can have agency.
- Translation is part of implementation of technology, a script will change in the process.
- Individuals construct their own perceptions of technologies, influencing the decision whether or not they will adopt it.
● There are many factors that together influence the adoption of a new technology. For the context of Ethiopia, especially triability and observability are important. DairyBISS can make use of that by making technology innovations visible and allow room for experimentation.
● It is important to establish a safe environment for the technology for it to develop without constant pressure from other (competing) innovations.
● A broad network, including different actors, increases this safe environment.
● The different knowledge involved in a network has to be well communicated, keeping lines of communication open. Organizations can contribute to this by creating a space on the boundary between the different parties.
● In order to have a sustainable project, the aim should be to integrate knowledge obtained from research with the context in which the project will be implemented.
● In order to ensure that new technologies are adopted, DairyBISS needs to move beyond the language barrier and ensure that the fundamental differences between Dutch and Ethiopian farmers are taken into consideration to prevent an impermeable boundary.

6.2. Cross-fertilization

This part of Chapter 6 brings together the gained knowledge on dairy farming in general, the Dutch experience with dairy production and information about the Ethiopian context. We therefore use information from Chapter 4 and Chapter 5 - which is then not referenced again. This part will start with a comparison of Dutch and Ethiopian conditions and then goes into detail on how the two can be combined.

6.2.1 Feeding strategies

Despite many differences between the Dutch and Ethiopian dairy sector and farming strategies, both countries have a long tradition in letting their cattle primarily graze to meet the animals’ feed requirements. Moreover, in both countries there is nowadays a trend towards more zero grazing farming, particularly when farmers opt for intensification and increasing dairy production. It seems however that the majority of Dutch as well as of Ethiopian dairy farmers still prefers grazing over zero grazing. Most Ethiopian farms are mixed farms on which farmers have both crops and livestock, whereas the majority of Dutch farmers decides for one or the other. For the following section we take Figure 2 as a starting
point, which was used to explain the aspects that should be taken into account when deciding for a specific grazing strategy.

### 6.2.2 Biophysical aspects

**Climate and soil**

The Netherlands has a temperate maritime climate with temperatures varying between 2 and 6 degrees in winter and 17 to 20 degrees in summer. There are rather high rainfall rates of approximately 700-900 mm a year. In Ethiopia on the other hand, a tropical monsoon climate in the highlands causes around 750 to 1000 mm rainfall in the rainy season, which is already more than in the Netherlands during an entire year. The temperatures differ significantly from the Dutch winter season but resemble summer temperatures as they range between 15 and 25 degrees in the highlands. These high temperatures (in combination with the intensity of the sun rays) may cause heat stress for cattle, especially during the dry season. The main differences thus are that in the Netherlands temperatures are relatively low for around three to six months per year whereas Ethiopia has a rainy and a dry season, which both influences the growth as well as quality of the grass needed for cattle feeding.

During rainy periods, both Ethiopia and the Netherlands have to deal with wet pastures which are not beneficial for cows, grass and soils. When wet lands are grazed by cattle, trampling of grass leads to higher pressure on the land and thus higher degradation and lower quality of soil and grass. This in turn influences the animal's milk output and in both countries can be a significant constraint to increase income through dairy production. Dutch farmers, have found practical solutions to solve this problem, such as drainage and dewatering. Particularly for the Ethiopian context it is important to take into account that extra irrigation might be needed in dry periods to prevent drought and in turn lower quality inputs for grazing dairy cows.

To maintain the wellbeing of the cattle and prevent decreasing milk production, Dutch research has shown that a strategy like siesta grazing, as introduced in paragraph 2.7, can be used in order to prevent cows from being outside at the hottest time of the day. To prevent heat stress, a shelter can also be put up in the field to create shade. Another solution is investing in sprinklers and fans. Again, this is particularly important for the Ethiopian dry season and times of higher temperatures, but might also gain relevance in the Netherlands during hot summers.
Animals

The animals used for dairy farming in the Netherlands are mostly Holstein Friesians, which is known today as the breed of cattle with the highest dairy production. In the Netherlands there are farms that have a production of about 40 to even 60 litres of milk per cow per day. The Zebu on the other hand, the Ethiopian local breed, produces between 400 and 680 litres of milk per cow per lactation period, which is between 1.3 and 2.2 litres a day, since the lactation period is approximately 305 days. In the most extreme case, this makes a difference of 60-1.3=58.7 liters milk per cow per day. It can be concluded that the sort of breed matters a lot for the amount of production. An important point to take into consideration, is that most Ethiopian farmers, mainly smallholders, only have access to local breeds with very low production rates. Cross-breeding of resilient local breeds and high production cows might be a solution for the Ethiopian context when opting for intensification of dairy production. However, animal wellbeing should be taken into account. Dutch experiences with the import of for instance Holstein Friesians to Ethiopia or other tropical countries raise the question whether 'Western' breeds are able to adapt to totally different conditions and circumstances and whether they can keep high milk production rates. The decision to increase dairy production of Ethiopian farmers by importing high production breeds thus needs careful consideration and outweighing of costs and benefits.

