Grassland-based multifunctional beef production
A farmer and food chain perspective

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Abstract

Historically semi-natural-grasslands (SNGs) have been an integral part of livestock production in Europe. During the intensification of agriculture after the Second World War, many SNGs were replaced by cultivated and more productive forage crops in order to supply an increasing number of livestock with high-quality feed. It is now acknowledged that SNGs generally host a high biodiversity and provide important environmental services; their conservation is therefore one of the priorities set by the Danish government for maintaining biodiversity. Many areas of SNG however remain not managed in an appropriate way despite the subsidies offered to the farmers for doing so.

The overall aim of this PhD project was to identify and understand barriers and potentials for the development of SNG-based suckler beef production systems. The study combines two different perspectives. Firstly, a farming system perspective where case studies were conducted on twelve Danish suckler farms with qualitative and quantitative data collection : the study explores farmers' choices and experiences related to their production system and use of grassland (**paper I**) and it evaluates technical results of beef farms with a low or high inclusion of SNG in the herd feed (**paper II**). Secondly, in a food chain perspective, the study explores how different quality dimensions are negotiated and communicated in food networks and how they link to farming systems and grazing practices in the Danish context (**paper IV**) and French context (**paper III**).

Different Danish beef production systems were identified; their differentiation is based on their feeding strategy, use of semi-natural grassland, type of breed and male calves reared as bulls or steers. In the system based on fattening of young animals immediately after weaning, it was shown that the use of SNG grazing before weaning, instead of cultivated grassland grazing, has no adverse consequences for the performance of the young cattle. In this system, up to 1 ha SNG per cow and her offspring can be grazed or cut. A production system based on high-growth breeds receiving only grass-based feed and with slaughtering of steers and heifers at 20-22 months is considered as promising as it combines a high use of grassland (up to 2 ha SNG per cow and her offspring), produces animals which are appreciated on the market, and provides other amenities in terms of animal welfare, environment, healthiness and safety of the meat. The SNG, however, probably needs to have forage of a relative high quality. The system identified with the highest use of grassland (one suckler cow and her offspring for roughly every 3 ha SNG) is based on rustic breeds kept permanently on SNG. This system produces animals with characteristics that differ from what is usually considered as quality meat by the slaughter industry in the Danish context due do their age at slaughter and low conformation. For animals from this system to be acknowledged as high-quality meat, the reference frame for what constitutes a quality product needs to be redefined. The cases studied here have shown the importance of getting stakeholders in the chain together to redefine quality frames. It is concluded that beef production systems based purely on grass and a high reliance on SNG can be considered as sustainable in terms of animal welfare, environmental impact, healthiness and safety of the meat and that it may be possible to identify them by a local "*terroir*".

This study has highlighted the role of the farmer's perspective in the use of SNGs. SNG-grazing is regarded as a method of conserving biodiversity and landscape, but most farmers did not relate the use of SNG directly with biodiversity conservation. Most of them were interested in nature, but focused wildlife conservation on other parts of their farms. The involvement of farmers in SNG-grazing would maybe be aided if their knowledge of plants and grassland species was advanced and if the connection between farmer management and environmental outcome was made clearer. In one of the cases, a local project of cooperation between farmers and authorities for biodiversity and landscape

conservation was a motivation for farmers to use conservation grazing. This participative approach could be developed in other regions in order to get more farmers involved. The perception of “good” farming includes for some farmers high growth rates and high output and makes farmers reluctant to use SNG. For some farmers, a close man-animal contact is a motivation or a prerequisite for beef farming and this close contact can be disrupted by SNG grazing if SNG is not close to the farm.

Semi-natural grasslands have a long history in agriculture where they have been an integrated part of farming systems for centuries. Modern agricultural farming systems are organised around other values and potentials and many SNGs have been abandoned. Our work suggests that the reintegration of SNG in farming systems cannot only be led by subsidy incentives. Efforts should be made to facilitate the marketing of the products originating from SNG-based systems and farmers’ involvement with the mobilisation of their knowledge and management skills could also be promoted.

Sammendrag

Historisk set har naturlige græsarealer (SNG) været en væsentlig del af foderforsyningen til husdyrproduktion i Europa. Under intensivering af landbruget, er mange SNG blevet opdyrket og erstattet med mere produktive foderafgrøder med henblik på at forsyne det stigende antal husdyr med foder af høj kvalitet. De resterende SNG indeholder en høj biodiversitet og andre bevaringsmæssige værdier, hvorfor bevarelse og pleje af SNG er en del af Natura 2000 indsatsen, som den danske regering har iværksat. Mange SNG arealer bliver imidlertid ikke plejet på en hensigtsmæssig måde på trods af de subsidier, der tilbydes landmændene for at gøre det.

Det overordnede formål med dette ph.d.-projekt var at identificere og forstå barrierer og potentialer for udnyttelse af SNG til produktion af oksekød baseret på afgræsning med ammekvæg. Projektet kombinerer to forskellige perspektiver. For det første et landbrugsbrug perspektiv, hvor casestudier blev udført på tolv danske bedrifter med ammekvæg, hvor der blev foretaget interview og indsamlet kvantitative data til beskrivelse af produktionen. Baseret herpå blev landmændenes valg og erfaringer i forhold til brug af græsarealer undersøgt (paper I) og de tekniske resultater fra kvægbruget blev vurderet i forhold til brugen af græs fra SNG i besætningen (paper II). For det andet, et perspektiv, hvor det blev undersøgt, hvordan forskellige kvalitetsdimensioner dokumenteres og formidles i fødevarekæden og hvordan de relaterer til landbrugssystemet og afgræsnings praksis i henholdsvis en dansk sammenhæng (paper IV) og i en fransk sammenhæng (paper III).

Forskellige danske oksekød produktionssystemer blev identificeret, baseret på deres fodringsstrategi, brug af naturlige græsarealer, kvægrace og opdrætning af handyrene som tyre eller stude. Et system baseret på græsning af SNG for køer af høj vækstkapacitet og kalve i diegivningsperioden kombineret med intensiv slutfodring af tyrene havde ingen konsekvenser for ungdyrenes produktion i forhold til ingen anvendelse af SNG. I dette system afgræssede en ko med opdræt op til 1 ha SNG. Systemer baseret på kødkvægsracer med høj vækstkapacitet, kombineret med udelukkende græsbaseret fodring fra såvel SNG som græsmarker i sædskifte via afgræsning og slæt og med slagtning af handyrene som stude ved 20-22 måneder kombinerer en høj udnyttelse af græsarealer (op til 2 ha SNG per ko med opdræt) med slagtedyr, som er værdsat på markedet ud fra de normale kvalitetsparametre. Det sidste system havde den højeste anvendelse af græsarealer (omkring 3 ha SNG per ko med opdræt) og er baseret på mere ekstensive racer som holdes permanent på SNG året rundt, med en begrænset tilskudsfodring. Dette system frembringer dyr med karakteristika, der adskiller sig fra, hvad der normalt betragtes som kvalitetskød ved slagtning i dansk sammenhæng pga. en høj slagtealder og lav klassificering for form. For at dyr fra dette system skal kunne markedsføres til en for producenten fornuftig pris kræver det at referenceramme for, definitionen af et kvalitetsprodukt udvides til at indeholde andre parametre, som afspejler dyrenes bidrag til naturbevarelse. Systemer baseret på høj anvendelse af afgræsning på SNG kan betragtes som bæredygtige i forhold til dyrevelfærd, miljøpåvirkning, sundhed og sikkerhed af kødet, og det er muligt at identificere dem ved en lokal ”terroir”.

Denne undersøgelse har fremhævet betydningen af landmandens natursyn på deres brug af SNG. De fleste landmænd forbandt ikke direkte afgræsning af SNG med bevaring af biodiversiteten, trods en generel interesse for naturen. Landmændene naturinteresse var typisk fokuseret på naturelementer på de dele af bedriften som var tættest på beboelsen og omkring markene. Inddragelsen af landmændene mere direkte i planlægning og gennemførelse af SNG-græsning, herunder information om arealernes naturværdier, og sammenhængen mellem driftspraksis og de naturmæssige resultat kunne bidrage til en større forståelse af afgræsningens betydning. Et eksempel herpå var et lokalt projekt med samarbejde

mellem landmænd og myndigheder omkring naturpleje, som havde øget landmandens motivation til at bruge SNG.

Opfattelsen af "godt landmandskab" omfatter for nogle landmænd høje udbytter og høj tilvækst, hvilket gør landmændene tilbageholdende med at bruge SNG. For nogle landmænd, er en tæt daglig menneske-dyre kontakt en motivation eller direkte forudsætning for produktionen og denne tætte kontakt kan være vanskelig ved SNG græsning, som ofte sker på fjernt liggende, større arealer.

Naturlige græsarealer har en lang tradition for at indgå i husdyrproduktionen, hvor de har været en integreret del af arealanvendelsen i århundreder. Moderne landbrugssystemer er organiseret omkring andre værdier og potentialer, hvorfor mange SNG nu ikke indgår i driften. Vores arbejde tyder på, at reintegration af SNG i landbrugssystemer ikke kun kan stimuleres af tilskudsordninger. Der skal desuden arbejdes med at forbedre afsætningen af oksekødet med oprindelse i SNG-baserede systemer og landmændenes engagement skal styrkes ved at øge deres viden omkring naturværdierne og hvorledes deres driftsledelse har indflydelse herpå.

Résumé

Pendant des siècles, les systèmes d'élevage européens ont fonctionné en lien avec l'utilisation des prairies semi-naturelles. À partir des années 1950, avec l'intensification de l'agriculture, de nombreuses prairies semi-naturelles ont été remplacées par des cultures fourragères plus productives pour alimenter un nombre croissant d'animaux d'élevage avec des fourrages de qualité. Il est maintenant reconnu que les prairies semi-naturelles sont généralement riches en espèces végétales et animales at qu'elles remplissent d'importantes fonctions environnementales ; elles sont, à ce titre, protégées en Europe. Au Danemark, la conservation et la restauration des prairies semi-naturelles sont l'une des priorités fixées par le gouvernement pour le maintien de la biodiversité. Toutefois, de nombreuses prairies semi-naturelles ne sont pas gérées de façon appropriée malgré différentes "primes à l'herbe" offertes aux éleveurs.

L'objectif global de ce projet de thèse est d'identifier et de comprendre les obstacles et les opportunités pour le développement de systèmes bovins allaitants basés sur le pâturage de prairies semi-naturelles. L'étude combine deux perspectives différentes. Tout d'abord, une analyse des systèmes de production agricole a été réalisée, basée sur l'étude de cas de douze exploitations allaitantes danoises avec une collecte de données qualitatives et quantitatives. L'étude explore les choix des éleveurs et leurs expériences liées à leur système de production et à leur utilisation des prairies (article I) et elle évalue les résultats techniques de ces exploitations avec une part plus ou moins importante des prairies semi-naturelles comme source d'alimentation des troupeaux (article II). Dans un deuxième temps et dans une perspective de filière, l'étude explore la manière dont les différentes dimensions de la qualité sont négociées et transmises dans les filières de viande bovine et la façon dont elles sont liées à des systèmes agricoles et à des pratiques de pâturage, dans le contexte français (article III) et danois (article IV).

Différents types de systèmes de production de viande bovine ont été identifiés au Danemark; leur différenciation repose sur leurs stratégies d'alimentation, leur recours aux prairies semi-naturelles, le type de race utilisée et l'élevage pour la voie mâle de taurillons ou de bœufs. Dans un premier système basé sur l'engraissement de jeunes bovins dès le sevrage, il apparaît que les performances des jeunes bovins ne sont pas affectées par les conditions de pâtures qui précèdent le sevrage en prairies semi-naturelles ou en prairies cultivées. Jusqu'à un hectare de prairie semi-naturelle par vache et sa suite peut être ainsi pâturé ou fauché. Un autre système, basé sur des animaux de races à fort potentiel de croissance, alimentés uniquement à l'herbe avec abattage de bœufs et génisses à 20-22 mois, est considéré comme prometteur. En effet, il combine une utilisation élevée des prairies (jusqu'à deux hectares de prairies semi-naturelles par vache et sa suite), produit des animaux appréciés par les filières; il est multifonctionnel en termes de bien-être animal, d'environnement, de qualité nutritionnelle de la viande et de la perception de sa sécurité. Dans ce deuxième système, les prairies semi-naturelles doivent cependant avoir des rendements fourragers élevés. Un autre système est basé sur des races rustiques qui passent toute l'année au pâturage sur les prairies semi-naturelles, souvent à faible valeur fourragère. C'est le système qui permet la plus grande utilisation des pâturages (une vache allaitante et sa suite pour environ trois hectares de prairies semi-naturelles). Ce système produit des animaux avec des caractéristiques qui diffèrent de ce qui est habituellement considéré comme une viande de qualité par l'industrie de l'abattage au Danemark. Pour que les animaux provenant de ce système soient reconnus comme produisant une viande de qualité, le cadre de référence pour la qualité doit être redéfini. Les cas étudiés ont montré l'importance de réunir et d'impliquer différents acteurs des filières, notamment des consommateurs pour parvenir à cette redéfinition.

Il apparait donc que les systèmes de production de viande bovine basés uniquement sur l'herbe et avec une forte utilisation des prairies semi-naturelles peuvent être considérés comme durables en termes de bien-être animal, d'impact sur l'environnement, de qualité nutritionnelle de la viande et de perception de sa sécurité. Il peut être également possible de les insérer dans une démarche de terroir.

Cette étude a également montré l'importance du point de vue des éleveurs dans leur utilisation des prairies semi-naturelles. Le pâturage des prairies semi-naturelles est considéré comme une méthode de conservation de la biodiversité et des paysages, mais la plupart des agriculteurs ne relient pas utilisation des prairies semi-naturelles avec conservation de la biodiversité. La plupart d'entre eux sont intéressés par la faune et la flore, mais concentrent leurs efforts pour leurs conservations sur d'autres parties de leurs exploitations. L'implication des agriculteurs dans le pâturage des prairies semi-naturelles pourrait être facilitée si leur connaissance des plantes et des espèces des prairies était développée et si le lien entre leur gestion du pâturage et la biodiversité des prairies était rendu plus clair. De nombreux éleveurs considèrent qu'être un « bon » éleveur passe par l'obtention de gains moyens quotidiens élevés des jeunes bovins et d'animaux « bien » classés en terme de poids et de conformation de carcasse; certains d'entre eux hésitent donc à utiliser les prairies semi-naturelles qui peuvent compromettre ces hauts rendements. Pour d'autres éleveurs, un bon contact homme-animal est une motivation ou une condition préalable pour l'élevage de bovins et ce contact étroit peut être perturbé par le pâturage des prairies semi-naturelles si elles ne sont pas situées à proximité de l'exploitation. À signaler qu'un projet local de coopération entre les agriculteurs et les autorités locales pour la conservation de la biodiversité et du paysage a été une motivation pour certains agriculteurs à utiliser les prairies semi-naturelles. Cette approche participative pourrait être développée dans d'autres régions afin d'impliquer d'autres agriculteurs.

Les prairies semi-naturelles ont fait partie intégrante des systèmes agricoles pendant des siècles, les systèmes actuels de production agricoles sont organisés autour d'autres valeurs et beaucoup de prairies semi-naturelles ont été abandonnées. Notre travail suggère que les incitations financières distribuées aux agriculteurs ne sauraient être suffisantes à la réintégration des prairies semi-naturelles dans les systèmes agricoles. L'évolution des modes de production ne peut réussir qu'avec la participation des agriculteurs en leur permettant de développer leurs connaissances et leurs compétences en gestion des pâturages. Des efforts devraient également être fournis pour faciliter la commercialisation des produits issus des systèmes basés sur les prairies semi-naturelles.

Contents

Appendix

The present thesis is based on the following papers, which will be referred to by their Roman numerals.

Introduction

1. Beef production based on grassland in the European context

The sustainability of livestock farming systems in relation to global concerns such as environmental impact of meat production, demand for meat products and quality of agro-ecosystem services has become a fundamental issue for public and scientific debate. Recent studies imagining the future of beef production in Europe have suggested that cattle production based on grassland and especially semi-natural grassland could answer some of these global concerns (Bernués et al., 2011; Hocquette and Chatellier, 2011; Stilmant et al., 2011).

Indeed, it has been shown that grassland- based production systems have several advantages in comparison to systems where feed is made of forage, cereals and plants product rich in energy and protein. The principal advantages are further described below.

As ruminants, beef cattle have evolved as grazers and have the capacity to live off grass and other plants because they can digest fibre via microbial fermentation in their rumen. Pasture-based systems allow the production of food for human consumption on land where no crops would be grown, if marginal land is used for grazing. Feeding crops such as cereals to livestock may be unsustainable because natural resources such as land, water and energy used by feed crops could be used for cultivating food crops or for preserving nature (Elferink et al., 2008). This is also referred to as the competition for land use between food and feed. Pollution with nutrients, pathogens and drug residues is usually lower in extensive grazing systems than in intensive systems with improved grassland and/or confined feeding (FAO, 2010). Mignolet et al. (1999)have shown that grassland beef steer production induces a lower pollution risk (per hectare feed) than a maize silage beef calf production system. In terms of climate impact, greenhouse gas emissions from extensive grazing systems and more intensive systems have been compared in different studies (Nguyen et al., 2012; Nguyen et al., 2010). Methane emissions from digestion are higher in extensive systems because of a higher slaughter age and lower forage quality, but grasslands can act as a carbon sink. Regions, climates and system management are highly variable but there is a potential for full compensation of emissions through grassland management in certain systems (Bellarby et al., 2012).