Grass

In terms of temperatures and rainfall, the climate plays an important role for the quantity and quality of grasslands eligible for grazing of dairy cattle. The low temperatures during Dutch winters lead to significantly slower grass growth than in summer. In this period, when aiming for constant high milk production, supplements have to be given to cows to compensate the lower amount and quality of grass (that is why Dutch farmers decide for zero grazing during winter times). In spring as well as in summer periods on the other hand, the Dutch climate is favorable for good quality grass growth. Similarly, Ethiopian farmers face difficulties in providing high quality grass to their cattle throughout the whole year. First of all, tropical grasses have in general a lot lower nutritional value than Dutch grasses (temperate grasses) as they are more lignified. Higher lignification of plants makes it more difficult for animals to digest these and they hence get less energy and protein out of it (W. Pellikaan, personal communication, June 1, 2015). Moreover, the seasonality and high fluctuation in weather conditions hinder constant grass growth. During the dry season temperatures are often too high and rainfall is lacking, in the rainy season flooding of grasslands discourages grass
growth. When opting for grazing, Ethiopian farmers thus need to take into account these aspects and balance the feed for their cattle accordingly.

It can be concluded that a simple adoption of Dutch feeding strategies and particularly grazing in Ethiopia is not feasible because of the completely different conditions of the soil and plants. The Dutch lessons learned derived from dairy farming and grazing would need adaptation to the specific situation in Ethiopia to be successfully applied.

6.2.3 Legislation and government policies
The focus of the Dutch and the Ethiopian government differ a lot. From 1984 onwards there were milk quota to prevent surpluses of milk production in the Netherlands. This policy was abolished in 2015 but replaced with a phosphate quota which entails that the amount of pasture land owned by the farmer determines how much manure (phosphate) a farmer is allowed to produce. The Dutch legislation also includes regulations for animal wellbeing, such as specific requirements for stalling in terms of space, light and other factors or compensations/subsidies for farmers who apply grazing, to support and increase its usage in the Netherlands. Also, the dairy sector is land-based, which means that when a farmer wants to increase the amount of cows, he also has to increase the amount of land, so a certain amount of space per cow remains available. Furthermore, the government values environmental issues very high. When looking at manure legislation for instance this becomes clear, since this is aimed at minimizing nitrogen and phosphorus. A special feature of legislation in the Netherlands has to do with its membership in the EU as all member states agree on specific laws and policies they need to take into account on national level. For the agricultural sector, these include for example regulations about water quality and nitrate levels to which farmers have to comply.

The Ethiopian government on the other hand is mostly striving to increase production and farmer’s income. One way of doing this is by ‘feeding and breeding’ programs which implies providing farmers with feed and breed. The focus is much more on generating income, liberalization of the market through structural adjustment policies (SAP’s) and subsidies for transport to the market than on environmental aspects. There are also no rules like milk quotas or animal well-being-related regulations (H. Teuben, personal communication, June 18, 2015). There is a change in focus of the Ethiopian government from supporting large state farms towards supporting smaller rural farms, so that these can raise their income and access the market as well. This is highly important for increasing income and economic development of smaller farms particularly in the highlands.
6.2.4 Economic aspects

Infrastructure

The Netherlands has a good infrastructure and a strategic location within Europe, which allows it to have extensive national and international trade for agricultural products. Dairy products are an important part of the Dutch economy and export sector. Due to the favorable infrastructure it is easy for dairy farmers to access the markets to purchase inputs and sell their outputs. In Ethiopia on the other hand, particularly farmers in the highlands – as in the region of interest – face significant difficulties in accessing the markets they would need to intensify their dairy production. The farmers cannot purchase necessary concentrates, feed supplements or fertilizer and they are constrained in selling their dairy products on the market. Hence, an intensification and upscaling as intended by DairyBISS is only possible with significant improvements in terms of infrastructure. Particularly small-scale farmers in remote areas of the country need to be better linked to local markets.

Market

In both countries a general demand for dairy products seems to exist and makes it profitable for farmers to focus more on dairy production. The Dutch market is already highly flourishing with exports to 150 countries and the fifth biggest milk production in the EU. Demand and supply are thus largely balanced in the Netherlands. In Ethiopia, however, the rising demand for dairy products is not yet met sufficiently. Nowadays, in most regions all segments of the population consume dairy products and the demand is likely to rise further in the future. As there is a demand, it seems at first glance profitable for farmers to intensify their dairy production and thereby increase their income. However, the difficulties for farmers to access markets and low milk prices severely constrain farmers to do so. At the moment more than 70 percent of the Ethiopian milk producers sell their dairy directly to consumers which points to the difficulties farmers have to sell their dairy on formal markets. Significant improvements in terms of market accessibility for farmers and the linkage between farmers, milk collection points and the markets are needed to make intensification of dairy more profitable.

Technology and capital

The production of dairy in the Netherlands has been largely facilitated due to availability of the latest technology. The possibility of intensification and automation of production increases the competitiveness and productivity of the Dutch dairy sector. Particularly automatic milking systems and several improvements in terms of grass quality and feed intake during
the last centuries made it possible for the dairy sector to develop and intensify, while at the same time taking care of animal wellbeing and environmental sensitivity. In Ethiopia on the other hand, there is a lack of technologies. Most farmers do not have access to and do not have the necessary capital to purchase machines that would facilitate dairy production as robotic milking systems or tractors and on the other hand technology in terms of seeds or fertilizer. This points to another important difference between the Netherlands and Ethiopia: the availability of capital for farmers. Despite high land prices in the Netherlands, Dutch dairy farmers on average have more capital available to purchase or lend the technology they need for intensifying dairy production. In Ethiopia on the other hand, many farmers face high costs of inputs and on top of that lack capital to invest in technology. That many Ethiopian farms are intensifying nonetheless means that they do so without the ‘best technology’ which would ensure best treatment of animals, land and the environment. Even though Ethiopia can profit from the technological advantages in the Netherlands, just importing Dutch machines and other technology to Ethiopia would not solve the problem of lack of capital to lend or maintain these machines. Also in terms of knowledge and managerial skills this would be problematic as discussed in further detail below.