It is usually assumed that consumers value products from pasture-based systems more than others (Emanuelsson, 2008); in fact, these systems can be relevant because they correspond to an ideal many consumers have about farming, with cows on a green pasture (Verbeke et al., 2010). They can also be regarded as superior for animal welfare if the animals are less confined than in other systems (Bernués et al., 2011). Comparing grain and pasture-finished beef meat, it has been shown that pasture meat might be more healthy, containing a higher concentration of polyunsaturated fatty acids (PUFA) (Enser et al., 1998; Gatellier et al., 2005) and of conjugated linoleic acids (CLA) (Scollan et al., 2006). PUFAs (with an appropriate ratio of n−6/n−3) play an important role in the prevention of some human diseases (cancer, obesity and cardiovascular diseases) (Simopoulos, 1991) and CLA seems to be linked to a multitude of potential health benefits, including inhibition of carcinogenesis and a reduced rate of fat deposition (Scollan et al., 2006).

In the European context, grazing of semi-natural grasslands (SNGs) plays an important role for ecosystem maintenance. SNGs are currently regarded as a land use worth enhancing and a resource worth preserving, following the increasing recognition of their many services to the environment and society, such as landscape value and maintenance of biodiversity (Gibon, 2005). Each country of the

European Union (EU) has bound itself to protect SNGs and farmers can get support in the form of subsidies for using and managing SNGs (Silva et al., 2008).

Evidences show that pasture-based production systems have the potential to be sustainable systems for production of meat and environmental services. The latest point – SNG conservation for biodiversity protection - is the starting point chosen in this study because policies and projects are actually implemented for developing or sustaining the use of SNGs in Europe.

2. Semi-natural grasslands and biodiversity in the European context

a. Definition of semi-natural grassland

Grassland refers to a biome dominated by grasses, species of the Gramineae (Poaceae); the vegetation of grassland also includes other grasses, legumes and other forbs, and at times woody species may be present. The word grassland has evolved to cover a wide range of lands committed to a forage use (Allen et al., 2011).

Permanent grassland, semi-natural grassland, native grassland, unimproved grassland are some of the overlapping terms used when dealing with non-ploughed grassland. They are defined and used with different meanings depending on the context; history of the grassland (if and when it was last ploughed or re-seeded) and the presence of indigenous and domesticated plant species are some of the criteria used (Allen et al., 2011). Permanent pastures are defined in European Regulation 1120/2009 as "*land used to grow grasses or other herbaceous forage naturally (self-seeded) or through cultivation (sown) and that has not been included in the crop rotation of the holding for five years or longe*." There are discussions about the acceptability of trees and shrubs as being part of these areas.

In this study we use the term semi-natural grassland (or SNG) for pastures that have not been ploughed or reseeded for five years or longer, and that are used for animal grazing or feed harvesting for the cattle: it includes permanent pastures as defined by EU support schemes and also ligneous pastures such as heathland and pastures with wetland species. In contrast, we use the term cultivated grassland (CG) for land which is ploughed and re-sown at an interval of less than five years.

b. Semi-natural grasslands in Europe

Until the mid-20th century (and more recently in some areas) permanent pastures played an important role in livestock production systems and thus represented an important part of the agricultural area. According to estimations by FAO (FAOSTAT, 2012) in 1961 permanent pasture constituted 50% of the agricultural area in the EU. They were usually managed at low intensity and low fertilizer input. The replacement of permanent grassland with more productive forage crops has been a major objective in agricultural development after the Second World War and the ploughing up of permanent grassland in lowlands and hilly areas has been one of the most significant changes in agricultural land use since the 1950s (Poiret, 1999).

Statistics on the areas occupied by SNG are limited by the lack of precise definitions and different approaches followed in different countries. A report from the European Environment Agency (EEA) estimated that 31.9% of the European agricultural land supported farmland of high nature value (mostly grassland) based on the EU27 countries (Paracchini et al., 2008)). There are large differences between the countries in terms of coverage and types of ecosystems: the percentage of high-nature-value farmland ranges from 5.0% of the agricultural land in Denmark to 78.4% in Slovenia. Another EEA report estimated the share of high-value farming of 15 to 25% of the agricultural area in EU-15 (European Environment Agency, 2004).

A recent review (Emanuelsson, 2008) noted serious losses of SNG due to the lack of grazing systems for maintaining SNG in Norway, Benelux, Denmark and in parts of Germany, UK and Sweden.

c. Semi-natural grassland and biodiversity

The biological diversity in European SNGs is very high. A very large proportion of Europe's most threatened bird species, vascular plants and insects live in these grasslands (Condé et al., 2010; De Bello et al., 2010; van Swaay, 2002). For Denmark, this is the case for 63% of the red-listed plants (Ejrnæs, 2009). Some grasslands in central Europe have been shown to be the most species-rich ecosystem in the world with up to 89 plant species per square meter, higher than what is found in tropical forests (Wilson et al., 2012).

Since grazing and mowing rarely kill the plants, defoliation is generally believed to reduce the competitiveness of plants (Klimek et al., 2007). The grazing by domestic cattle, as non-selective grass roughage eaters, leads to the suppression of large and abundant plants, which increases plant diversity if grazing intensity is moderate (Hulme, 1996). Furthermore, grazing and mowing practices increase small-scale structure diversity and light and temperature radiation (Pykälä, 2000). Small-scale structure diversity may increase biodiversity inside the pasture, enabling species establishment through niches, whereas more light and a higher temperature may increase the diversity between grassland and the other adjacent ecosystems. Floral diversity and local conditions of higher temperatures and solar radiation create conditions that are favourable for many birds, butterflies, bumblebees, grasshoppers and wasps in the ecosystem (Öckinger et al., 2006).

Their anthropogenic origin explains why grassland areas (except in the alpine and arctic areas) soon convert into bush when they are abandoned (Metera et al., 2010). Besides the intrinsic value of species richness in SNG ecosystems, their high biodiversity makes them providers of several ecosystems services such as pollination (Ockinger and Smith, 2007), seed bank and possibly pest control services (Kotze and O'Hara, 2003).

d. *Conservation of semi-natural grassland*

The value of semi-natural grasslands is now well acknowledged in Europe and political decisions have been taken in order to maintain them.

"*Since permanent pasture has a positive environmental effect, it is appropriate to adopt measures to encourage the maintenance of existing permanent pasture*" (Council Regulation (EC) No 1782/2003).

Unlike, for example, natural forests where nature reserves can be established, semi-natural grasslands require management and management requires active farmers who can fully or partly make a living from these grasslands. The principal instrument in place for supporting SNG use is subsidies.

Despite this engagement, SNGs of high biodiversity are threatened ecosystems in many parts of Europe; the main threats are intensification (re-seeding, heavy fertilizer use), abandonment with subsequent shrub encroachment and transformation to arable land (Condé et al., 2010).

3. Danish context

a. Semi-natural grasslands in Denmark

Denmark has the lowest share of high-nature-value farmland in its farming area of all the European countries: the values in European reports range from 1% (based on Farm Accounting Data Network) to 5% (based on land cover, Corine database) (European Environment Agency, 2004).

In the first half of the 19th century, open nature landscape types (heathland, sand dunes, salt marshes, dry meadows, bogs and meadows) covered about 60% of the land area (Wilhjelmudvalget, 2001). Nowadays they occupy about 7% of the agricultural land area (Danmarks statistik, 2012). Traditionally, these SNGs have been used for the grazing of cattle, primarily heifers of a dairy breed, but this has diminished due to a general specialisation of the agricultural sector and not least an intensification of the dairy production leading to the use of permanent indoor feeding systems. Another reason of this decrease is that the economic rationale for "extensive" grazing farms has become difficult and many areas have therefore been abandoned or ploughed.

Danish permanent grasslands present a very diverse range of ecosystems and can be classified as: heath, dry meadow, salt marsh, non-coastal meadow and moor and fen. They are mainly situated on the western coast of Jutland and along the valleys of the rivers (see figure 1).

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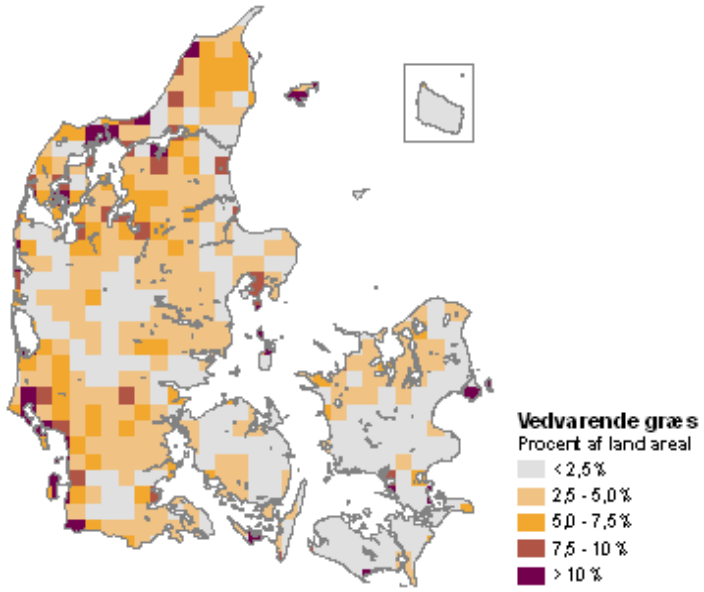

Figure 1: Percentage of permanent grassland in the land area in a 10 km^2 grid (Anonymous, 2003)

It is difficult to assess the productivity and forage value of SNGs because they vary in terms of floral composition, management and from year to year, but a rough estimation has been made by Buttenschön (2007) (table 1). It can be compared to 4000 to 6000 FE/ha expected in cultivated grasslands.

Table 1: Estimation of SNG yields in Denmark (Buttenschön, 2007)

Type of pasture	Production (gross, kg dry matter per ha)	% of utilisation	Yield (net energy for cattle – FE/ha) [a]
Heath	2000-3000	15-20	250-400
Acid meadow, nutrient-poor	4000-5000	25	600-800
Dry meadow, nutrient-rich	4000-5000	25-30	800-1000
Wet meadow, nutrient-rich	7000-8000	30-50	1800-2800

[a] FE: Scandinavian feed unit, 1 FE is about 7,8 MJ metabolisable energy

In the last 20 years the total area under permanent grassland has stabilised (Danmarks statistik, 2012) , but their ability to support a high biodiversity is declining (Ejrnæs et al., 2011). Therefore, many of the plants and animals which are threatened by extinction in Denmark are related to grassland ecosystems; this is the case for 63% of Danish red-listed plants (Ejrnæs, 2009).

Maintaining SNGs and their biodiversity is a goal of Danish policies, for which a target of an additional 40,000 ha to the 130 000 ha under the Natura 2000 scheme has been set for 2020 (Regeringen [Danish government], 2009). Despite this engagement, grassland abandonment and encroachment of shrubs and trees remains a major problem, as the most recent report on the status of biodiversity in Denmark points out (Ejrnæs et al., 2011). It is estimated that "open nature landscape" which needs to be managed by grazing or cutting in order not to grow into bushes is about 134,000 ha, excluding the Natura 2000 areas (Busk A.G., 2012). It is not known how many of these areas are used by farmers for grazing or cutting, but 68,000 ha are registered in a scheme where farmers are committed to using these areas for grazing or cutting for a period of five years, for which they receive a subsidy. This corresponds to only 18% of the total area needs management by cutting or grazing (Nygaard et al., 2011). For reaching the government target for 2020, about 100,000 new hectares of SNG should be registered with commitments for grazing or cutting.

b. *Beef production and meat sector*

In Denmark beef production from suckler herds is relatively small compared to the dairy sector; there are about 5.7 times more dairy cows than suckler cows (Anonymous, 2012d). There are a little less than 100,000 suckler cows in Denmark, mainly on farms with relatively small herds − on 84% of the farms herd size is below 20 cows (table 1) (Anonymous, 2012d). In comparison, the average herd size in the EU-27 is 31 suckler cows per farm (Anonymous, 2011b). These small cattle farms are spread throughout the country, but especially be found in western and northern Jutland, where also most of the SNG areas are located (Anonymous, 2002). Hypothetically, these cattle would have the potential to graze most of the SNG that needs to be grazed (Nygaard et al., 2011). There is very little or no information available on the organisation of the production systems on Danish suckler farms.

The meat industry has evolved over the last decades towards a concentration of the slaughter and processing industries and of the retail sector. In Denmark, Danish Crown, which is a cooperative slaughterhouse, slaughters 60% of the cattle in Denmark, seven medium-sized slaughterhouses slaughter 35% and the remaining 5% are slaughtered at small slaughterhouses that process less than 50 heads per week (Anonymous, 2012d). The same structure usually also transforms the carcass into packed meat for consumption. Danish Crown is the owner of Friland A/S, which is a major player for

"quality beef" in Denmark since the 1990s and has developed concepts based on quality beef products such as organic beef and young cattle from beef breeds. In the retail sector there is also a high concentration as 89% of the market is in the hands of three supermarket chains (Anonymous, 2011a). There are no statistics on the number of butchers in meat marketing, but there are only about 400 butchers left in Denmark (one butcher per 14000 Danes). The meat which can be bought mainly originates from dairy cows and dairy young bulls (table 2). In a supermarket, there is usually very little differentiation of the beef other than the price. The list over authorized beef meat outlets (Anonymous, 2012b) shows that the elements of differentiation of the meat are tenderness of the meat, breed and country of origin; few claims are related to on-farm production methods for 2012, and there are three certified segments: organic, animal welfare and use of nature grazing.

Table 1: Suckler cows by herd size in 2011 in Denmark (Anonymous, 2012d) - Farms are included in these statistics if they use more than 5 ha in Denmark.

	Farm (%)	Suckler cows (%)
1-19 cows	84	48
20-29 cows	8	16
30-49 cows	5	16
More than 50 cows	3	20

Table 2: Production of slaughter animal by categories included both dairy and beef breeds in Denmark in 2010 (Anonymous, 2012a; Anonymous, 2012d)

Total slaughter weight (1000 tonnes carcass)	134
Cows (% of total)	45
Heifers (% of total)	9
Bulls (% of total)	43
Steers (% of total)	3
Veals (% of total)	0,4

Aims and structure of the PhD study

1. Aim and research approach

The aim of this PhD study is to identify and understand barriers and potentials for the development of pasture-based beef production systems including conservation grazing in Denmark.

An intermediate objective is to characterise and describe beef production systems with a high use of grass in the diet and which can include conservation grazing of semi-natural grassland.

In Denmark, despite subsidies given to the farmers, large areas of SNG remain managed in an inappropriate way. Understanding the mechanisms behind farmers' use of different types of grassland resources would help in the design of policies and projects to reach the objectives for SNG maintenance. In the Danish context, suckler systems are relatively marginal and there is no available knowledge about suckler systems and their use of SNGs. At European level, researchers have been working with beef production on semi-natural grasslands mainly through experiments (Fraser et al., 2009; Hessle, 2007; Hessle et al., 2011) which show that meat production based on SNG is a viable option, but little is known about farmers' actual management and their results. Some studies have looked at SNG in a land-use perspective (Girard et al., 2008) and other studies have modelled the interactions between cattle feeding and floristic diversity (Jouven, 2006); but studies combining both approaches and looking at the links between herd management and land use are rare.

We have used two issues for the design of the present study: the first is the importance of regarding farmers as actors and the second is the importance of the food chains and their definition of the "good product".

Farmers are the actors who make the choice of farming and management systems within an economic and social context. Farmers' perceptions of nature (Ahnström, 2009), their values and self-perception (Siebert et al., 2006) have been recognised as being of importance in various studies dealing with farmers' involvement in nature or environmentally friendly management. Thus, the present study was designed with case studies of farms and interviews with farmers where the farmers were encouraged to talk about their feelings and thinkings about their choice of farming systems. This study is reported in **paper I**.

The work of P. Stassart and his colleagues (Mormont et al., 2006; Stassart and Jamar, 2008) has shown the importance of understanding the reference frame for the food chains, which means how actors define what a "good product" is. They have shown that the tacit agreement around the "lean and tender" conventional reference in the Belgian beef sector can be incompatible with the development of organic beef. They also showed that new reference frames can be built up when involving several actors such as consumers, activists and farmers (Stassart and Stilmant, 2012). Following the idea of the importance of the food chains in setting reference frames, the present study investigated various food chains, their negotiations for and definition of a quality product and its impact on production systems. This has been done in Denmark (study reported in **paper IV**) and in a French region (study reported in **paper III**). The French cases are used as counterpoints and highlight the specificity of the Danish food chains. In France, beef meat is differentiated by several quality labels (6% of total beef production), which are mainly marketed by butchers and also by supermarkets (Anonymous, 2011c; Berthomeau et al., 2011). Cattle raised for quality beef labels have usually been raised on grass for two to three years, often on permanent pastures and then finished with high-energy diets. Suckler-cow systems play a key role in French livestock farming: more than one in two French cows is a suckler cow and cow-calf production yields 60% of the beef consumed in France.

It was decided to concentrate the study on suckler herds. The development of the production of steers from dairy breeds in Denmark has previously been extensively studied by B. Nielsen (2003).

2. Methodology

This study was built on an interdisciplinary strategy, bringing agronomical and sociological approaches together in order to study land-use practices from a systemic point of view. It is based on case study methodology. Case study has been defined as an "empirical enquiry that investigates a real-life phenomenon within its real-life context" (Yin, 2003). There were case studies on beef farms in two investigations: Interviews with farmers and farm visits (**paper I**) and on-farm measures and registrations (**paper II**) and case studies of food chains based on interviews with butchers, slaughterhouse workers, cooks, certification officers, and farmers in the chain (**paper III and IV**). These studies do not include consumer research, but actors in the food chains reflected on their contacts with consumers, and literature from consumer research was used.

The detail of the methodology of each study is reported in the corresponding papers.

The present study can be sub-divided into four sub-studies each reported in one manuscript. They are (1) Analysis of farmers values and their farming systems and the use of semi-natural grassland (SNG) and cultivated grassland (CG) for herd feeding. It is based on case studies with interviews on 12 Danish farms and reported in **paper I**; (2) Assessment of production results, animal welfare and biodiversity of the same farms (10 of the 12 farms) reported in **paper II**; (3) Quality definition and communication in food chains in Denmark (**paper IV**) and in France (**paper III**).

III - Brief overview of each paper

The present study can be sub-divided into four sub-studies each reported in one manuscript. They are (1) Analysis of farmers values and their farming systems and the use of semi-natural grassland (SNG) and cultivated grassland (CG) for herd feeding. It is based on case studies with interviews on 12 Danish farms and reported in **paper I**; (2) Assessment of production results, animal welfare and biodiversity of the same farms (10 of the 12 farms) reported in **paper II**; (3) Quality definition and communication in food chains in Denmark (**paper IV**) and in France (**paper III**).

The objective of **Paper I** was to understand farmers' choices and experiences related to the grazing of semi-natural grassland (SNG) in comparison to cultivated grassland (CG). We conducted detailed case studies based on qualitative interviews and farm visits to 12 Danish beef farms.

We constructed a model based on farmers' values related to their production, which allowed us to understand and explain farmers' use of SNG. These values are "productivity and high animal growth", "low input – low cost" and "care and close farmer-animal contact ". Farmers who are oriented towards productivity and high animal growth only include SNG for the feeding of reproductive animals, while inclusion of SNG for farmers in a "low input - low cost" orientation makes sense in their farming system. Farmers who highly value a close contact with their animals have different attitudes towards SNG grazing mainly depending on the distance between the farm and the SNG area.

Farmers' values related to nature quality are mainly not directed towards SNG. For many farmers, SNG grazing is not an environmental commitment and they do not perceive SNG as especially more beneficial for the environment than CG.

Marketing channels for the meat can be seen both as a barrier and potential for more SNG-grazing. We observed that some farmers changed their systems to include SNG in order to sell to a new channel, but the values of the major Danish marketing channels conflict with a high inclusion of SNG.

Paper II aims at evaluating technical results of beef farms with a low or high inclusion of SNG in the herd feed, and identifying constraints and possibilities for combining conservation grazing with animal welfare and product quality. It is based on data recordings from ten Danish farms over one year. The size of the herds varied from 5 to 213 suckler cows. We identified four different systems based on type of breed and feeding strategies: (1a) a traditional system, which is based on high-growth-potential breeds with summer grazing on cultivated grassland (CG) with no SNG and finish-feeding of young animals for slaughter; (1b) a system similar to (1a), where SNG was used for summer grazing in complementarity with CG and constituted up to 20% of the feed supply of the herd over one year; (3a) a system based on high-growth-potential breeds on CG and SNG, with up to half of the diet deriving from SNG; and (3b) a system based on a rustic breed grazing SNG all year round.

Systems 1a and 1b produced similar high-quality carcasses (over 8 points on 1-15 points EUROP scale for young males), and growth of the herd (over 200 kg live weight gain per livestock unit over one year) seemed not to be affected by the use of SNG. Systems 3a and 3b were based almost exclusively on grass for feeding (over 96% of the diet). Our limited sample shows that it is possible to produce a high-quality carcass in system 3a (over 8 points on EUROP scale for young males), with a relatively high percentage of SNG in the feed. System 3b produced low-quality carcasses according to slaughterhouse standards, but consumers may attach different quality standards to this more natural scenario.

In terms of impact of the systems on conservation of biodiversity, system 3b showed a higher potential in a product perspective (over 100 m^2 of valuable biotopes conserved per kilogram of carcass) than system 3 (20 to 30 m^2), which in turn is higher than in systems 1 and 2 (between 0 and 2 m^2).

We could not reach clear conclusions about the superiority of one system over another in terms of animal welfare because the results are very farm-dependent, but farms in systems 3a and 3b achieved high aggregate scores and the farms with the lowest aggregate scores were in systems 1a and 1b. The principal welfare issues were linked to confinement and lack of space in the animal housing in systems 1a, 1b and 3a and to weight loss in winter in system 3b.

Farms in system 2 were included in the study reported in paper I but are not reported in paper II as the farmers could not participate in the data collection.

The aim of **Paper III** was to explore how different quality dimensions (safety, aesthetics, ethics and rootedness) are created in food networks; how these qualities are transferred along the network until the consumers; and how this process is supported by the organisation of the food network. Our postulate was that combining the quality and organisational dimensions and exploring the link between them would provide an interesting perspective for improving the sharing of values in food networks. This framework was applied to five case studies of "pasture-raised beef" food networks in France, representing a diversity of organisations such as a public label scheme, cooperative-owned brand and direct sell from farmer to consumer. The results highlight the importance of the role of certification and personal commitment for the creation, and also for the mediation of added-value. Qualities that are exclusively created at farm level (in these cases, ethical qualities) are transmitted directly from the farmer to the consumer either by direct contact or through posters, which are made possible by certification. The involvement of other actors in mediating "farm only"-based qualities is limited but actions to this end are undertaken.

Paper IV is based on a multiple case study analysis of six quality beef meat food networks in Denmark. It examines the coherence between beef production systems beef, the handling of the product in the food chain and communication of the quality of the meat in the chain and to consumers. In several of the cases we observed incoherence between farming practices and communication about farming practices. The image that the animals have had "*a good life out on a green pasture*" is emphasised even in the chains that rely on production systems with confined finishing of the animals for several months before slaughter. We observed it both in long chains with supermarket outlets and in chains with direct farmer-consumer contact. Generally, we observed that chains attempt to connect to consumers' ethics but rarely convey factual information about farming practices. It might make it difficult to sell meat from grass-only systems because these practices affect organoleptic qualities (flavour, tenderness, colour) and make the meat slightly different from conventional meat. The example of the grazing association shows that when consumers get involved in production and production decisions, they can experience differences between grass-only feeding systems and systems with confined finishing and chose the first one.

IV Results and discussion

In the first part of this section, the different beef production systems identified in this study will be presented and described. In the second part, different dimensions for analysing the sustainability of the production systems will be presented and discussed. Each of these dimensions will subsequently be applied across the production systems and will be discussed in relation to the results of this study and relevant literature. For each of the dimensions, the results and discussion will allow the identification of possibilities and barriers for the development of grass-based and SNG-based systems.

1. Production systems of beef and use of grasslands

a. Description of systems

Beef production from suckler herds in Europe is largely based on grassland production with a variation of systems across climatic regions and dynamics of rural development. In the studies reported in papers I, II, III and IV, cases were identified within suckler-based beef production. The classification used in this study highlights the role of grassland and semi-natural grassland in the beef production of the systems, and is therefore useful for discussing the development of grass-based beef production systems. Cases have been classified into three systems according to the composition of the feed, reflecting the importance of grass in their feeding regime. Details of these systems are summarized in table 3. System 1 is characterised by the rearing of cow-calf on grass, directly followed by confined feeding of the young animals after weaning. System 2 is characterised by the rearing of cow-calf on grass, grazing of the young animals and finish feeding with concentrate. System 3 is based on grass-only feeding where cattle are grazing in summer and get conserved grass in winter; they are slaughtered directly from grass or forage. The systems differ also in terms of breed and age and weight at slaughter. These systems can further be subdivided into sub-systems according to the place of semi-natural grassland in the systems and the age at slaughter. The systems discussed in this thesis represent the systems studied in France and Denmark. They are:

- 1a: cow-calf on cultivated grassland (CG), finishing directly after weaning
- 1b: cow-calf on semi-natural grassland (SNG), finishing directly after weaning
- 2a: the young cattle spend one grazing season outdoors after weaning, then finishing
- 2b: two or three grazing seasons before finishing
- 3a: grass-only feeding with use of both CG and SNG, one or two grazing seasons.
- 3b: grass-only feeding, all-year-round on SNG, two to five grazing seasons.

Bulls are produced in systems 1a, 1b and 2a and males are castrated for producing steers in systems 2b, 3a and 3b. In system 1, heifers are on some farms treated as the bulls but with a little longer finish feeding and on other farms they have one grazing period (in Denmark) or several grazing seasons (in France) before finishing, as in system 2. Farms in system 3 were found in Denmark but not in France. Browsing the literature about beef farming in France we do not find examples of grass-only systems in France. Organic beef as well as speciality beef such as PDO-marked Fin Gras du Mezenc, fattened with mountain hay, are described, with cattle given a cereal and protein complement to their grass-based diet (Chapus, 2008; Pelletier et al., 2011).

The two last rows of Table 3 illustrate the place of grassland to herd feeding in the different systems, some of the values are only based on a few cases but they have a more general value, as they make sense according to agronomic and animal feeding knowledge. They show that systems 2b and 3b can be managed with a very high use of SNG for feed production (over 90% of the herd feed intake). Systems 3a

and 3b could theoretically be managed as grass-only systems; in the cases investigated in paper II a smaller part of the feed was in the form of straw − a very low quality forage.

b. Representativity and limitations

This classification of the systems fits well with the major European beef production systems which were defined in a work by the European Commission (Canali et al., 2001) in terms of age and weight at slaughter of the animals as well as feeding regime. For suckler herds the following groups were identified:

- 16-month bulls fed grass silage and concentrates, 16-18-month bulls fed maize silage and concentrate, 12-15-month bulls fed a cereal-based diet. All these systems are based on the finishing period starting directly after weaning as with system 1 of the present study.
- 2-year-old steers with one grazing season and finishing based on concentrates, corresponding to category 2a or 2b of the present study
- 2.5-year-old steers and heifers with grass-based feed, finished on pasture in their third summer. This corresponds to category 3a of the present study.

The European commission report (Canali et al., 2001) also details systems with rearing and fattening of steers and heifers from dairy breeds, which were out of the scope of this study, namely suckler herds with meat production.

In the present study categories were refined to reflect variation in the systems depending on their use of grassland. This categorisation is based on an agronomic understanding of the systems. The three systems cover all possible suckler systems based on feeding strategy: no grazing after weaning, grazing/grass feeding after weaning and later finishing with concentrates or only grazing/grass feeding. Within the three main systems there is some variability which can be illustrated to some extent based in the case studies presented but they probably do not cover the full variability of European, or Danish and French systems.

Farms in system 2 in Denmark are included in the study reported in paper I, but are not reported in paper II as the farmers could not participate in the data collection.

The sampling strategy for selecting the farms in Denmark was to capture the diversity of production systems based on a variety of marketing channels of the meat, breeds and size of the herds. This was successful as a considerable variety of farming systems can be described here. It would, however, be worth continuing this study by extending it to include a larger number of farms.

Table 3: Characteristics of the beef production systems identified in Denmark and France and discussed in this study

	System 1: Finish feeding with cereals and concentrates starting after weaning		System 2: Grazing or forage feeding after weaning ,finishing with cereals and concentrate		System 3: Grazing and grass-feed-based feeding only	
	1a	1b	2a	2b	3a	3b
	cow-calf on CG	cow-calf on SNG and CG	one grazing season	2 or 3 grazing seasons	CG +/- SNG	All year round on SNG
Type of breed	High growth potential (Charolais, Limousine…)	High growth potential (Charolais, Limousine…)	Medium potential breeds (Simmental, Angus, Hereford…)	All type of breeds	High growth potential	Rustic breeds
Age at slaughter	10-18 months	10-18 months	14-20 months	Over 30 months	20-28 months	30-54 months
Typical slaughter weight	300-320 kg (Dk) 350-400 kg (Fr)		About 300 kg (Dk)	160-450 kg according to breed[b,f]	Around 300 kg (Dk)	190–280 kg (Dk)
Examples Danmark	Farms A, B, C[a]	Farms E, F, G[a]	Farms D and I [b] And heifers from some farms of system 1		Farms D and H	Farms I and J
Market outlets in Denmark	Friland Limousine, Angus and Kødkvæg Direct-sell farmer–consumer		Nordjysk Naturkød, Friland Kødkvæg [e]		Organic, direct-sell farmer-consumer and grazing association	Direct-sell farmer-consumer, organic, and grazing assoiation
Examples in France	Young bulls – sold on bulk market, and farmer selling directly to consumer [c]			Farms selling for gourmet meat and speciality labels (Label Rouge, Nature park Label, PDO)		
Share of grass in herd feeding	30-65% [a]	60–85% [a] 63-65% in Fr.[d]		85-94% [d]	98-99% [a]	96% [a]
Share of SNG in herd feeding	< 4% [a]	14-18% [a]		Up to 94% (nature park Label and PDO)[c,d]	Up to 45% [a]	Up to 96% [a]

[a] paper II, [b] paper I, [c] paper III, [d] (Devun and Guinot, 2012), [e] probably also some organic beef producers, not included in this study, [f] (Casabianca et al., 2005), CG: Cultivated Grassland, SNG: semi-natural grassland, PDO: Product Denomination of Origin, Fr.: France, Dk.: Denmark

2. Dimensions for analysing the sustainability of beef production in the different systems

a. Approach

For understanding the phenomena determining the reproducibility of beef production systems, it is essential to combine different approaches and scales. The concept of sustainability is appropriate as it gives a holistic view of the systems. The concept of sustainability is not objective or static; it depends on the present and future needs of society, which are also changing (environmental demands, ethical concerns) (Bernués et al., 2011) and also of the perspectives of the actors. Sustainability is usually analysed across three dimensions: environment, economics and social. Hocquette and Chatellier (2011) suggested a scheme for analysing the sustainability of livestock production (figure 2).

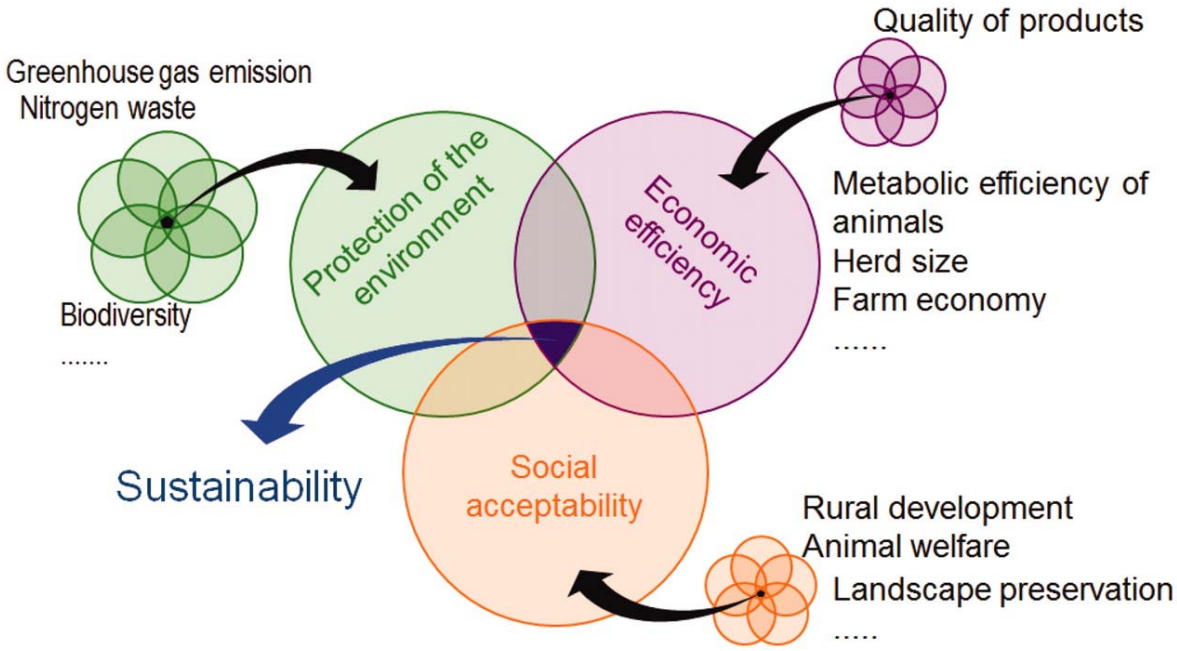

Figure 2: Sustainability of livestock farming is a multidimensional approach with three major dimensions, which result, in turn, from the aggregation of different criteria (Hocquette and Chatellier, 2011).