**Land availability**

Both the Netherlands and Ethiopia have to deal with increasing land scarcity. More than 65 percent of Dutch soil is used as farmland but due to population growth and urbanization, the amount of land available is shrinking steadily. This increasing scarcity leads to high prices of land which in turn requires more capital from farmers to purchase grassland. Similarly, the volume of pasture lands in Ethiopia is decreasing as well. The land available for each Ethiopian farmer is diminishing from generation to generation since the pasture land is divided between all of the children when the parents pass away (S. Oosting, personal communication, June 3, 2015). As most farmers see the governmental land as common property, they let their cattle graze on natural pastures and common grazing lands. An intensification and upscaling of Ethiopian dairy farms is thus only possible up to a specific point when land is too scarce to satisfy the requirements of all cows. Particularly the grass quality (because of less recovery time) will suffer from this over-utilization which in turn decreases milk production of the cows and thus makes intensification less profitable. These negative environmental and in turn economic consequences of dairy intensification need to be taken into account as well as possible solutions to prevent them.
Labor
Besides land and capital also labor availability plays a role when it comes to deciding for dairy farming or intensification of it. Whereas this does not seem to be a problem in the Netherlands, Ethiopian farmers struggle with intensifying their dairy production also because of labor scarcity. This might be explained by the increasing urbanization tendencies, as particularly young men move from their parents’ farms to cities to find employment outside of the agricultural sector. This shortage of labor hinders the adoption of dairy technology and makes increasing production even more difficult for farmers.

6.2.5 Social aspects
Preferences
Particularly when it comes to the cultural background in the two countries of interest, significant differences make clear that a pure translation of Dutch knowledge on dairy farming to the Ethiopian context is not possible. As explained in Chapter 3, deciding for a specific kind of farming and for a feeding strategy is primarily a very personal decision that each individual farmer has to make. This holds true for both countries and we can assume that some farmers in the Netherlands as well as in Ethiopia just prefer grazing over zero grazing whereas others opt for zero grazing. Tradition also plays a large role when it comes to deciding for a feeding strategy. For centuries, in the Netherlands as well as in Ethiopia, the traditional way of feeding cattle has been to let the animals graze in the field. However, in both countries zero grazing as a feeding strategy is increasingly used nowadays, particularly when farmers want to increase milk production. In the Netherlands, the preference of consumers and the government to see cows graze outside adds to this as grazing meets the population’s expectations of a perfect farm which in turn increases prices for ‘green’ milk. We cannot see any clear similar preference for Ethiopia but got the impression that society sees grazing as the ‘normal’ way of feeding cattle as this has been tradition for a long time.

Religion and culture
Especially when starting from a Western view and background, the implementation of a project in Ethiopia should consider some important cultural features. The fact that a large part of the Ethiopian population on lent 200 days per year in which they do not consume any milk, points to the necessity of processing raw milk into butter or cheese (however, only 7 percent of produced milk is now processed). This clearly differs from the steady demand for milk throughout the year in the Netherlands. Moreover, milk produced by small-scale farmers in
Ethiopia is mostly consumed at home and any surplus is given to neighbors for free as it is culturally not accepted to sell milk. This points to the fact that dairy production in Ethiopia is now mostly aimed at subsistence and not at selling so that small quantities appear to be sufficient for farmers. However, dairy cattle is also not seen as a source of milk only, but also as potential meat, draught power, manure, insurance and a sign of wealth. The whole handling with and towards dairy cattle is thus a different one in Ethiopia than in the Netherlands.

Whereas farmers in the Netherlands seem to be really inventive and proactive in creating and sharing solutions to problems encountered (as the project Koe en Wij has shown), Ethiopian farmers tend to be more sceptical and hesitant when it comes to adopting new strategies. Several interviewees pointed to the culture of ‘seeing is believing’ in Ethiopia, particularly for elder and less-educated farmers. They have to see technology and techniques working in practice first, and need to see that they can make economic profit of it, before they change their farming patterns. For any projects to be implemented in Ethiopia, this is an important aspect to take into account.

6.2.6 Managerial aspects

Knowledge

The previous section also points to some managerial differences between Ethiopia and the Netherlands. Ethiopian farmers have limited knowledge on different feeding strategies and their implications and on how to improve dairy farming techniques. They require trainings and technologies to get more knowledge about how feeding strategies influence dairy production and how they can optimize and intensify their dairy production to foster economic development. Some training centers have been set up by the government and local authorities to spread expertise and knowledge on dairy farming. Also cooperatives as in Ginchi (see Chapter 5) show that Ethiopian farmers are collaborating more and creating networks to use and exchange knowledge more efficiently. In the Netherlands this seems to be happening at a greater extend, as the large amount of knowledge that is available is for instance shared and collected in the LTO or in entrepreneurial networks. Particularly after being forced to find solutions to concentrates shortage after the Second World War, Dutch farmers and scientists have started to expand their knowledge through research on feeding strategies and dairy farming. There is thus not only more soft technology available for Dutch farmers, but it is also spread better between all parties involved and reaches farmers on the ground more easily. In the Ethiopian context this is at an earlier stage and can be significantly expanded, particularly
when it comes to farmers in more remote areas that do not have access to urban centers and networks.