In the present study, the perspectives of different actors in beef food chains are considered. It is as if we would try to build a three dimensional figure of sustainability with different concern carried by different actors. Livestock production systems are shaped from the demands made on them in the market; the animals are sold for meat production which implicates different actors of the food chain – farmers, professionals at the slaughterhouse and transformation industry, butchers, cooks and consumers. The perspectives of these actors on animal and meat shape farming systems in terms of their willingness to pay for the product, chose it among others and give meaning to it.

The perspective of the different actors is analysed through the concept of quality. In the present study, quality is considered as a social construction, where the operators of the network carry out negotiations on the technological qualities of the goods exchanged. Qualifying a product is thus not just a question of

the characteristics of the final product, but the result of convergent representations of the different actors of a food network (Casabianca et al., 2005). Quality cues are communicated and chosen for marketing for consumers, but also reflect actors' choices and concrete actions related to the product.

The analysis is based on interviews with these actors. In the case of consumers, however, it is based on available literature from consumer research and on the communication of the food network with consumers.

b. Quality as communicated to consumers

In the case studies of quality beef meat chains in Denmark and in France (papers III, IV and Annex A (poster)), the meat product and the different dimensions quality can take for beef meat were analysed. The analysis was inspired by the tradition in marketing of describing the core product and augmented product characteristics. Here is a list of all possible dimensions of quality encountered during the case studies in a consumer perspective, both in France and Denmark:

- Safety (sanitary quality, freshness)
- Health and nutrition (presence of healthy micro-nutrients, fat)
- Convenience (packaging, easiness to handle and to prepare)
- Organoleptic (flavour, juiciness, tenderness, colour)
- Ethics (animal welfare, contamination, landscape, biodiversity, supporting local farmers, respect for natural rhythm)
- Rootedness (connection to traditions, culture, the food is produced by someone, somewhere, regional identity, local breed)

These quality cues are similar to the ones which have been identified in other food networks (Brunori, 2007; Conner et al., 2008; Edwards and Casabianca, 1997; Morris and Young, 2000; Niggli et al., 2008).

Consumer studies have shown that consumers have different expectations of beef quality. Based on a pan-European study, Grunert and Valli (2001) divided consumers into four segments: the "moderate" relate mainly quality to taste and tenderness, the "health-conscious" look for lean and tender products, the "concerned" focus on animal and eco-friendliness, the "knowledgeable" know a lot about the characteristics of beef leading to its quality and are not very concerned about environmental issues. At the time of the study, the "moderate" and the "knowledgeable" were the dominant segments in the Danish as well as in the French population, at respectively 62.3% and 26% in Denmark and 56.1% and 18.1% in France.

c. Quality for farmers in their farming activities and in the production of beef meat

During the interviews with the farmers, they were asked about their likes and dislikes and what constituted the driving forces in their activity as cattle farmers (paper I). They can be grouped under the following dimensions:

- Personal enjoyment (of the contact with animals, of observing nature, of driving tractor)
- Intellectual satisfaction (solving challenges, getting better results, making experiments, being a recognised breeder...)
- Ethics (respect for nature, respect for the animals, organic, producing good meat for people)

- Relation to other farmers (as part of a breeder association or a local group for landscape management) and to the rest of the society (show that you are a good farmer, sell good meat to people, get positive feedback from consumers, attract tourists)
- Sound economy

These factors are important for farmers in order to continue farming and for their choice of farming systems and management of their herd. Farmers produce mostly animals and have little contact with the meat itself but most of them had an opinion about product quality, especially the ones practising direct sell, as also discussed by Delavigne (Delavigne, 2008). Their considerations linked types of feed and feeding management with meat flavour and tenderness; they also considered type and length of maturation of the carcass.

d. Quality for the other actors in the supply chain

Quality of the product was also examined for different actors of the chain such as butchers, slaughterhouse workers, supermarket workers and cooks (papers III and IV). Their considerations mainly relate to the following issues:

- Uniformity of the product (easiness of working with the "same" product, easiness of satisfying the expectation of the purchaser)
- Capacity to satisfy consumer expectations in term of colour, visible fat, flavour and tenderness
- Muscle size and conformation (depending on carcass characteristics, a muscle can be cut so that it is sold for grilling or for slow-cooking, thus with a price difference)
- Stable relationship with suppliers and customers
- Maintaining traditions and knowledge of good handicraft
- Good stories from the producer which can be used for marketing
- Coherence between farming practices and own ethics, supporting local rural development

e. Dimensions for the analysis across the systems

These issues related to farmers, meat chain actors and consumers can be discussed across the beef production systems including different types of grass use. This discussion across the systems allows an assessment and discussion of strengths and weaknesses of the different beef production systems and of their integration in the beef meat market, and thus allows the identification of barriers and drivers to the development of pasture-based systems.

The following issues are relevant when discussing the results presented in papers I, II, III and IV.

- Animal growth and resource efficiency
- Environmental impact
- Animal welfare
- Quality of the products for transformation and organoleptic quality
- Safety
- Locality and traditions

These issues are related to the ones presented by Hocquette (2011) and represented in figure 2 but integrate also some dimensions which originate from the diversity of actors' perspectives.

3. Animal growth and resource efficiency

SNGs have for many years been considered a limiting factor for the development of more efficient livestock systems and their replacement with more productive forage crops has been an objective in agricultural development (Gibon, 2005). SNG-based systems usually give lower animal growth than systems based on cultivated crops (Fraser et al., 2009) and are often considered as inefficient (Bernués et al., 2011). The results presented in this study (paper II) show, however, that animal growth can be relatively high, also in systems including grass-based feeding and SNG-grazing.

Results show that system 1b can produce growth of the herd and a daily gain of young bulls similar to system 1a (figure 3). Thus an input of SNG-grazing for the cow-calf herd of up to 20% of the feed seems to have no negative effect on herd and bull growth. This can have two reasons. One is that the growth of calves before weaning is similar on CG and SNG, as has been observed in Norway (Steinshamn et al., 2010) in a comparison of mountain pasture and low-land cultivated pasture, or in Ireland (Drennan and McGee, 2009) and Finland (Niemelä et al., 2008). Steinshamm hypothesised that the cows might have directed more resources towards milk production rather than body reserve deposits and thereby lessened the adverse impact of feed restriction. Another reason can be that there were differences in weight at turnout onto pasture and that those differences were compensated by a higher growth at a later time. This could be endorsed by the fact that farms in system 1b had relatively higher average yields on CG than farms in system 1a. This result of similar weight gains for farms with SNG grazing as with CG grazing for the cow-calf phase (systems 1a and 1b) is consistent with large regions of permanent pastures supporting beef systems in "calf-to-weanling", for example in France (Dussol, 2003) and in the UK (Hopkins, 2008).

The systems with animals exclusively on grass (3a and 3b) produce steers slaughtered at an older age than bulls in system 1. Growth rates of steers are usually lower than those of bulls (Hessle and Kumm, 2011; Jarrige and Auriol, 1992).

In system 3a slaughter weight of the steers is similar to that of bulls slaughtered in systems 1a and 1b, but the steers are about eight to ten months older. It shows that finish-feeding after weaning for three to five months with silage-concentrate can give similar results in terms of animal slaughter weight as grazing and conserved grass feeding for 11-15 months for Limousine-type breeds. However, in the cases reported here, dressing percentage was on average lower for the farms in system 3a than in system 1.

On farm J, where SNG-feeding made up 45% of the herd feed, steers spent their second grazing season on SNG and were 1.5 months older when slaughtered than on farm ML but achieved a similar slaughter weight (23 months and 316kg +/- 25 at farm J; 21.7 months and 318 +/- 32 kg at farm F). This last result is in contrast with the findings of Nielsen and Kristensen (Nielsen and Kristensen, 2007) who showed that permanent pasture was not optimal for steers after the first grazing year and that clover-grass pasture should be preferred.

In system 3b, the combination of the factors of rustic breed, production of older animals and SNG all-year round gave relatively lower weight gains for the steers. Their slaughter weight was similar to the statistical data for those breeds in Denmark (Nielsen, 2009).

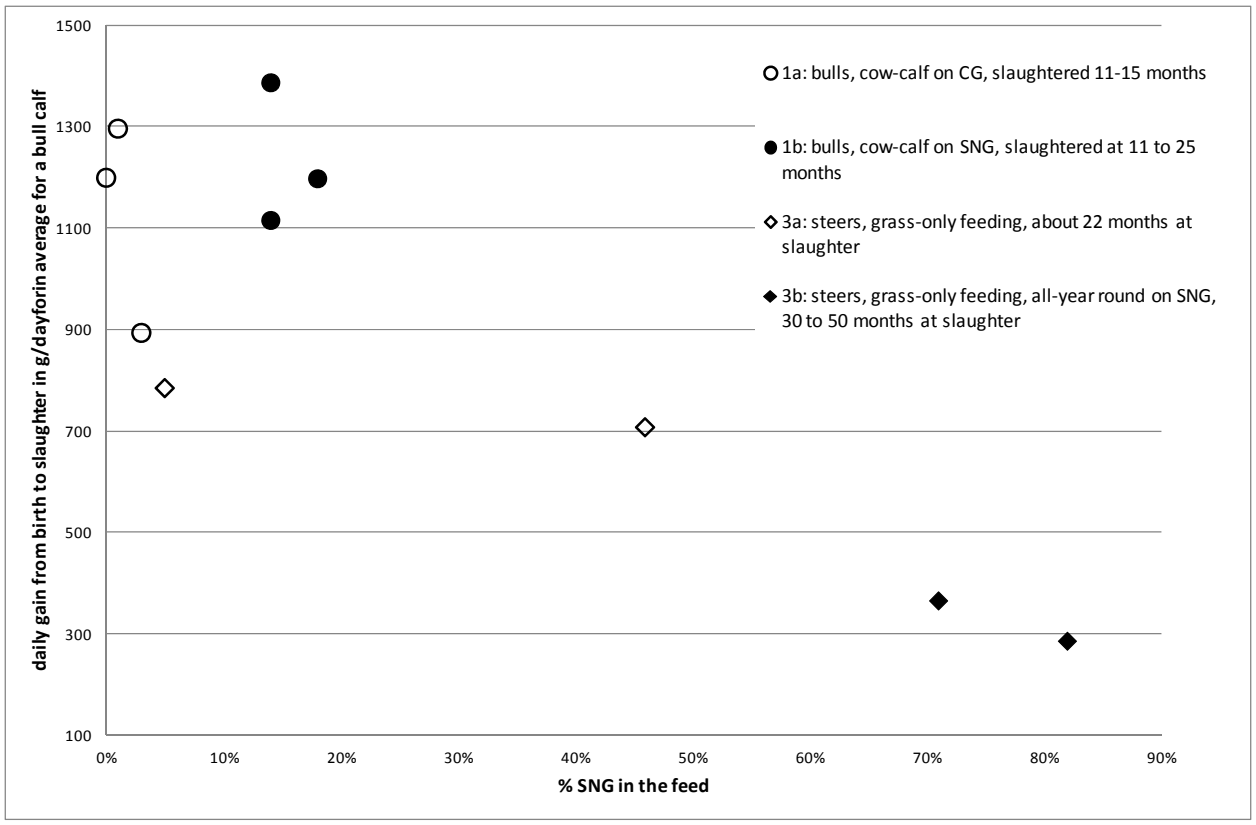

Figure 3: Estimated daily gain from birth to slaughter of young males for each farm in relation to the proportion of feed deriving from semi-natural grassland. (paper II)

In terms of daily gain, systems with concentrate-silage feeding (system 1) were superior to systems relying only on grass (system 3). The daily gain can be compared to the feed input for measuring efficiency. The amount of energy content in the feed for growing animals was calculated at herd level (table 9 in paper II). Systems 1a and 1b were on average more efficient than system 3a, which in turn was more efficient than system 3b in converting energy of the feed into live-weight gain. Depending on the factors taken into account in order to assess efficiency, the results might be very different. Wilkinson (Wilkinson, 2011) has discussed this issue and revealed a greater efficiency of cereal-beef than pasture-beef if total energy of the feed was taken into account. But it might be more relevant to look at the edible content of the feed, i.e. feed which could be used for human food, and for this scenario he shows that upland suckler beef systems are more efficient in terms of edible input/edible output than intensive systems. This effect might be greater for SNG, if you consider that crops for human food can be cultivated on CG.

Production and productivity of the different systems are perceived differently by different farmers. Some farmers have a strategy of reducing costs without focusing on animal growth. The low cost of SNG feed, linked to the level of subsidies, is appealing to them and they can also choose to feed their cattle on grass after weaning. The farmers in system 2a were also motivated to feed their cattle with SNG grass after weaning by a market outlet (Nordjysk Naturkød) which offers premium prices for animals that have grazed for at least 150 days in protected nature areas.

For other farmers, having high growth rates, comparing these to other farmers' results, and being an acknowledged breeder are important factors for their motivation and identity as a "good farmer". This

has been conceptualized by, for example, Burton (Burton, 2004; Burton and Wilson, 2006) who discussed farmers' identity shifts from a "productivist" model where emphasis is put on maximising production (here high cattle growth and high conformation of the carcass) to a "post-productivist" model where farms should be delivering multifunctionality (here SNG grazing) and farmers need to redefine their identity. One of the farmers thought that SNG grazing was not good for animal welfare because it was limiting to animal growth (paper II). These farmers' perceptions might be linked to the global discourse on beef farming where breeding associations, slaughterhouses and other farmers' association praise high growth rates.

Barriers and potentials for more grass-fed and SNG-based systems – Animal growth

Potentials:

- Herds with SNG-grazing for the cow-calf phase before finishing can achieve similar daily gains of the bulls as farms with CG-grazing (systems 1b and 1a).
- Herds with grass-only feed and production of steers of high-growth breeds can achieve a relatively high production output and growth rate, even with 45% of the feed from SNG (system 3a)
- Some farmers are responsive to economic incentives for grazing SNG, like subsidies reducing feed costs and premium prices for the meat from SNG, even if it means lower growth rates of their herds

Barriers

- Low production output and productivity of the system with rustic breeds all-year on SNG
- Some farmers' ideal of farming is tightly linked to high growth rates of the cattle and they are therefore reluctant to use SNG.

Dilemma

- Grass-based feeding can seem inefficient when looking at energy input per output unit, but can be seen as more efficient in terms of output per edible input; and thus competes less with human food resources.

4. Environmental issues

a. Measure of the impact of beef meat production on environmental issues

Farmers are encouraged to use SNG-grazing in order to protect the biodiversity of this ecosystem. However, it does not automatically mean that biodiversity is higher on SNG than CG; there are also biodiversity-poor SNGs (Ejrnæs et al., 2011).

The effect of the different management systems on local biodiversity can be estimated using indicators (paper II). The term "indicator" has been defined as a variable which supplies information on other variables that are difficult to assess and which can be used as a benchmark for decisions (Gras et al., 1989). In the case of biodiversity, assessing total species richness gives considerable practical problems and indicators are used such as the selection of particular taxa, such as low-mobility butterflies (Noe et al., 2005) or specific plant species (Billeter et al., 2008). These indicators represent, however, only one part of the reality.

In this study, four indicators were applied for grasslands used for grazing and forage production: percentage of clover cover, percentage of perennial plant cover, proportion of valuable biotopes (as defined and delimited by the Danish Administration) and length of hedges. The results show that SNGs have either a high proportion of valuable biotopes or of perennial plants. Some CGs can make an important contribution to biodiversity due to the presence of hedgerows, but only a few of the farms had hedgerows. One kilo of meat (slaughter weight) corresponds to about 200 to 300 m^2 SNG "conserved" for farms in system 3b, where SNG is the basis for feed production. Farms with SNG-grazing for cows with calves and with indoor fattening of young animals allow 9 to 22 m^2 SNG per kilo slaughter weight (system 1b). This contribution is much lower per kilo output, but at a landscape level these systems also contribute to grassland conservation (paper II).

These results show an interesting potential of grassland-based beef production systems for contributing to the maintenance of ecosystems that support a high biodiversity, which also is the objective of conservation grazing. The indicators used were rather general and it would be interesting for future research to identify indicators of biodiversity and of the diversity of Danish pastures which would be easy to monitor and for farmers to observe the impact of in their management, and to communicate any benefits of to consumers and other actors.

Mignolet et al. (1999) have shown that there is a relatively higher potential of nitrate contamination per hectare in maize-based beef production systems than in grass-based beef production systems. In the study reported in paper II, data were collected on fertilizer and pesticide use for forage production. There was no pesticide use on grassland in the year of the study on the 10 farms. Our data were not sufficient to make a robust calculation of the nitrogen balance of the grasslands but as the SNG was not fertilized in the majority of the cases, the nitrogen balance of these SNGs was probably negative (export of meat and limited fixation due to low clover presence).

b. Farmers concerns for the environment and their perception of the use of grasslands and SNG

Farmers were asked about their perception of nature quality and about their role in terms of nature protection and contamination (paper I). They mentioned the following issues:

- Their observations of wildlife (especially birds) on their farm and the link between their farming practices and wildlife

- Their role in creating and maintaining ecosystems such as planting hedges, taking care of ponds and water streams and for some of them undertaking conservation grazing
- Their personal enjoyment of the contact to nature and wildlife in their life as farmer
- Their uncertainty about the contribution of their beef production to greenhouse gas emissions (Danish authorities recommend that people reduce their consumption of beef for the sake of the climate)
- The fact that grass-based production uses less chemicals than cereal-based production

Farmers were interested in nature quality, but, for many of them, SNG-grazing is not directly linked to their interest in nature. When they want to provide better conditions for wildlife, farmers seem to focus to the unproductive areas, i.e. hedges and streams or close to their house and these actions are not necessarily turned towards SNG-grazing. We did not investigate farmers' knowledge and understanding of biodiversity in relation to SNG; other studies have shown that it is important to motivate farmers (Herzon and Mikk, 2007; Wilson and Hart, 2001). Herzon and Mikk (2007) suggested that schemes may "work better if linked explicitly to the support of specific species, which farmers themselves know well and feel positive about, rather than to the abstract concept of 'biodiversity'". In a case study in Denmark, Noe et al. (2005) concluded that dialogue with advisors and specialists was a key component for influencing farmers' perception and awareness of wildlife. This might be an interesting option for the protection of Danish grasslands. Some of the farmers knew the names of endangered plants or animals living on their SNG and were proud to cite them. Specific knowledge about SNG characteristics might help farmers take responsibility for biodiversity and stimulate their reflection on nature quality.

Furthermore it seems that Danish farmers are not involved when their land is classified and evaluated for biodiversity by the authorities. Informing farmers about desirable species and advising on management systems that they could practise to enhance biodiversity could be a way of getting more farmers interested and concerned about SNGs.

Farmers seem very concerned about the debate on the sustainability of food and beef consumption and associated increases in greenhouse gas emissions. For example, the "food pyramid" recommends reducing beef consumption (Anonymous, 2012c) for the sake of the climate. There is still debate in scientific circles on the impact of different beef feeding strategies and production systems on greenhouse gas emissions, especially because carbon sequestration in grasslands is difficult to assess, and because, for example, the impact of soya in the feed, which has been imported from countries with deforestation is also a controversial issue. Scientific studies give contrasting results depending on the methods and systems studied (Crosson et al., 2011).

c. Communication of environmental issues to consumers by food networks

Communication and marketing based on the positive value of conservation grazing to protect biodiversity is often presented as a way of developing grazing practices (Bernués et al., 2011; Emanuelsson, 2008). The case studies of the food networks in France and Denmark (papers III and IV) highlight and nuance this issue.

In Denmark the word "naturpleje" which literally means "care of nature" or "nature conservation" is used on websites and packaging of meat of different food networks (Friland Kødkvæg and Limousine, Nordjysk Naturkød, Slagter Sørensen). Friland explains it in this way: *"cattle graze areas that public authorities have selected as officially protected to protect animal and plant life in the area. This ensures, in a natural way, that the area does not become invaded by bushes and at the same time cattle get a natural and healthy growth*". (Own translation). This is consistent with the reality on the farms that

practise conservation grazing, but the fact that for farms in system 1b conservation grazing is only part of the cow-calf phase and that the animal slaughtered is finally reared indoors with silage and concentrates is not mentioned and can be misleading for consumers. In fact, there is no way for consumers to know whether the meat comes from a system with a high proportion of conservation grazing (according to our results 200-300 m^2 SNG / kg slaughter weight in system 3b) or a very low proportion of conservation grazing (10 to 20 m^2 SNG conserved / kg slaughter weight in system 1b). Other food networks such as Nordjysk Naturkød and Slagter Sørensen actively use conservation grazing and its implication for landscape and biodiversity in their story-telling, especially on the internet. Farmers in system 3b with direct-sell to consumers informed their customers, but felt that it was not an important concern for them. In the grazing association, biodiversity protection is the goal of the association and the principal motivation for its founding members, who also monitor and observe changes in plant cover in the grazed SNGs.

In France the concept of "conservation grazing" is not much developed outside people working with land use planning, where grazing is used against shrub encroachment in a territorial and landscape perspective. Beef meat is often sold as coming from a "terroir" and natural pastures are implicitly part of this "terroir" definition, but we did not find any explicit communication about SNGs. The link to the "terroir" and the mandatory use of SNG is part of the certification of the Nature Park Label but not communicated specifically in the chain or to the consumers. For the farmers in the Label Rouge and direct farm sell in France, maintenance of hedges was important for their image to consumers, maintaining a traditional landscape of "bocage". In the Danish context, the use of "terroir" concepts could be further developed, as there are attempts to do in the Skjern Å region. SNG conservation could then be part of a global story of an "origin" with its stories and representations.

In consumer studies, environment and biodiversity are cited as important motivations for organic consumers in general (Zander and Hamm, 2010), but it is rarely/never mentioned by consumers when asked or tested for their preferences for meat attributes(Elbrønd and Bjerg, 2012). On the other hand, scholars have shown that consumers have a greater liking for organic beef when they have explanations about farming systems and its impact on environment (Napolitano et al., 2010). Consumers' willingness to pay for biodiversity has also been shown to be higher when it is directed towards particular species with a possibility for affective links (Jacobsen et al., 2008; Martín-López et al., 2007). From these insights from the literature, it can be suggested that the development of SNG-beef marketing could be promoted by the use of emblematic species linked to SNG pastures.

Barriers and potentials for more grass-fed and SNG-based systems – environmental issues

Potentials:

- High potential for conservation of biodiversity of grass-based and especially SNG-based production
- Farmers' interest in nature
- SNG and its biodiversity can be part of a local "terroir" and praised as such by consumers

Barriers

- Marketing of meat of many different systems use the "conservation grazing" concept, regardless of how much conservation grazing is part of the feeding regime.
- Farmers' interest in nature is (often) not directed towards SNG
- Doubts about the effect of intensive vs. extensive beef production on environment, especially for greenhouse gas emissions.

4. Animal welfare

Animal welfare is broadly acknowledged as an important factor in the sustainability of livestock production by, among others, citizens/consumers, farmers, advisers and scientists, but these actors often have different perceptions of it (Dockès and Kling-Eveillard, 2006; Vanhonacker et al., 2008). Perceptions and measures of animal welfare are strongly influenced by a society's moral understanding, with a continuum between acceptable and non-acceptable states. (Ohl and van der Staay, 2012).

When assessing animal welfare for cattle it is usually believed that the longer the cattle are on pasture the better the welfare, as grazing is a natural behaviour for cattle (Müller-Lindenlauf et al., 2010; Welfare Quality® Consortium, 2009). It is also a perception of people that grazing is important for animal welfare (Boogaard et al., 2008). In the systems analysed in this study, cattle in system 3 spent more time on grass than cattle in system 2, which in turn were more on grass than cattle in system 1. Animal welfare would then be expected to be better in systems 3 and 2 than in system 1. However, grazing is only one component of animal welfare and other aspects should also be considered; it has, for example, been shown that suitable conditions during winter or difficulty of stockmanship are challenges to animal welfare in extensive conditions (Turner and Dwyer, 2007).

a. Assessment of welfare and discussion of its results

In the study reported in paper II, indicators were developed for assessing the welfare on the different farms of this study. The farms offer diverse conditions: all-year outdoor system, farms with both outdoor and indoor animals… It was challenging to build an indicator that would allow comparison of the farms and establish coherence in the scientific knowledge on animal welfare as well as expectations of society. Existing welfare assessment protocols are designed for assessment in confined systems (Bartussek et al., 2000; Welfare Quality® Consortium, 2009). Both system-based parameters and animal-

based parameters were used. System-based parameters describe features of the environment and management, such as space allowance, feeding and drinking facilities, access to pasture. Animal-based parameters register the state of individual animals. Besides indicators from the Welfare Quality assessment protocol (Welfare Quality® Consortium, 2009), criteria based on perceptions of Danish consumers and farmers (as implemented in the Welfare certification scheme of the Danish Animal Welfare Society) were used, as well as indicators suggested by Turner and Dwyer for extensive systems (Turner and Dwyer, 2007). Deep litter in animal housing is stipulated by the Danish Animal Welfare Society for the certification of "animal welfare"-friendly farms in Denmark. It was incorporated in this study, although deep litter has not been demonstrated as being superior to rubber or other soft surfaces (Tuyttens, 2005). Use of deep litter for animal welfare was also praised by some farmers such as farmer E:

"If you have the cubicle, without straw, and you know ... so the shit can go down, like on a pig farm (…). It is not good for the cattle. It is the same as with you, you don't sleep on the floor. You have a bed where you sleep." (farmer E)

The choice and weight of the indicators was intended to reflect the diversity of systems and farming conditions.

The results showed no superiority of one system over another (table 4), but grass-based systems had overall a very high welfare. This result of no superiority of one system over another is partly linked to the aggregation of indicators where one criterion balances out another, because of farms being confronted with a number of issues and challenges.

Table 4: Welfare of cattle – standardized ranking on a 0-10 points scale for each criterion with 0 being very poor and 10 very high welfare.

System	**1a**			**1b**			**3a**		**3b**	
Farm	E	G	B	F	L	A	C	J	H	K
Winter										
System-based	6	8	7	8	7	5	5	7	8	9
Animal-based	9	8	4	10	10	4	10	10	8	8
Summer										
System-based	8	8	7	7	8	8	9	8	10	8
Animal-based	10	10	10	10	10	9	9	10	7	10
Average	**8,6**	**8,4**	**7,2**	**8,7**	**8,2**	**6,6**	**8,8**	**8,7**	**8,2**	**8,8**

This result ties in with farmers' overall positive perception of the welfare of their cattle (paper I) like: "*I couldn't see how it could be done any better. Because I think the animals have the best life and the best conditions to have a good health*." (farmer I). Farmers very often compare their beef herd with what they have experienced in other livestock systems, such as the dairy or pork production. From the 12 farmers interviewed, eight have previously worked or lived on a farm with pork production, bull fattening or intensive dairy system (three times milking/day) or still do it. In beef farming they value the opportunity of a long contact to cows and calves, long grazing periods and a positive human–animal

relationship: "*when I had the pigs it was a job that I could not... It was only to get some money. But this here, I of course make some money but I enjoy it too. That is more important. Because you are motivated for doing it. And that is good for the cattle*." (Farmer I).

Based on the analysis of the indicators, it can be concluded that the principal welfare issues are linked to confinement and lack of space in the housing in systems 1, 2 and 3a and to weight loss in winter in system 3b and 1. However, for more reliable information from this indicator, it would have been interesting to have more than two measurements in the year (it was measured once in August to represent summer conditions and once in March for winter conditions), as there might be variations and trends that were not possible to spot with so few observations. For example, if the animals were dirty on the day of the observation, was this representative for their conditions in this period or specific for that day?

In more detail, the principal issues regarding animal welfare that we identified from this study are presented in table 5.

Table 5: Principal issues in animal welfare for different production systems, identified in this study

System	Challenge for animal welfare
All herds	Undernourishment of certain categories of animals during part of the year (heifers and cows in system 1 and 3 during winter).
For animals grazing	Parasites Shelter from wind and rain
For animals indoors	Diseases, especially calf diarrhoea Appropriate housing with enough space for all animals Dehorning
For system 1	Confinement of animals in the fattening period, also in summer
For animals in system 2b, 3a and 3b	Castration
For animals in systems 2b and 3b	Animals becoming feral

Many of these aspects are discussed in paper II. Their relevance is subject to discussion. We will take here the discussion on two of them, because they are linked to systems with SNG grazing.

Undernourishment

Low body condition scores were recorded in winter for herds kept outdoors (system 3b) and for some heifers and cows in system 1a. Absence of prolonged hunger assessed by variation in body condition scores is used in the Welfare Quality protocol assessment (Welfare Quality® Consortium, 2009).

Weight loss and poorer body condition are commonly part of beef farming in situations of seasonal scarcity of forage (Canali et al., 2001). For wild ruminants in natural conditions, periods of undernourishment can be considered as normal; this undernourishment is limited in intensity and duration. Beef cattle can also be exposed to detrimental nutritional deficits for parts of the year. This

occurs when foraging is limited to the grazing of dry and dead grass. Growing cattle are sometimes kept as stores in such situations before the fattening period (Canali et al., 2001). Ohl and van der Staay (2012) discussed the issue of free-ranging grazers in nature conservation areas in the Netherlands, where the question arose whether prolonged food restriction due to poor grazing conditions during a long cold winter led to unnecessary suffering in these animals and constituted a welfare issue. They argued that hunger is not necessarily associated with a negative welfare state, provided that the animal is free to react to this state adequately by, for example, expressing foraging behaviour and finding food. They add that welfare in this example only would be compromised if the animals were not allowed to adequately react to the circumstances up to a level which it perceives as positive (i.e. foraging and finally finding food) or if their physiological adaptability was exceeded (not fulfilling nutritional needs). A question is, when is this adaptability exceeded? There is a clear understanding that death of animals due to undernourishment is not acceptable, but where does the line go? (Appleby, 1996)

Most farmers in this study were not concerned about the impact of undernourishment on animal welfare and were more concerned about its impact on animal growth (paper I). Without going so far as to call it undernourishment, farmers reflected on the restriction in feed input due to the low quality of the forage on SNG, which was perceived as negative by some farmers : "*they would have a better life on better grass*" (farmer L), while others meant that the cattle could cope with it without problems.

Feral animals and natural behaviour

In the public perception, extensively managed animals have a good welfare because they do not face behavioural restrictions and because animals have evolved to cope with natural challenges (Turner and Dwyer, 2007). Scientists, however, contest this perception, drawing attention to the specific challenges of animals with little contact with humans (Turner and Dwyer, 2007).

In large SNG areas with large herds, trees and bushes, the traditional beef farming system with a close human–animal contact is transformed to a relationship more closely resembling that in ranching systems, for example in USA and Australia. Cattle can develop a different behaviour by, for example, hiding from and developing a fear of humans. This has different consequences for the farmer's work and animal welfare as it can make it difficult for the farmer to detect disease or other problems and animals can be stressed when they are handled for vaccination or other operations. On most of the farms studied these problems were not present, but it was an important issue for one of the farms in system 3b. As discussed in paper I, for several of the farmers a close contact with the animal was an important motivation for having the beef farm activity. It was especially important for hobby farmers, but also for several professional farmers where beef is not the main source of income. "*You can see, they are a little bit like friends. I like it*" (farmer H). "*I spend more time with the animals than strictly needed (…) I enjoy winter because then the animals are inside*" (farmer A.) This close farmer–animal contact can be challenged if the cattle are put onto a SNG where its size and distance from the farm make it difficult for the farmer to maintain a close relationship with the cattle. Other farmers consider this more natural behaviour as positive for animal welfare and have adapted their management to it.

This challenge for the relationship between farmer and cattle and for animal welfare associated with SNG grazing seems not to have been reported before, but the opposite situation has – from extensive to more intensive cattle management, by Richards (2007) in an Australian setting. Richards showed that the shift from cattle ranching to cell-grazing with closer management of the cattle had important consequences for the perceptions of cattle welfare by farmers and was perceived as negative by some and positive by others.

b. Use of the concept of animal welfare in the food networks

In Denmark, actors in the food networks had an idea that "cattle that have had a good life will also taste good". This perception can be traced back to the organic waves in the mid-nineties (Delavigne, 2005) where many slogans and public debates insisted on the link between good animal welfare and good taste of the meat. This type of argument is still heavily used. All the chains (except the grazing association) in Denmark attached an important role to animal welfare in their advertising and storytelling, both on farmers' own websites, on meat packaging labels in the supermarkets and on websites from the producers' association. Beef from Friland, the biggest supplier of "alternative" beef meat on the Danish market, is either marked with the organic label or with a label "recommended by the Danish Animal Welfare Society". Meat marked with this last label comes from systems 1a and 1b. The basic message of story-telling is that the animals have been on grass showing nice pictures of animals outside on a green pasture. Other information given could be the (short) distance to slaughterhouse, age at weaning and good care by the farmer. The message is similar in organisations marketing animals from systems 1, 2 or 3. It was concluded that the use of the image of grazing cattle and message about grazing are problematic in relation to cattle from system 1a and 1b. A cook who had bought Friland beef meat for almost 20 years described the farm and animal life envisaged: "*the cow has been going outside, chewing grass; it has been going with it offspring. It has had a good life out on a green pasture*". It can be hypothesized that information on meat packaging and leaflets accompanying the meat is misleading and that many consumers might think that the cattle for meat production comes directly from grass. On one site we can, for example, read: "the herd spends the whole summer grazing in the very nice valley". In reality, this is only partly the case because the nursing cows with calves graze during the summer, but animals for slaughter are kept inside for 4-5 months before slaughter (paper IV). There is globally for systems 1a and 1b a lack of understanding in the food networks about the fact that the weight/conformation at the required age of slaughter can only be achieved through intensive and confined finish-feeding, whereas the communication of welfare tends to highlight grazing practices.

In the study in France, animal welfare was, in contrast, very rarely mentioned (paper III). There are some requirements in the certification schemes for insuring animal welfare, but there is no or little communication about this. Buller and Cesar have analysed animal welfare claims in French quality schemes through interviews with slaughter and sales managers and concluded that animal welfare is very much embedded in a broader concept of quality including the landscape and the rural environment, nature and naturality, the work of the farmer and animal health This beneficial rurality is implicitly allied to better-tasting food (Buller and Cesar, 2007). This pattern can be recognised in the case studies reported in paper III and we share Bullers' analysis of it. In the French cases, pictures of cattle on grass are also used in the marketing of the meat (Label Rouge) as well as pictures of animals indoors (supermarket label). In the case of the Label Rouge, farmers were praised for their capability of finish-feeding, choosing the feed which will give the perfect muscle development and marbling at the right time on the animal's life.