**Skills**

This lack of knowledge in Ethiopia also translates into a lack of skills when it comes to efficient but environmentally sensitive dairy farming. There is not much planned feeding of cattle and not much conserving of feed which can be traced back to the lack of awareness on how feeding is best proceeded to get the maximum milk production. Several interviewees have pointed to the poorly developed managerial skills of Ethiopian farmers as many just randomly feed or graze their cattle without proper planning and thinking through. Dutch farmers’ skills seem to be much more developed as over centuries they have found solutions to problems concerning drainage, dewatering, ditches, trampling, dikes, urea concentration in milk and keeping the grass quality high. This knowledge can definitively be useable for Ethiopian farmers, but only when taking into account the specific local conditions and circumstances that differ from the Dutch context.

**6.2.7 Summary**

For a better overview and to make this cross-fertilization of more practical value for DairyBISS, the last section of this chapter wants to bring together all findings. We do so by formulating an advice for DairyBISS on which aspects to take into account for their project in Ethiopia. This summary of our research is twofold. First, there are specific findings about the Ethiopian context that DairyBISS needs to consider when implementing their research program in Ethiopia. Second, we provide some specific advice on how the cross-fertilization with the Dutch knowledge and lessons learned in the area of dairy farming could look like. Findings are summarized in Table 1.
Table 1. Knowledge about Ethiopian context and possibilities for cross-fertilization with Dutch knowledge.

<table>
<thead>
<tr>
<th>Ethiopian situation</th>
<th>Possibilities for cross-fertilization with Dutch knowledge</th>
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</table>
| 1. The Ethiopian climate is characterized by a tropical monsoon with heavy rainfalls (wet season), a dry season that lasts for around half of the year, and temperatures between 15 and 25 degrees on average. Particularly during the dry season cattle may suffer from heat stress. | 1. The Dutch knowledge on drainage and dewatering can be used to face the challenge of wetlands in Ethiopia (for example ditches and dikes).  
1. The Dutch knowledge on irrigation of grasslands can be used to face the challenge of droughts during the Ethiopian dry season (for example collecting water during wet season).  
1. The Dutch experience with siesta grazing can be used to prevent and reduce heat stress and increase grass intake for dairy cattle in Ethiopia. |
| 2. Ethiopian local breeds have a much lower production level than Dutch breeds like the Holstein Friesian. | 2. Importing Holstein Friesians (‘the dairy production cow’) from the Netherlands can overcome low dairy production from Ethiopian local breeds as the Zebu. Cross-breeding might be necessary to make the Dutch animals more resilient and adaptive to local circumstances. |
| 3. Tropical grasses have lower nutritional value (because they are more lignified) than temperate grasses grown in the Netherlands. | 3. The Dutch knowledge on supplementing feed of cattle can be used to overcome the lower nutritional value of tropical grasses in Ethiopia. Dutch research on grass quality and breeding of different types of grasses might help to grow a new grass species with increased nutritional value compared to prevalent grasses in Ethiopia. |
| 4. The Ethiopian government wants to increase income of dairy farmers by introducing improved feeding and breeding, structural adjustment programs, subsidies for farmers and liberalization of the market. The focus thereby lies on inputs and less on marketing and processing of dairy products. | 4. DairyBISS can and should work together with the Ethiopian government to increase private business development. Both actors aim for increasing production and income of dairy farmers to enhance overall economic development.  
4. As the focus of the Dutch government is more on sustainability and environmental aspects in contrast to the Ethiopian one, lessons learned from the Dutch experience in this field cannot be directly translated to the Ethiopian context. |
<table>
<thead>
<tr>
<th>Section</th>
<th>Text</th>
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<tbody>
<tr>
<td>5.</td>
<td>Due to poor infrastructure, farmers do not sufficiently have, but need access to markets in order to sell their output and purchase inputs for dairy farming. The linkages between farmers, milk collection points and markets are rather poor.</td>
</tr>
<tr>
<td>5.</td>
<td>DairyBISS could help establish and improve farmers’ access to the market by setting up milk collection points and facilitating linkages between farmers, the collection points and markets.</td>
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<tr>
<td>6.</td>
<td>Milk prices are rather low in Ethiopia which makes crop production in most cases more profitable than dairy production.</td>
</tr>
<tr>
<td>6.</td>
<td>By improving farmers’ access to markets and balancing costs and benefits of inputs and outputs better, DairyBISS could help Ethiopian farmers to make dairy production more profitable.</td>
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<tr>
<td>7.</td>
<td>Ethiopian farmers lack access to hard technologies (machines, fertilizer, seeds) and do not have enough capital to invest in the intensification of their farms.</td>
</tr>
<tr>
<td>7.</td>
<td>The Dutch knowledge on hard technologies (machines, fertilizer, seeds) can be used to overcome the existing knowledge gap in Ethiopia. It might also be possible to import specific technology to Ethiopia and provide it to farmers. The Dutch experience with financing of dairy farms and necessary investments to make dairy production profitable could be used in Ethiopia to overcome farmers’ shortage of capital to invest in the intensification of their farms.</td>
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<tr>
<td>8.</td>
<td>More and more Ethiopian dairy farmers (want to) intensify their dairy production.</td>
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<tr>
<td>8.</td>
<td>The Dutch knowledge about positive and negative consequences of intensification of dairy production can be used in Ethiopia to prevent repetition of Dutch mistakes.</td>
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<tr>
<td>9.</td>
<td>Ethiopia faces increasing land scarcity, particularly if more farmers upscale. Poor grass quality and environmental degradation can be consequences.</td>
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<tr>
<td>9.</td>
<td>If applicable, Dutch lessons learned on how to use land more efficiently can be applied in Ethiopia to prevent land scarcity which in turn can help decreasing the risk of poor feed intake and environmental degradation.</td>
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<tr>
<td>10.</td>
<td>Ethiopia faces increasing labor scarcity, particularly due to urbanization.</td>
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<tr>
<td>10.</td>
<td>If applicable, Dutch knowledge on how to increase incentives for particularly young people to work in the agricultural sector and how to make the dairy sector more attractive can be useful to overcome the</td>
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<tr>
<td>11.</td>
<td>Deciding on a specific feeding strategy is always a highly personal decision.</td>
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<tr>
<td></td>
<td>11. Even though a lot of knowledge and lessons learned from the Dutch experience could be helpful for the Ethiopian context, it is important to keep in mind that deciding on a specific feeding strategy is always a highly personal decision that each individual farmer has to make.</td>
</tr>
<tr>
<td>12.</td>
<td>Traditionally, Ethiopian farmers graze their dairy cattle in the field.</td>
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<td></td>
<td>12. That grazing is the traditional way of feeding dairy cattle in Ethiopia might make it easier for DairyBISS to convince farmers of grazing (if they have changed to zero grazing) or convince them that improvements of the grazing events can increase their dairy production. Displaying the successful development of the dairy sector in the Netherlands might help in achieving this.</td>
</tr>
<tr>
<td>13.</td>
<td>Even though this is becoming less (number of Muslims or Protestants is rising, and the younger Christian generation is less strict Orthodox), a significant part of the Ethiopian population is on lent 200 days per year. During this time no raw milk is consumed.</td>
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<tr>
<td></td>
<td>13. As the Dutch consumption patterns of dairy products and consumer demands largely differ from those of Ethiopians, Dutch knowledge and lessons learned in this field are not directly applicable for the Ethiopian context. 13. Due to long fasting periods, Dutch knowledge and technology for processing and storing milk products can be used to overcome difficulties for Ethiopian farmers to keep income from dairy products on a steady level.</td>
</tr>
<tr>
<td>14.</td>
<td>It is culturally not accepted to sell milk in Ethiopia. Most milk is consumed at home and possible surplus is given to neighbors.</td>
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<td></td>
<td>14. When implementing a dairy-related project in Ethiopia, DairyBISS has to take into account special cultural features that differ from the Dutch culture (for example difficulties farmers face to sell milk). This means a one-to-one translation of knowledge and experience is not possible and desirable.</td>
</tr>
</tbody>
</table>
15. Most Ethiopian farmers tend to be rather sceptical towards innovation and intervention (‘seeing is believing’).