It is certainly the case that many people have little direct experience with contemporary animal farming (Boogaard et al., 2008). Moreover, many people have a romantic view of animal farming on the one hand – referring to the 'rural idyll' in which humans and animals live in perfect harmony – but on the other hand, people are also confronted with images in the media about intensified animal production, including issues concerning poor animal welfare (Delavigne, 2008). Lamine and Stassart (2006) have been working on representations of animal welfare for farmers and consumers; they highlighted the

importance of the affective relationship between the farmer and the cattle in different types of system, as we also did in this study (paper I). This dimension of a "man-animal relationship" is not made visible in the public discourse on welfare where regulation and measurable parameters are in focus. Lamine and Stassart (2006) reported several initiatives like the creation of a leaflet where farmers expressed and narrate their relationship with their animals, of a small film co-constructed by farmers and consumers and of meetings between farmers and consumers. These initiatives allowed the debate of animal welfare to move from a confrontation of points of view to a construction of platforms for a common understanding.

Barriers and potentials for more grass-fed and SNG-based systems – Animal welfare

Potentials:

- Overall good welfare for animals in all systems
- "Grazing" is an easy message to convey to consumers
- Some farmers think/experience that being in a nature area is good for animal welfare

Barriers

- Some farmers think/experience that SNG-grazing challenges the good farmer-cattle relationship
- Some farmers think/experience that quality of SNG is not enough to sustain animal performance
- Difficult communication about grazing as some retail chains use grazing arguments regardless to the fact that they use a long period of confined finish-feeding.

5. Quality of the product for transformation and taste/tenderness

Several farmers in this study stated that part of their motivation for producing beef was to "*produce good meat for the people*". "Good meat" is defined and appreciated differently in different cultural contexts and this has considerable implications for the production systems and for product value. Differences relate to the desired age and weight at slaughter, the necessity of finish-feeding and the use of different techniques for handling the carcass.

a. Age at slaughter and slaughter weight

In France as well as in Denmark, slaughter age and slaughter weight form the basis for the calculation of the price paid to the farmer for each animal. However, there are important differences between France and Denmark in preferred slaughter age and weight, which are related to differences in meat consumption.

In the Danish cases, young animals (under 22 months) were easily sold by the farmers and their characteristics mostly considered as satisfactory by the food networks for producing "good meat". On the other hand, animals from rustic breeds at ages above 30 months in system 3b were difficult to market, and farmers received a low price for them because of their age, carcass weight and shape (paper IV). Direct sell to consumers is a way for these farmers to have the quality of their meat acknowledged. In Denmark, when butchers or cooks mention "good meat", they always mean "tender meat" (paper IV); problems experienced with quality were related to tough meat. For many of them, their experience was that in order to get the tenderness, the animals need to be slaughtered at a young age. Friland requires a maximum age of 30 months for organic steers and heifers; in Nordjysk Naturkød, the limit is also 30 months, but the farmers we met were selling animals under 24 months. In Friland Limousine, the production is now centred on calves between ages of 10 and 12 months.

It is a different situation in France where animals older than 30 months are praised for giving an appropriate flavour and marbling (with finish-feeding) (paper III). French food networks selling beef as a high-quality product, such as Label Rouge, emphasize the flavour and juiciness of the meat and require heifers to be a minimum of 28 months, steers minimum 30 months and young cows up to 7-9 years old (Roche et al., 2000). Production systems for these animals are based on grass with two or three grazing seasons and finish-feeding before slaughtering (system 2b). The French farmers selling their meat directly to consumers through box delivery or farm shops were producing young animals (15-18 months) for families in the cities looking for tender beef and were not so focused on the flavour. In a study conducted in the mountains in central France in 2006, they observed that the categories of animals chosen for direct sell were mostly 30-month heifers and young cows (Limon, 2006), while a report from the north-west of France reported a diversity of practices, some farmers specialising in young bulls (about 15 months) and others in heifers or steers at around 30 months (Galan and Pavie, 2008). These different choices may be linked to the type of consumers and their expectations of the meat quality. French beef farmers often combine different commercial strategies and types of animals produced, for example "baby beef" (15 months) for the mainstream market and 30-32-month heifers for a certified channel. As one farmer put it: "*the bulls just need to eat, eat as much as they can. For the heifers, we have to take more care. It has to be good meat*."

In summary, the Danish market prioritises young animals for their higher tenderness, leanness and milder flavour, whereas the French market for high-quality meat prefers older animals with a higher flavour intensity. There is also a French market for younger animals for, as expressed by one farmer, "*young families*".

In a scientific perspective it has been shown that flavour intensity is higher in meat from older animals (Lebert et al., 2003). Tenderness is influenced by many other factors apart from age and differs for different muscles (Bouton et al., 1978). In the French retail chains it is thought that long (dry) aging and butchers' knowledge of the meat will insure high tenderness independent of the age at slaughter if animals are finish-fed (paper III).

Finish-feeding with cereals and concentrate or slaughtering directly from grass?

Other differences between French and Danish beef production lie in the importance and the role of finishing the animals. To our knowledge, productions that slaughter beef cattle directly from grass do not exist and are not recommended in France, even in systems with a high reliance on grass, e.g. the Full Marbled of Mezenc, fattened with mountain hay and concentrate (Trift, 2003). In Denmark, finishing on

grass is a marginal practice, but the meat sourced from steers and heifers between 20-24 months on grass is accepted as a high-quality meat in Friland organic.

From a scientific perspective, it used to be commonly accepted that grass-fed beef was of lower eating quality than grain-finished cattle; studies had shown problems with flavour, variability (Bowling et al., 1978; Xiong et al., 1996) and reduced tenderness (Bowling et al., 1978). Other more recent studies found no differences in palatability attributes (French et al., 2001; French et al., 2000; Muir et al., 1998; Young and Kauffman, 1978). Muir et al. (1998) suggested that in many forage and grain studies differences in eating quality may have been attributable to differences in carcass weight and fatness, with cattle fed the high-energy diet (usually the grain-based diet) being heavier and fatter than those fed the forage-based diets. It seems that there is now scientific agreement on the fact that high palatability of the meat can also be achieved with grass-based diets with high-energy forage to reach a relatively high slaughter weight. This seems to be the model followed by the farmers in system 3a, as farmer F said: "*for the last two months they have to be on very good grass*"

Farmers not using concentrate finishing saw it as a positive differentiation of the meat by its flavour:

> "*I think the meat will be better you do not use too much grain. I think if cattle get grass, hay, silage, and not so much grain they will have a better meat quality. A different kind of meat. More tasty*" (farmer F).

and

> "*this meat has a strong taste because they don't get corn, and they eat a lot of things and herbs. And then it tastes different. (…) Yes, a little bit sweeter. And I will cook it, it won't reduce, the beef is this size before and after*" (farmer H and wife).

In the grazing association (paper IV), consumers-actors initially decided that after the grazing season on SNG, animals should be finish-fed at the home farm before slaughtering, but they found that the carcass became too fatty and they decided to slaughter directly from pasture. It shows that system 3b can be actively chosen by consumers, even if the large retail chains do not consider animals from 3b as "good enough".

Maturation of the meat and its quality

Meat aging increases tenderness of the meat in comparison with unaged meat (Warren and Kastner, 1992) and aging can be used in order to increase meat quality and tenderness of grass-based and older animals (French et al., 2000).

Traditionally, beef carcasses were stored unpackaged in a cooler for the desired length of time and to enhance tenderisation and development of the characteristic aged flavour, which is now referred to as "dry-aging." However, with prefabricated beef, more of the aging process occurs in vacuum bags. As this process increased in popularity, because of convenience, higher yields, and longer shelf-life, the traditional dry-aged products became more of a specialty item (Warren and Kastener, 1992).

The advantage of one technique over the other for maturation on flavour is debated: several studies have shown that dry-aged meat has a beefier and 'roastier' flavour (Campbell et al., 2001; Warren and Kastner, 1992), while other studies have not measured any difference (Jiang et al., 2010; Laster et al., 2008).

In the French retail chains analysed in paper III, high meat quality was believed only achievable after maturation on bones. Dry maturation on bones was part of all the certification schemes reported. This meat is sold at butcher shops, to restaurants and at the butcher counter in some supermarkets.

In Denmark vacuum aging is widely used, also independent butchers receive meat in muscle vacuum-packed. Dry-ageing is still practised in small slaughterhouses, which mainly work for farmers selling directly to consumers or who produce meat for their own consumption. It is also used by top chefs who have access to the e.g. "Gold Room" of Danish Crown for maturing the meat as they would like it.

Scientists have shown that tenderness of the meat can be improved if the hanging of the carcass in the first 24 hours (during rigor mortis development) is changed from a traditional hanging by the Achilles tendon to pelvic suspension (Ahnström et al., 2006). A Swedish study concluded that this method could improve the eating quality of SNG-fed cattle (Hessle, 2007). However, a manager of a slaughterhouse did not consider this technique as an option as the carcass then occupies more space in the cooling room (further analysis of data given in paper IV).

Across the various case studies it was clear that the definition of what "good meat" is, and how it should be obtained varied considerably between France and Denmark and also within each of the two countries. These variations have an important impact on the production systems chosen by the farmers and thus on the proportion of grass and SNG-based feed in the systems. One of the cooks interviewed in the study reported in paper IV was using two very different types of meat − one was meat from 10-12–month-old Limousine bulls fed silage and concentrate after weaning and vacuum-aged, and the other was 20-22–month-old Limousine steers or heifers fed grass only and dry-aged. He said about the meat: "*they are both very good meats to work with. They are just very different… they don't have the same character, I will prepare them differently and I will not serve them for the same kind of guests*".

Barriers and potentials for more grass-fed and SNG-based systems – meat quality

Potentials:

- Steers of a high growth breed fed grass only are considered to produce high-quality meat in the Danish context.
- Bulls and heifers with a season on grass after weaning are considered as producing a high-quality meat in the Danish context.
- Steers and heifers from a rustic breed spending all year on SNG are positively chosen by some consumers
- If the system with rustic animals spending all year on SNG is deemed to deliver animals of variable tenderness, modification of hanging techniques and aging after slaughter could probably solve the problem, feeding before slaughter with forage of good quality could also be used
- Grass-feeding gives a particular flavor intensity, which can be enhanced with dry-ageing.

Barriers:

- Animals from the systems with rustic breeds on SNG all year are considered to be poor quality on the Danish market due to their age, low slaughter weight and low carcass condition
- Pelvic suspension and dry-aging, which could increase meat quality of animals from grass-based systems, are considered as too expensive for slaughterhouses

6. Safety and healthiness

Recent results from focus-group studies in four European countries have shown that consumers mostly defined beef safety in relation to their personal health. Safe beef was perceived as beef that is not harmful to consumer health. Healthy beef was associated with the production system of a traditional farm encompassing grass-fed beef, cattle fed with natural feed and raised outdoors (Verbeke et al., 2010).

In the case study in France, farmers and professionals in the meat chain were feeling very concerned about meat safety and referred frequently to the BSE crisis (mad cow disease) (paper III). In the certified chains as well as for farmers selling directly to consumers, their concern was very much directed towards animal feed and the ingredients used in the concentrate. This was particularly clear in the debate about the use of GMO-free feedstuffs (found typically in imported cattle feedstuff such as soya). There was a clear preference of farmers for using GMO-free feed, but they distrusted the feedstuff industry, believing them incapable of insuring that the feed bought really was GMO-free. In the Danish cases, farmers and professionals in the meat chain did not raise such concerns about GMO in the feed (paper IV). However, organic meat is marketed as being based on GMO-free feed. A survey

(Forbrugerrådet, 2012)) has shown that Danish consumers feel concern about this issue as two-thirds of the respondents said that they would not buy an animal product if they knew that it had been fed a diet containing GMO. This fits relatively well with results from a consumer survey in France, UK and Germany from 2000, which showed that more than 90% of the surveyed consumers wanted a mandatory labelling programme for beef produced from cattle fed genetically modified crops (Roosen et al., 2003). The scare after the BSE crisis might well be over (Verbeke et al., 2010), but focus on animal feed and its impact on beef safety is still present in the minds of many consumers and farmers. Grass as the natural feed of cattle is considered safe by consumers (Van Wezemael et al., 2010), also expressed by a Danish farmer: "*it is pure nature that the cattle eat*" (farmer G).

Research has shown that products (meat and milk) from grass-fed animals contain nutritionally beneficial fatty acids, notably n-3 polyunsaturated fatty acids and conjugated linoleic acid (CLA) which is not the case or less so for concentrate-fed animals (Enser et al., 1998; Gatellier et al., 2005). This is due to high levels of α-linoleic acid (18:3 n-3) in grass and to the production of trans 18:1 (trans-vaccenic acid) in the rumen (Wood et al., 2008). Grass-based diets have been shown to produce differences in meat attributes depending on grass composition such as the presence of red clover and pasture biodiversity (Lourenco et al., 2008). For lambs, studies have shown a positive effect of biodiverse pasture on fatty-acid compositions of the meat in comparison to cultivated pasture (Adnøy et al., 2005). The effect of a grass-based diet on meat composition is progressively reduced if it is followed by a finish-feeding phase, though it has been shown that grazing cattle offered daily concentrate supplementation also had a beneficial fatty-acid profile (Gatellier et al., 2005). Healthiness, in terms of fatty-acid content, of meat from systems 2a and 2b will depend on intensity and length of the finish feeding, although these arguments were not used in the cases reported in papers II and III, even if they seem very promising for grass-based systems such as systems 3a and 3b. Healthiness of grass-based beef is very much used in the US (Gwin, 2009).

Barriers and potentials for more grass-fed and SNG-based systems - Safety

Potentials:

- Grass is considered as a safe feed for animal and human health in comparison to crops, which may be genetically modified, or concentrate which main contain potential harmful additives
- Meat from cattle fed only grass has potentially a favorable composition in terms of desirable components for the human diet.

7. Origin, locality and traditions

Labels of origin of the meat are broadly used on the European meat market, referring to a region of production through private label or PDO and PGI (protected denomination of origin and protected geographical indication). Consumers' studies have shown that consumers relate mention of origin to confidence in safety (Davidson et al., 2003; Hoffmann, 2000; Verbeke et al., 2010) and eating quality (Davidson et al., 2003; Hoffmann, 2000). Identifying trends in meat consumption, Grunert (2006) argued

that consumers are increasingly interested in "stories" being linked to meat, creating consumption experiences which extend beyond the basic function of the product.

In the case studies reported in papers II and III, we have observed different ways of identifying the region/farm of production:

- The consumer buys the meat from an identified farmer. The consumer can be in direct contact with the farmer in the case of a direct sale or there can be an identification of the farmer/farm on the meat package or at the butcher shop
- The region of production is identified with one or possibly several of the farmers delivering to the label presented
- The country of origin – which is mandatory in European legislation for selling meat

These references are used for telling "stories" to consumers, in retail chains selling meat from animals from SNG-based systems as well as for more intensive production systems. In paper IV we discussed the fact that these stories were mostly quite vague and did not give precise information on, for example, whether animals had been fed grass and/or concentrates.

In France several labels refer to a "terroir" concept for selling the meat: terroir was first developed for wines as a way of describing the unique aspects of a place that influence and shape the wine made from it, such as soil, climate, topography, plant species and human know-how and traditions of processing (Barham, 2003). In the case of beef the aspects can be local breed, historical production and local wet ecosystem (like the Camargue Bull AOC) or specific flora of highland pasture and specific fattening procedures (Full Marbled of Mezenc) (Casabianca et al., 2005). The case reported in paper III with the Salers in a national park is also based on the use of highland pasture and the related landscapes. SNG is an integral part of a terroir and its characteristics in terms of flora can have a direct impact on, for example, meat flavour (Full Marbled of Mezenc, (Trift, 2003)). SNG is an integral part of the landscape in many French beef-producing regions and images from this landscape are used for marketing meat as high quality.

In Denmark the situation is slightly different; differentiation of food products has traditionally not been based on region of origin and there is no local beef breed left. In the cases reported in paper III, regionality was, however, used in different cases where especially northern and western regions of Jutland were presented as "wild" and "natural". New Nordic Food is maybe setting a trend led by chefs and restaurants that look for diversity and typicity of food from the Scandinavian countries. SNG-based production reflecting local ecosystems could be a way of valorising beef meat in this context.

Barriers and potentials for more grass-fed and SNG-based systems – origin, locality and traditions

Potentials:

- SNGs are part of local ecosystems and landscapes; their diversity could be a basis for a differentiation of "terroir" and differentiation of meat products.
- It is now technically possible to track each piece of meat in a supermarket back to the farm and thus to tell the story of this particular farm.