15. The Dutch experience with implementation of dairy-related projects in Ethiopia or culturally similar countries can help in making it successful to convince farmers of the intervention and innovation, despite their scepticism. Different model farms functioning as a ‘niche’ can be a place to experiment and ‘see’, which could be a way to overcome the scepticism.

15. Different model farms functioning as a ‘niche’ can be a place to experiment and ‘see’, which could be a way to overcome the scepticism.

16. Ethiopian farmers have limited knowledge on dairy farming and feeding strategies.

16. The Dutch knowledge on dairy farming and feeding strategies can be highly useful to increase dairy production in Ethiopia as most farmers lack this knowledge.

17. Most Ethiopian dairy farmers do not plan the feeding of their cattle and do not conserve any feed. This can be traced back to a lack of managerial skills.

17. The Dutch experience with training of farmers to inform about farm management and dairy farming strategies can help overcome the lack of managerial skills that prevents many Ethiopian dairy farmers to plan their cattle feeding properly and thus increase dairy production.

18. During the last years, more Ethiopian farmers have started to collaborate in networks and cooperatives to exchange knowledge and receive trainings.

18. When implementing a dairy-related project in Ethiopia, DairyBISS needs to take into account the fact that more Ethiopian farmers have started to collaborate in networks and cooperatives to exchange knowledge and receive trainings during the last years. A cooperation with these locally initiated programs is highly advisable as it ensures sustainability and acceptance by locals.
7. Final advice

This project has made a contribution to a project of the research program DairyBISS to increase private dairy sector development in Ethiopia. More specifically, the main question was to what extent grazing could be an answer to the current feeding problem of dairy cattle in Ethiopia. Therefore, the report dealt with existing knowledge of Ethiopian farmers about grazing and dairy farming and illustrated the points that lead to current problems of dairy farmers to meet the increasing demand for dairy products. Moreover, information and lessons learned from the Dutch experience with dairy farming and increase of dairy production have been presented to then see how this knowledge could be used in Ethiopia. The chapter on implementation theory has also shown that particularly development studies research offers a range of theories on how to implement development projects in a culturally sensitive and sustainable way. The last section highlighted the differences between the Ethiopian and Dutch context and points to the most important lesson learned from this research: context highly depends. Our main advice for DairyBISS is thus that a pure translation from one context to another is never possible. The significant differences between the Netherlands and Ethiopia in terms of climate, culture, management and other aspects make it unfeasible to purely apply Dutch knowledge about dairy farming and feeding strategies to Ethiopia.

We cannot clearly answer the question to what extent grazing can be a solution for the current feeding problem of dairy cattle in Ethiopia out of different reasons. First, the underlying assumption of this question is that grazing is not used in the area of interest as a feeding strategy and that there is a feeding problem of dairy cattle in Ethiopia. From our research we cannot confirm that farmers mostly rely on purchased fodder but on the contrary, the traditional way of feeding dairy cattle is through grazing and only slowly do farmers adopt zero grazing strategies. However, our findings suggest that the low quality of grass and constraints for farmers to access markets (to purchase concentrates, supplements, fertilizer or seeds) make high quality feeding of cattle indeed difficult. Second, whether grazing is a suitable strategy to increase dairy production in Ethiopia is highly dependent on many different factors. Even though grazing might be a good option from the viewpoint of animal wellbeing or labor scarcity, other aspects as land scarcity, lack of managerial skills, environmental degradation or low quality of grass among others speak clearly against adopting grazing on a larger scale to increase dairy production. The answer to the research question thus depends on what factors are taken into account and valued highest – if a farmer wants to increase dairy production but has no land available, zero grazing is the only way to
do so. On the other hand, if a farmer values animal wellbeing high and likes to see his cows outside, then he might see grazing as the best feeding strategy to increase dairy production. Third, and most importantly, deciding for a specific feeding strategy is a highly personal decision as has been mentioned before. There is no universal answer to which is the ‘best’ feeding strategy and grazing can thus not be seen as a panacea for increasing dairy production in every context. What works for the Netherlands does not have to work for Ethiopian farmers (and particularly not for all) as well. The cross-fertilization section has supported this by pointing to the numerous differences between the two countries and cultures.

Despite not being able to answer the main research question, we were able to provide first insights into the sub questions of our research on which knowledge and strategies on dairy farming exist in the Netherlands and in Ethiopia and how these can be combined. The last section of this report wants to bring together these findings from previous parts by formulating a concrete action plan for DairyBISS on how to continue with their project in Ethiopia. A table (Table 2) is provided to make the link between the various sections of theory and practice in this report more explicit and to make clear how the provided theory can be used by DairyBISS in practice. By combining the background on Dutch lessons learned, the Ethiopian context and the implementation theory, concrete actions are formulated on how to continue with the project implementation.

The following table can be read in various ways. In case a reader is specifically interested in an action guide, only the first ‘Actions and strategies’ column has to be read. On the other hand, when readers want to know about the background of the actions, the last two columns, ‘Theory’ and ‘Practice’ provide insights into how the specific actions are derived from the research findings. It is not possible to establish a direct link between one theory and one action, just as one technique cannot be directly implemented in a broad context, but per subject there are several theories and practices that lead to the actions stated in the same row.
Table 2. Action plan for the continuation of the DairyBISS project

<table>
<thead>
<tr>
<th>Communication and cooperation</th>
<th>Actions and strategies</th>
<th>Theory</th>
<th>Cross-fertilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spreading knowledge</td>
<td>Spread knowledge via Ethiopian experts (ILRI/teachers/farmers), instead of external experts. These can work as ‘bridges’ between the Dutch and Ethiopian knowledge. Foreigners can give the information on the technology (guide) but then it has to be translated for and by the Ethiopian farmers so that they can decide what to do with it.</td>
<td>Script of technology theory: designers have to create a guide on how to use the technology, but this has to be translated (in an abstract sense) for and by the users afterwards. <strong>Boundary work theory:</strong> knowledge has to be well communicated which might be enhanced by a common language and background. A bridge between contesting knowledge claims has to be established.</td>
<td>Overcoming locals’ scepticism towards intervention by foreigners is important to be able to cooperate with Ethiopian farmers to bring new technologies into practice. <strong>Overcoming the language and cultural barrier</strong> in Ethiopia is difficult for foreigners (as DairyBISS) as local farmers trust other locals more easily.</td>
</tr>
<tr>
<td>Cooperate</td>
<td>Cooperate with existing farmer cooperatives.</td>
<td>Building on existing local knowledge and structures.</td>
<td>More and more Ethiopian farmers collaborate in networks and cooperatives</td>
</tr>
</tbody>
</table>

Have a local expert or project manager/contact person/COORDINATOR/spokesperson in every region or district who speaks the local language and knows the local context. This helps building trust and networks and increases understanding between DairyBISS and local farmers.

Train locals to train others to initiate a snowball system of knowledge spreading and exchange.
training centers and with the government (e.g. concerning their feeding and breeding programs).

Cooperate with existing projects by foreigners

to learn from their experience and mistakes (e.g. Grazeland: not properly working together or cooperating with locals but rather hiring them as employees, which causes a hostile attitude by other locals. Furthermore, local farmers cannot identify with the dimension of Grazeland in terms of land and capital. As this points to the inequality between foreign innovators and local farmers, it does not create an atmosphere of cooperation, but rather envy. It often occurs that farmers feel offended by the way their land is ‘invaded’).

The Ethiopian government fosters dairy farming development by initiating programs and providing farmers with knowledge and resources.

Actively include local farmers

in the design and implementation of every project from the beginning (e.g. by shared ownership). Once people feel they can contribute and influence the project, they are more willing to adapt and cooperate.

Strategic Niche Management:

when all actors are invited to participate during the entire process, there will be more sense of shared ownership which ensures sustainability of the project.

Dutch experience with inclusion of farmers in farming projects shows that farmers become innovative and creative in finding solutions to occurring problems and are more committed to the project.

Research

Social aspects

| Do research on local conditions, existing strategies, farmers’ needs | Innovation diffusion theory: the relative advantage of an adoption | Dutch knowledge cannot be directly applied to the Ethiopian context but needs adoption |
and desires. To triangulate the information, use different data collection methods. Interviews with individual farmers, focus groups and questionnaires seem to be most promising to get the relevant information.

**Be flexible** and adapt the project according to the gained information on the local situation.

Among others, following questions should be covered with the research:
- What do local farmers see as a problem?
- What do they struggle with in terms of farming?
- What feeding strategies do they use and why?
- What do they want and need?
- How would they like to be included in a project like this?
- What do they expect from foreign investors?
- What do they think is feasible and possible for them concerning dairy farming within this specific context (e.g. specific feeding strategies, machinery, amount of land)?
- Which land is currently used for which purposes, also unofficially, maybe without the government knowing?

innovation, whether an individual perceives the innovation as being better than existing similar ideas, determines whether it is adopted or not.