V. General discussion and conclusion

This study has shown that beef production systems based purely on grass and a high reliance on SNG can potentially be considered as sustainable in terms of animal welfare, environmental impact, healthiness and safety of the meat and that they possibly can build up a an identification to a local "*terroir*". The characteristics of the products can be different from what is usually considered as quality meat in the Danish context. The slaughtering industry's expectations for the conformation and age of cattle (young and muscular animals) could be said to be incompatible with a grass-based and SNG-based feeding system; in particular they exclude the systems with rustic breeds that spend all year on SNG and likely other systems with production of animals older than two years. It is problematic because the system with rustic breeds permanently on SNG is the system which can "care" for the highest surface of SNG per suckler cow (about 3 ha SNG per mother cow and her descendants) and also probably for SNG with poor forage quality which some of the high-growth potential breeds used in the other systems are not able to utilise. For animals from these systems to be deemed high-quality meat, the reference frame of what a quality product is needs to be redefined. The cases studied here have shown the importance of getting players together to redefine quality frames; this was the case both for the grazing association and also for farmers gathered in an area with a territorial project of protection of biodiversity − their meeting with a butcher gave rise to a specific meat chain with differentiated products.

This study has highlighted the role of the farmer's perspective in the use of SNGs. SNG-grazing is regarded as a measure of conserving biodiversity and landscape, but most farmers did not relate the use of SNG directly with biodiversity conservation. Most of them were interested in nature, but focused wildlife conservation on other parts of their farms. The involvement of farmers in SNG-grazing would maybe be aided if their knowledge of plants and grassland species was advanced and if the connection between farmer management skills and environmental outcome was made clearer. The perception of "good" farming includes for some farmers high growth rates and high output and make farmers reluctant to use SNG. For some farmers, a close man-animal contact is a motivation or a prerequisite for beef farming and this close contact can be disrupted by SNG grazing if SNG is not close to the farm. In one of the cases, a local project of cooperation between farmers and authorities for biodiversity and landscape conservation was a motivation for some farmers to use conservation grazing . This participative approach could be developed in other regions in order to get more farmers involved, as it also has been shown in other countries (Stenseke, 2009).

We have discussed in this thesis the fact that SNG-based production can be the basis of "good stories" for the communication with consumers. Actually, some of the good stories of grazing cows have been hijacked by chains with finish–feeding and no grazing after weaning. It would be beneficial for the other systems if they instead would promote the good quality of finish-feeding with cereals and leave the image of grass and grazing to be used by the systems which base meat production on grass. The interviews highlighted the fact that butchers and cooks in Denmark had very limited knowledge of the link between the demand for "young animals with muscular carcass" and the farming systems; in other words, animals slaughtered at 11 months and 320 kg carcass weight cannot physiologically have been growing on grass only. A possible way of emphasising the specificity of SNG and grass-only-based productions could be by listing the animal feed used on the meat package as done by some chains. For example, the PDO beef Mirandesa in Portugal lists the feed that the animal has eaten in its lifetime on

the label of the meat packaging, such as cows' milk, grass, herbs and minerals. Generally, communication of knowledge about farming and food in society to the media and schools could be encouraged and this should include not only the green images and marketing but also something of the complexity of food production.

Our results and conclusions are based on the understanding gained from case studies. We defined types of farming systems which cover all possible suckler systems based on their feeding strategy, but some of the systems described are based on data from only a few farms. It would be worth expanding this study with more case studies to deepen the comprehension and variability of the systems. Especially the system described as system 2, where the data presented here are based on interviews and where no measurements could be undertaken on these farms.

Semi-natural grasslands have a long history in agriculture where they have been an integral part of farming systems for centuries. Modern agricultural farming systems are organised around other values and potentials and many SNGs have been abandoned. Our work suggests that the reintegration of SNG in farming systems cannot only be led by subsidy incentives; efforts should be made to facilitate the marketing of the products originating from SNG-based systems; farmers involvement with the mobilisation of their knowledge and management skills could also be fostered.

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Appendix

Paper I

Grazing semi-natural grassland: Beef farmers' values and experiences in Denmark.

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Grazing semi-natural grassland: Beef farmers' values and experiences in Denmark

Abstract

Temperate semi-natural grasslands (SNGs) are biodiversity hotspots in Europe and appropriate grazing practices can help to maintain their high biodiversity levels. Despite subsidies to SNG grazing, grassland abandonment and encroachment with shrubs and trees remain a major problem for European biodiversity. Our objective was to understand farmers' choices and experiences related to SNG grazing in comparison to cultivated grassland (CG) grazing. We conducted detailed case studies based on qualitative interviews and farm visit on 12 Danish beef farms. We constructed a model based on farmers' values related to their production, which allowed us to understand and explain farmers' use of SNG. These values are "productivity and high animal growth", "low input – low cost" and "care and close contact farmers-animal". Farmers who are oriented towards productivity and high animal growth only include SNG for the feeding of reproductive animals while inclusion of SNG for farmers in a "low input – low cost" orientation make sense in their farming system. Farmers valuing highly a close contact with their animals have different attitudes towards SNG grazing mainly depending on the distance between the farm and the SNG area. Farmers' values related to nature quality are mainly not directed towards SNG. For many farmers, SNG grazing is not an environmental commitment and SNGs is not perceived as especially more beneficial for the environment than CG. Farmers' values and management choices are influenced by contextual factors. Marketing channels for the meat can be seen both as a barrier and potential for more SNG grazing. We observed that some farmers changed their systems to include SNG in order to sell to a new channel but the values of Danish major market channels are conflicting with high inclusion of SNG.

Key-words

Permanent pasture; animal welfare; biodiversity; farmers' attitude; meat quality; conservation grazing.

Introduction

Semi-natural grasslands (SNGs) have long played an important role in livestock production systems in Europe but changes in agricultural production systems have lead to plowing and cultivating of SNGs or their abandonment (Gibon, 2005). SNGs are currently regarded as a land use to enhance and a resource to preserve, following the increasing recognition of their many services to the environment and society (Gibon, 2005). Several policies have been initiated but their effect on the maintenance and nature quality of SNG is questioned (Condé et al., 2010). Farmers, as land use managers, are key–actors and take decisions on the use and management of grassland areas. This article presents case studies of Danish beef farmers and their perspectives on the barriers and potentials of using SNG in their beef production.

The existence of SNGs in Europe is due to human activities and they are maintained by mowing, close grazing and changed edaphic conditions (Singh et al., 1983). Their anthropogenic origin explains why, when grasslands are abandoned (except in the alpine and arctic areas), they soon convert into bush (Metera et al., 2010).There is evidence that grassland management by grazing livestock at moderate levels contributes to the maintenance of plant diversity by reducing the abundance of competitive dominant species (Olff and Ritchie, 1998). Grazing, in addition, has a profound influence on small-scale grassland heterogeneity by creating disturbances in the soil and the sward structure, thereby enabling niche establishment of some species (Adler et al., 2001). SNGs are thus biodiversity hotspots in Europe (De Bello et al., 2010; van Swaay, 2002) and a large proportion of the threatened species is dependent on the

grassland ecosystem (Condé et al., 2010); in Denmark, it is the case for 63% of the red-listed plants (Ejrnæs, 2009).

In the case of Denmark, the semi-natural areas used for agricultural purposes (i.e., SNGs) only account for 7,2 % of the total agricultural area (Danmarks Statistik 2011, own calculation). SNGs are heterogeneous in terms of type of ecosystem; they encompass meadows, dry meadows and heath land, salt marshes and moor and fen (Kristensen and Horsted, 2011). Traditionally, these SNG have been used for grazing of cattle, primarily heifers of a dairy breed, but this has diminished over the last decade due to a general specialization of the agricultural sector and not least an intensification of the dairy production leading to the use of year-round indoor feeding systems. Maintaining SNGs is a goal of Danish policies, for which a target of 40,000 ha has been set for 2020 (Regeringen, 2009) as part of the compromise taken at COP10 with the Nagoya Protocol (Anonymous, 2011) . This encompasses both the establishment of new areas and the preservation of existing areas that should not be abandoned. Several policies and funding instruments are in place to support this goal. Despite the above, grassland abandonment and encroachment with shrubs and trees remains a major problem, as the last report on the status of biodiversity in Denmark points out (Ejrnæs et al., 2011).This development has created a need for other types of animals for grazing SNG areas. Cattle, horses, goats and sheep are used for grazing; their impact on grassland structure and biodiversity depend on differences in their body size, dental and digestive anatomy (Rook et al., 2004). For conservation grazing the choice of animal species depends on the characteristics of the ecosystem, the grazing management and the desired outcome (keeping shrubs down, maintaining existing plant cover…). Kristensen and Horsted (2011) identified beef cattle as the most promising grazer in Denmark based on an evaluation of existing types and numbers of animals. Beef cattle would be able to utilize two thirds of the SNG area in DK (Kristensen and Horsted, 2011).

It seems that many supporting factors for SNG use are met in Denmark: subsidy incentives to the farmers, number of beef cattle, localization of SNG spread all over the country and opportunities of marketing the meat using conservation grazing as a quality in the story-telling. Only a fraction of Danish beef cattle are, however, used for grazing SNG (Kristensen and Horsted, 2011). It is therefore interesting to explore the potentials and barriers for using SNG in beef production in a farmer perspective.

We identified several studies dealing with farmers' decision and management of SNG as general studies of farmers' involvement in environmental schemes. Battershill and Gilg (1997) and Herzon and Mikk (2007) have looked at a mixture of schemes or at schemes that had several objectives where SNG grazing was just part of a larger picture involving agro-environmental practices. They, therefore, did not analyze in detail the practices and management at the farms and neither did they compare specifically SNG grazing to other agro-environmental schemes. In the study by Wilson and Hart (2001) farmers were already using SNG and agro-environmental schemes were meant to reduce the intensity of SNG use, as fertilizer use and stocking rate. The work of Girard et al. (2008) focused on farmers practices and feeding strategies and offer some useful insights in the French context.

In this study, we adopted an explorative approach, focusing on values and perceptions of farmers in beef cattle systems in order to identify barriers and potentials for SNG grazing. We investigated their perceptions of using SNG in beef production in interaction with their own values about nature quality and environment, with production strategies and with their perception of market demand for meat.

2. Methodology

2.1 *Sampling strategy*

Farms and farmers were selected to obtain variation (Flyvbjerg, 2006) to account as much as possible for different beef farming systems. Variation in the sample was important because we wanted to explore the importance of different strategies of farmers on their use of SNG and thus explore a variety of values and argumentations. There is no systematic list of beef farms with characteristics of their production in

Denmark. Our sources for finding farms were an advisor (mainly large herds), association of breeders of specific breeds, farm shops, farms selling their meat through Friland Meat or Nordjysk Naturkød which have a website for the consumers with a list of the farmers engaged in these channels and a brief description of their farms. We selected farms from these different sources considering the following criteria: (1) size of the herd: average herd size in Denmark is of around 12 cows per farm; a large number of farms operate with less than 20 cows, driven to complement other agricultural activities or as a "hobby" by non-professional farmers (as shown for example in a case study for central Jutland, see table 1 in (Kristensen, 1999)). Herd size would possibly reflect economic importance of the beef income in farm and family income (2) type of breed: rustic breeds are presented in Danish reports (for example (Kristensen and Horsted, 2011)) as more appropriate for SNG grazing than high-growth potential breeds because they can be outdoors all year-round. These breeds account however for less than 10% of the total number of suckler cows in Denmark (Anonymous, 2010). (3) sale of the meat in different marketing channels because marketing channels were one of the few sources, we could identify farmers from. We identified 5 main relevant marketing channels based on our previous knowledge and web research. They are briefly presented in Figure 1.

Farmers have five different marketing channels through which to sell their meat:

- Undifferentiated sale, to a cooperative or independent slaughterhouse. The meat is sold to catering branches, Danish supermarkets or exported.
- Friland (Limousine, Angus or Kødkvæg) market the meat on the basis of meat tenderness and good animal welfare.
  Farms are annually controlled by the "association for animal protection" (Dyrenes Beskyttelse). The main criteria for farmers are: adequate space and suitable organization of the indoor area, animals have to walk around freely, mother cows should have grazing available in the summer, and calves should not be separated from their mothers before they are five months old. Animals slaughtered under the Limousine and Angus concepts are young − maximum 12-14 months old − in order to ensure tenderness.
- Friland Økologi, for organic meat. Organic standards emphasize animal welfare and a limited use of chemicals.
- Nordjysk Naturkød, in the northern part of Jutland. Farmers can sell their meat under this concept if the animals have grazed for at least 150 days of their life in a nature-protected area of this region (which are SNGs). The product is branded as a high-quality meat with a sustainable production contributing to the conservation of the nature and landscape of the region.
- Directly to private people. A farmer can have animals slaughtered and subsequently prepared by a butcher. Private consumers can buy a quarter of an animal (40 to 60 kilos) and freeze it for their own consumption. Some farmers also sell detail pieces.

There are no clear statistics available for estimating the relative share of these different channels on the Danish market, but "Undifferentiated sale" dominates, whereas the other channels remain small niches (with the hypothesis that 15% of slaughtered cattle in Denmark come from suckler systems which makes up about 75000 cattle slaughtered per year from suckler systems. Slaughter register from Friland for 2011 is 1820 cattle slaughtered and for Friland Økologisk 6200 steers and heifers including the ones from dairy systems. Sell of Nordjysk Naturkød was under 1000 animal per year)

Figure 1: Marketing channels

These investigations led to a list of 152 farms. From this list we selected 25 farmers keeping a broad diversity of characteristics in term of herd size, type of breeds and marketing channel. For most of them, we did not know beforehand whether they were using SNG or not and to what extend. From the 25 farmers, 12 accepted and were able to participate to the study. The 12 farms fall reasonably in the diversity gradient of farms with farms with small herds and large herds, several breeds represented and use of contrasting marketing channels (see also farms presentation in table 1). The study took place during winter 2009-2010.

2.2 Case study and interview strategy

Each case study was constructed around a farm visit followed by a semi-structured interview. The farm visit allowed the farmer to present the farm, describe farming practices and discuss them. The semi-structured interview was organized around the following subjects: farm history and motivations of the farmer and his family; herd and farm management: grazing practices, reproduction, feed productions; experience and practices in relation to marketing of the meat; use of permanent grassland: experience with their past and present practices, challenges, reasons for their management choices, possibility of integration of more permanent grassland in the system; environmental practices regarding chemical use and hedges or wet ecosystems; farmer's perspective about animal welfare and the Danish certification scheme for good animal welfare. At the end of the interviews, we concluded by speaking about the farmer's likes and dislikes and we agreed on a list of farmer's drivers and motivation for having beef cattle, based on the discussion during the interviews.

Each interview and farm visit was fully taped and transcribed. They lasted from 55 minutes to 4 hours.

Table 1: Structural characteristics of the 12 beef farms.

Farm	Economic importance of beef activity	No. of mother cows	Breed	Organic	Grazing semi-natural grassland	Access to semi-natural grassland	Marketing
A	Full-time farmer Beef = 30% farm income	35	Limousine + mix	No	9 ha wet grassland - ploughed after the interview	rented for free from a neighbor	Direct sell Slaughterhouse
B	Hobby No income	10	Limousine + mix	No	No	1 ha owned	Slaughterhouse
C	Hobby Income is not important	40	Limousine	No	40 ha hilly meadows	Owned	Direct + slaughterhouse
D	Hobby No income	30	Simmental, Hereford, Angus, Highland	No	120 ha heath	Rented for a symbolic price	Nordjysk Naturkød
E	Hobby Beef income = equivalent to one extra salary	60	Limousine	No	No	10 ha owned, leased out	Friland Limousine
F	Full-time farmer Beef = 20 to 50% of farm income	35	Limousine + mix with milking cows	Yes	Marginal	7 ha owned and used for sheep grazing	Friland Organic and private
G	Hobby Beef income = equivalent to one extra salary	50	Angus	No	Marginal	1-2 ha owned	Friland Angus
H	Hobby No income	6	Highland Cattle	No	15 ha salt marsh	Partly owned, partly rented from neigbors	Direct
I	Full-time farmer Beef = 30% farm income	30	Simmental And crosses of Simmental	No	240 ha heath	Rented from the state and militar for low cost / free	Nordjysk Naturkød
J	Full-time farmer Beef = 70-80% farm income	110	Limousine	Yes	200 ha wet meadows	Owned + rented from the state or region	Friland Organic+ direct
K	Beef farm as a hobby employing a full-time employee Very little income	100	Galloway	Yes	300 ha heath	Owned	Friland Organic+ direct
L	Landowner not farming himself Two employees Profit-oriented farm	250	Cross Hereford – Limousine	No	65 ha wet meadow	Owned	Friland Kødkvæg

2.3. Data analysis

The interviews were transcribed and coded using Transana™. The analysis led to the emergence of themes (Kvale and Brinkmann, 2009). Themes were not predefined but defined while reading the interviews transcript again and again. Some of the themes are directly related to the questions we asked, but some new themes also emerged from the interviews. The themes were then used to analyze each farm as a case and for analysis across cases. We selected and analyzed the themes related to barriers and advantages of SNG grazing from the farmers' perspective.

2.4. Validity of the study

We validated our data and our analysis to ensure the quality of the study in two steps. First, during the interview and the farm visit, we were always going from the concrete and visible to the more conceptual discussion and coming back to the concrete, thus ensuring coherence between both of them. Second, we presented an analysis of each individual interview as feedback to the farmers, and we discussed it with them during a farm visit in April 2011. This discussion has been used to adjust the analysis if needed.