To make a project sustainable, **involvement of locals** and the target population (dairy farmers) is crucial.

**Interpretive flexibility:**
As technology is not always implemented or used in a linear way as intended by the designer, flexibility is needed. Technology is interpreted differently by different actors, highly dependent on the specific context within which the innovation is implemented.

to local conditions. Therefore, information needs to be gathered on the local situation, also to understand why farmers apply the specific strategies they use at the moment.
| Technical aspects | Do further research on the technical aspects concerning implementing the project in the specific Ethiopian context. Among others, following questions should be covered with the research: - What sort of grass with a high nutritional value can be imported to Ethiopia? - To what extent can cross-breeding of high dairy production cows and resilient local breeds be a solution for low production rates? - How can farmers best deal with seasonality and climatic fluctuations? - What technology is needed and to what extent can it be imported? | ‘Best solutions’ developed by thematic experts or researchers are not always the most suitable ones for a specific context. Bringing together the social and technical aspects of an innovation is crucial (social construction of technology theory, actor network theory). Interpretive flexibility: As technology is not always implemented or used in a linear way as intended by the designer, flexibility is needed. Technology is interpreted differently by different actors, highly dependent on the specific context within which the innovation is implemented. | Dutch knowledge cannot be directly applied to the Ethiopian context but needs adoption to local conditions. Therefore, information needs to be gathered on the local situation, particularly on the differences between the Netherlands and Ethiopia in terms of (hard) technology, climate, breeds, soil and nutritional value of the grass and other aspects. |
| Projects and events | Hold a round table in Ethiopia with the target group of the project (Ethiopian dairy farmers) to initiate knowledge exchange and get first information on what farmers want and need. Involve the local government, elderly and the young generation in every project to ensure ‘innofusion’ and ‘domestication’ of the project. | Knowledge exchange and gathering of background information should be the first step of a project before starting the implementation. Knowledge from different actors (Dutch experts and locals) should be valued the same. There is no ‘best solution’ that can just be implemented to other contexts. | Dutch knowledge cannot be simply applied in Ethiopia, but an adoption to local circumstances and conditions is needed. Share the lessons learned from Dutch dairy farmers. Share and understand local knowledge. The local government should be approached and included from the beginning as a local partner to increase private business development. |
To make a project sustainable, **involvement of locals** and the target population (dairy farmers) is crucial.

**Involve elderly,** as they have an important influence on structures and technologies in current farming systems.

**Include the younger generation,** which can be a good starting point, since they are more open to innovation and change.

Create and maintain a platform for knowledge exchange between different local and foreign stakeholders (for the long term).

Ensure that actors involved in meetings feel appreciated and valued and **approach everyone on the same level.** Ensure open communication lines.

**Offer specific ‘office hours’ of a local farming expert** who can provide information on different strategies and advice individual farmers on possibilities for development of their farms or on specific questions they might have.

**Constant knowledge exchange** (both ways) between the involved stakeholders is important to make a project successful.

**Interactive learning processes,** collective action and interaction between involved actors (local and foreigners) is crucial.

**The creation of a network** is needed to gain access to the knowledge other actors have, to create a platform for the new technology, to facilitate interactions between stakeholders and provide necessary resources.

**Broad networks** involving outsiders provokes more learning processes.

**Organizations (like DairyBISS) can function as a bridge** between different

Create access to Dutch knowledge for Ethiopian farmers and create possibility for them to see which aspects they can use on their farm and how they can combine these with their current farming strategies.

Create access to Ethiopian experience with dairy farming for Dutch experts to widen their knowledge on dairy farming.
| **Model farms:**
*Create model farms/examples* which local Ethiopian farmers can access to then decide whether they want to adopt the strategies used or not.

*Adapt these model farms to local conditions* and resources available. Make the innovation (e.g. a specific kind of grazing) easily understandable and observable for farmers.

Observability could be further enhanced by convincing some local farmers to adopt the innovation and show this to other farmers (*‘farmwalks’*).

*Provide room for experimentation* and offer possibilities for farmers to try out the new technology.

| **Trainings:**
*Organize trainings or workshops* for Ethiopian farmers to get knowledge on existing farming strategies and advice on how to reach the individual farmer’s goals.

*Adapt these trainings to the needs*

| Five stages of decision-making processes leading to adoption of an innovation.

**Innovation diffusion theory:** five factors influencing the adoption of an innovation (e.g. triability, observability)

**Strategic niche management theory:** importance of real-life experiences in demonstration projects.

→ leave room for experimentation and observation and give farmers time to adopt the innovation.

| To overcome the scepticism of Ethiopian farmers towards innovation, Dutch knowledge on dairy farming should be provided in an easily understandable way so that they can ‘see and believe’.

**Complement lack of knowledge** in Ethiopia on dairy farming, feeding strategies, management and intensification.

**Exchange and transfer both soft and hard technology** that is applicable to the Ethiopian situation.
farmers have and employ an Ethiopian to hold the sessions as (s)he will be more easily trusted.

| **Infrastructure**-related aspects should be taken into account for any event or project. Farmers will only use the offered platform, workshops or model farms if these are in a strategic location that farmers can easily reach. | **Innovation diffusion theory**: accessibility of an innovation is important to be adopted. | **Provide access to both markets and services**, so farmers can share information and trade, since now they do not sufficiently have access to markets, milk collection points, training centers or spokesmen. |
| Services could be provided to enhance farmers’ access to markets or events, particularly from remote areas. |
8. Discussion

The objective of this report was to tackle the interface between the technological and social implications of applying grazing techniques to increase dairy production in Ethiopia. The theoretical and practical lessons for both the Netherlands and Ethiopia have enabled us to provide DairyBISS with an extensive report and practical tools on how to implement grazing in Ethiopia. These practical tools provide a solid base for the further continuation of the DairyBISS project in Ethiopia. A strength of this report is that the large emphasis on the social aspect of introducing innovations brought new insights with regards to the usability of grazing in promoting extensive dairy production. More importantly, the social focus complemented the technological knowledge that DairyBISS already inhibited and provided tools to implement grazing projects in a context-sensitive way.

Although the report is of added value, the conducted research was, due to the limited time and financial resources, based on a literature review and interviews with both Dutch and Ethiopian researchers in the Netherlands. We have not been able to visit Ethiopia neither did we have access to local researchers for proper context-sensitive fieldwork. Therefore, this report cannot provide a complete image of how Ethiopians view the innovations made in the dairy sector. Another limitation can be found in the composition of the consultancy group. The commissioner of this project initially requested plant- and livestock scientists to provide an answer to the question of DairyBISS. However, the consultancy group only existed of International Development students. To ensure that this lack of knowledge did not influence the report multiple interviews with livestock researchers have been conducted. These interviews ensured that both the technological and social implications could be taken into consideration in the final report.

Despite the extensive report, there are still a lot of knowledge gaps that could and should be fulfilled before implementing a new technology in Ethiopia. Further research should focus on how local farmers perceive innovations from the outside and on why local smallholders, at this moment, do not adopt new innovations. When a more thorough answer to these questions can be provided, innovations can be made more suitable for the Ethiopian context. In order to successfully conduct the research a local researcher has to be hired. This local researcher is more sensitive to the local context, compared to a foreign researcher, and could therefore be more capable to investigate the reasons why local smallholders do not adopt efficient new innovations at the moment. Ideally, this research is carried out before the implementation of new innovations and trainings.
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## Appendix 1. Comparison of grazing and zero grazing strategies

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grazing</strong></td>
<td></td>
</tr>
<tr>
<td>● Cows are made for grazing - grazing is more natural</td>
<td>● Loss of control over cattle - diet, health, behavior</td>
</tr>
<tr>
<td>● Better for animal welfare and health</td>
<td>● Grass is very sensitive to climatic conditions and quality can thus fluctuate</td>
</tr>
<tr>
<td>● Lower rates of leg injuries, less incidences of lameness, mastitis</td>
<td>● Highly risky and less predictable feeding strategy</td>
</tr>
<tr>
<td>and other maladies</td>
<td>● Farmer has to balance grass growth and herd energy requirements</td>
</tr>
<tr>
<td>● Consumer preference for milk from grazing cows</td>
<td>● Climatic conditions may increase the risk for heat stress, parasitic diseases and other maladies</td>
</tr>
<tr>
<td>● Positive farm image</td>
<td>● Grazing always brings loss of biomass</td>
</tr>
<tr>
<td>● Higher income due to consumers’ willingness to pay for ‘green’ dairy</td>
<td>● Higher environmental impact - cows defecate and urinate, fertilize for grass</td>
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<tr>
<td>products</td>
<td>● Higher labor use for cleaning fertilizing and labor for treating soil</td>
</tr>
<tr>
<td>● Grazing is cheaper - lower feed costs and less asset costs</td>
<td>● Infrastructure costs might be high</td>
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<tr>
<td>● Highly balanced and better nutrition - can offer cows a higher variety</td>
<td>● High management skills and knowledge from the farmer is required</td>
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<tr>
<td>of plants</td>
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<tr>
<td>● Less labor intensive - higher labor productivity</td>
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<tr>
<td>● Milking time is lower - upscaling and increasing livestock is</td>
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<tr>
<td>easier and less expensive</td>
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<tr>
<td>● Less ecological and environmental impact - less mineral fertilizer,</td>
<td></td>
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<tr>
<td>concentrates, effective resource use and lower energy</td>
<td></td>
</tr>
<tr>
<td>consumption</td>
<td></td>
</tr>
<tr>
<td><strong>Zero grazing</strong></td>
<td></td>
</tr>
<tr>
<td>● Produces on average more milk</td>
<td>● Decrease the welfare and health of animals - less room to move, not in natural environment</td>
</tr>
<tr>
<td>● Better in reaching the animals’ nutritional requirements - better</td>
<td>● Environmental impact is much higher - higher emissions, eutrophication and acidification</td>
</tr>
<tr>
<td>looked after</td>
<td>● Labor intensive - bring feed to cows, clean housing</td>
</tr>
<tr>
<td>● Energy intake can be controlled more effectively</td>
<td>● Investments on housing, storage facilities and equipment</td>
</tr>
<tr>
<td>● Less affected by fluctuation of grass and soil quality</td>
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<tr>
<td>● High quality feed throughout the year</td>
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<tr>
<td>● Not affected by land scarcity, upscaling without land possible</td>
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<tr>
<td>● Higher labor efficiency</td>
<td></td>
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<tr>
<td>● Higher energy use efficiency</td>
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<tr>
<td>● More efficient use of resources</td>
<td></td>
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<tr>
<td>● Reduced nitrate loss and lower environmental damage on land</td>
<td></td>
</tr>
<tr>
<td>● Biomass loss is lower</td>
<td></td>
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</tbody>
</table>