3, Findings and discussion

3,1, Farmers' use of semi-natural grassland (SNG) and cultivated grassland (CG) in beef production

The 12 farms differ in their use of grazing as a feed source and the extent to which grazing occurs on SNG. Farmers make a clear distinction depending on the animal function between reproductive or meat production. Reproductive animals (cows and heifers) spend time grazing during the summer on all farms. When there is SNG grazing on a farm, it is prioritized for reproductive animals. On many farms the feeding of animals for slaughter is based on high-energy feed in the form of compound feed and/or pasture with high-quality grass at a specific time of the year. On some farms, however, animals for meat production also graze on SNG for part of the summer or even throughout the year. Figure 2 represents a scale with a continuum of practices for grazing and feeding. This scale reflects the degree of control the farmer has on the production of grass (two-species sown grassland vs. highly diverse nature area) and thus partly on the productivity of the animals. This scale goes from a situation where the environment is very much controlled (bottom of the scale) to a situation where a wild nature supports totally the production of meat (top of the scale).

Farmers in this study have potentially access to both cultivated land, where they can sow grass, and to permanent grassland (SNG). SNG is either owned or can be rented to other landowners to a cheap price or often for free (Table 1). The farmers who don't use or minimally use (less than 2 hectares) SNG for beef production (farmers B, E, F and G) all would have access to SNG either from their own land (farmer B) or from neighboring areas which are not grazed. Thus use of SNG and CG for beef production is very much a matter of choice of the farmer: choice of production system and of the way to manage their business according to their own values and priorities and to external factors.

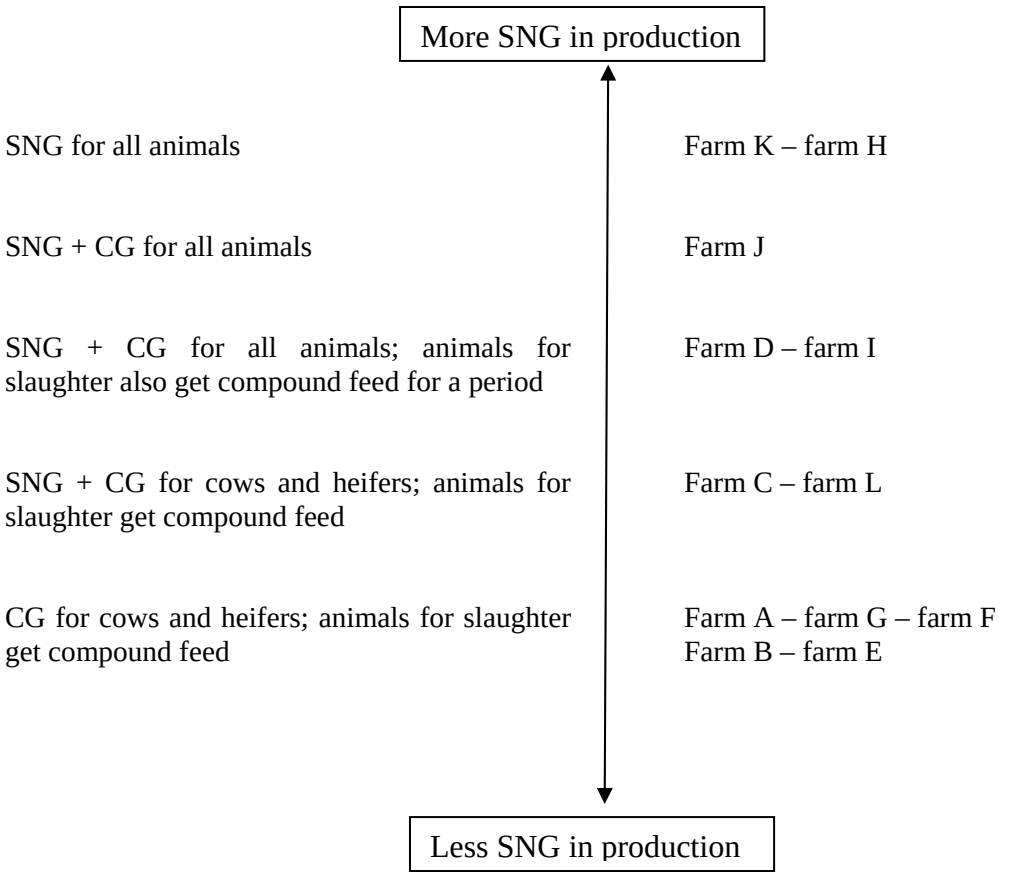

Figure 2: Summer feeding practices on the 12 farms with partitioning between grazing on cultivated grassland (CG) or semi-natural grasslands (SNG)

3,2 Farmers' interest in nature quality and link to their farming and landscape practices

When we asked the farmers about nature and wildlife on their farms, they all had stories to tell about wild animals, and especially about their observations of birds. For example farmer G said:

"In 1985 when we came here, there was just barley. The ground was very bad. We did not see many birds. In the stable we had no birds. After we started, there were coming a lot of swallows and now we see a lot of birds in spring and autumn coming from north. (…) The hedges can take the wind from the cattle and it is very good to see some birds and rabbits and foxes and we have also deer. In the winter time, when I feed the cows with silage, there are some seeds, there are coming doves, they stay here the winter time. I had never seen that before. So that is very good for very very many birds to have cattle outside the whole winter. There is coming some mosquitoes and things they can eat. Sometimes I can see some small birds staying on the back of the cow. and "pick pick."

Farmer A: "*We have chosen to plant trees in the hedges that have fruits for the birds for autumn and winter… It nice to see wild animals here…"*
Farmers understand themselves as people who appreciate nature and describe their farming activity as part of nature. They are witnesses of animals' activities and nature changes and also actors impacting on

nature by farming and managing land. Of the 12 farmers 6 of them mention their personal enjoyment of nature as a driver for being a beef farmer (Table 2).

Table 2: Farmers' drivers and priorities for the beef activity

Farm	Drivers and priorities for the beef activity
A	Contact with the animals; profitability; producing good meat (tasty) for the Danes; easy work (in comparison to the vegetables)
B	Contact with the animals; physical activity like driving the tractor
C	Animal welfare and taking care of the nature are an evidence; breeding is exciting and motivating; personally enjoying the nice nature; having a direct contact with consumers who give him a good-feedback on the quality of his meat; physical activity
D	Personal enjoyment of having animals; personal enjoyment of the nice nature and wild animals around; animal welfare; having a balanced economy
E	Animals have a good life and therefore give a perfect product to consumers; Breeding – being part of the breeders association; profitability; being busy on a farm with animals
F	Close contact with animals with a good welfare; profitability; respect for nature and environment (organic); producing products of good quality for the consumers and the society
G	missing data
H	Living and having around a very nice nature, nice place, close to the water; close contact to "happy" animals; sell meat of good quality directly to people they know; possibility to show people that you are making good farming
I	Profitability ; enjoy personally going to the nature area and see the animals there; animal welfare; tourists are happy to see the nice landscape with the cows
J	Being part of the movement of agriculture in the society and in the place they leave; profitability
K	Personal enjoyment to see happy animals – animal welfare; organic; nice nature for people; producing very good meat, tasty and healthy; a big nature without many people, they feel very comfortable and it is good for resting.
L	Perspective of the manager on the owner's priorities: Profit; tidiness and cleanliness; low bills and low costs; animal welfare, but not for the animals, for the economy; hard workers.

Farmers take different actions in favor to nature, traducing their interest in nature quality. We have identified 3 different types of practices for wildlife and biodiversity: one type is centered on the house and the quality of the leaving place for the family; a second one is centered on field borders and eventually small biotopes close to the fields, for example, restoring meanders in the river, planting hedges of trees along their fields; a third one includes the fields and farmed area. The farm is for the farmers a place to work but also a place to leave. Three of the farmers have bought their farm and explain their choice of this particular farm because of the quality of the nature (farms C, H and K). When farmers describe their practices to enhance nature quality, ´many of them describe practices like planting trees and create or take care of a lake. Within the fields cultivated or semi-natural, farmers mention their use or non use of pesticide and their impact on biodiversity. "*we don't use pesticide so we have more different plants around our pasture*" (farmer G)
"*we don't spray, they [the birds] better like that*" (farmer F).

Concerning SNG grazing, the farmers - except from two of them - don't link SNG grazing with biodiversity or nature quality. Most of the farmers who have grazing on SNGs enjoy the nature their cattle

help to maintain. Several of them mentioned that they really like going out for a walk to look at their cattle and at the birds or other animals in the nature area. It would be a positive aspect to them personally, but they do not relate it with a compromise in taking care of the biodiversity – landscape themselves. Generally, many farmers consider CG as environmentally friendly. When asked about the environmental impact of their production, several emphasize that in CG production you do not "*spray poisons*"(farmer I). "*This kind of farming where we don't use so much fertilizer; and no pesticide; and our fields are green the whole year (..) That is good enough I think.*" (Farmer G.) This is a view of CG and SNG shared by many of the farmers but two farmers explicitly linked SNG with nature quality. Farmer I showed some knowledge about the importance of grazing for biodiversity: "*this area (…) there is a lot of flowers up there. Special art of plants. So we made a deal, that after the 1st of July, I can graze it. it is about 140 different kind! After the 1st of July I graze it, because it is good for the plants*." (farmer I) and "*there is not much cattle left in the farms. But it is very good to clean the nature for grass. Otherwise it will get something like this...it closes everything. The cattle keep it down and they get their feed.*" (farmer I). Another farmer (farmer K) linked directly her motivation of maintaining nature quality to SNG grazing and uses moral, normative arguments: "*I think, from the beginning we had an idea of making beef without using soya and all those things you can buy. we would like to feed them in our own grass*." (farmer K)

From these interviews we can observe that farmers are interested in nature quality but that, for many of them, SNG grazing is not directly linked to their interest for nature. When they want to compromise for better conditions for wildlife, farmers will do it in the unproductive areas, i.e. hedges and streams or close to their house. The focus of farmers on the landscape elements close to their house has also been demonstrated by Busck (2002) in a case study in Denmark. Our findings contrast with a recent Swedish study, which concludes that private aesthetic motivation governs farmers' readiness to preserve landscape (Milestad et al. 2011), while in our study this was only the case for a few farmers, where the others dissociate their personal pleasure from their commitment to SNG grazing. Ahnström (2009) concluded that "farmers' interest in nature matters for biodiversity." From our data, we see the same phenomenon: many farmers take actions to enhance biodiversity on their farms; but these actions are not necessarily turned towards SNG grazing. Why not? We did not investigate farmers' knowledge and understanding of biodiversity in relation to SNG, while some studies (Wilson and Hart, 2001; Herzon and Mikk, 2007) have shown that it is important for motivating farmers. Herzon and Mikk (2007) suggest that schemes may "work better if linked explicitly to the support of specific species, which farmers themselves know well and feel positive about, rather than to the abstract concept of "biodiversity"". In a case study in Denmark, Noe et al. (2005) concluded that dialogue with advisors and specialists was a key component for influencing farmer's perception and awareness of wildlife. This might be an interesting option for the protection of Danish grasslands. Some of the farmers knew the names of endangered plants or animals living on their SNG and were proud to cite them. Specific knowledge about SNG characteristics might help farmers take responsibility for biodiversity and stimulate their reflection on nature quality.

3,3 Farmers' values about human-animal relationship and animal welfare

The analysis of the interview brought us to focus on the link between farmer and cattle in order to explain their perceptions of SNG grazing. SNG grazing is seen and experienced as positive or negative for animal health and welfare depending on the different values attached to the status of the animal. Farmers referred to different values when speaking about their animals' behaviour and welfare in a natural pasture. We identified two different sets of values:

- The wildness / domestication aspect or human-animal relationship
- Animal nutrition and welfare

Farmers refer directly to those values when narrating about their choice of practice.

All farmers experienced that animal welfare was very important for the animals and their production. Farmer C said that taking care of the animals was a "*natural*" part of having cattle. Furthermore, welfare is a necessary condition for animal productivity: *"I know if I take good care of the cattle, then they thrive and if they are doing well, then the cows will be with calves, the birth are going well, they will grow fast, and so on..."* (Farmer C.)

However, the views about what animal welfare means in practice and what status animals have are very different from farmer to farmer.

Contact man – animal

For several of the farmers a close contact with the animal is an important motivation for having the beef farm activity. It is especially important for hobby farmers, but also for several professional farmers where beef is not the main source of income.

"You can see, it is a little bit as my friends. I like it" (farmer H)

"I spend more time with the animals than strictly needed (…) I enjoy winter because then the animals are inside." (Farmer A.)

The importance of the emotional human to animal relationship has also been met by Dockès and Kling-Eveillard (2006), who categorized this type of farmer as "Farmer for animal: the animal is an important part of his life". The close contact between human and animal is not only an emotional relationship but also important for the management of the animals and the work of the farmer:
"*When we take the cattle from the field and go inside, I always call them and they always follow me. I always go in front of my cattle. I don't go back. They follow me. And if they think I am stupid they won't follow me. They know, when they follow me, it is good: for example new grass, ..."* (Farmer E.)

Structure and size of a SNG can eventually challenge the close contact human–animal. Some natural pastures like heath or coastal marsh include bushes and trees. In these areas cattle can develop a different behaviour than on straight grassland, by, for example, hiding. Some natural pastures are large and can have hilly parts. Therefore it can be difficult for a farmer to keep an eye on individual animals when they are in that area.

This might have different consequences for the farmer's work and animal welfare. It can make it difficult for the farmer to detect disease or other problems. But these obstacles can be overcome. For example, Farmer G explained: "*The first year (…) calving outside, often hidden in the woods. We could not find them. I have learned now that if there is something wrong, the calf can't drink; the cow is sick, you can hear the calf or the cow. If you cannot hear, than everything is fine*."

The animals can become wild with less human contact. This is acceptable for some farmers and not for others.

According to farmer I, "*The cows, when they go out to the nature, they make different when they go home* [different behavior] *they get a deal of the nature and they go back to where they come from*." . Farmer I, who sees it as positive, later said: "*I think the animals have the best life and the best conditions to have a good health. When they go out in the area. If you go to this area, there are a lot of places where they can go to hide, they can go and get their body healthy*."

Farmer F said about the possibility of having his animals in a nature area: "*and it should be here around because I think it is important that you can see your animals every day, talk to them. It should be not so far*."

When animals have too little contact with humans, they might turn so wild that a farmer cannot really "farm" them anymore but instead becomes a hunter Larrère and Larrère (2000) describe it as breaking the "domestic contract" that exists between man and animal. This was experienced by two farmers in our study.

"*She could not catch the animals, we tried the whole year and it was impossible. We got some men to help us but it did not succeed. We were speaking about getting a hunter to shoot them in the field, maybe* [using] *a lasso.*" (Farmer K.)

Animal welfare is a complex concept including the biological needs and feelings of animals (Hubbard and Scott, 2011). Expressing a natural behavior and having a good human-animal relationship are both considered important criteria for good animal welfare (Tuyttens, et al., 2010). In the case of grazing in natural areas farmers can experience that these two aspects are inter-competitive and can be mutually exclusive.

Many SNGs in Denmark are fragmented and sometimes far from the farms (Kristensen and Horsted, 2011). This has previously mainly been presented as an economic problem for farmers in relation to their cutting and grazing as transport costs are higher than with grasslands around the farms (Kristensen and Horsted, 2011). We conclude here that the fundamental motivation for some farmers for a close contact with their animals is also a reason for their difficulty with having cattle grazing on SNG.

Animal nutrition and welfare

SNG gives a low yield of energy per hectare "*there is not much grass here*" (farmer D), according to literature two to ten times lower than CG (Kristensen and Horsted, 2011). Cattle are then limited in their energy intake by their physical capacity (they cannot process more volume); they feel satiated but the energy intake might not be enough for a high performance (growth, lactation) or even maintenance. The farmers have different interpretations of the impact on animal welfare: what is important for animals? Is it best for them to have plenty of energy-rich food or are animals robust, being able to adapt to low-energy input in some periods? Robustness is usually taken as part of breeds' characteristics: some breeds are more robust in harsh conditions than others. The farmers in our study acknowledge this. But even within the same breed, for example Limousine, some farmers think that they can cope with SNG grazing and others that they cannot, even in the same kind of environment (meadow). That is where their attitudes and values play a role.

Farmer L*:* [Grazing in the nature area] *It doesn't do the animals any good for the animals. The animals would have a better life on better grass. (…) on higher land with better grass they would grow more. (…) sometimes it's a bit wet, the grass is short. If we could have the animals on the high land, we would get even better animals.(…) Of course the best for the animals is to be outside as long as possible and they must have water and so on. But it's a matter of food if an animal is happy."*

This opinion was shared by Farmer E.

Other farmers in our study had no problem with the low energy content in natural pasture in relation to animal welfare. They consider that animals are robust and can cope with those conditions without it being a problem for animal welfare. They emphasize only the growth of young animals, which is limited, but do not relate this with animal welfare considerations.

Following these different values and attitudes about the farmer–animals relationship and animal welfare issues, farmers experience nature grazing as either a positive or negative for their herd. Some of the farmers who experienced nature grazing as being negative for their cattle would maybe still keep their animals in a nature area for economic reasons, for example, but with a reluctant attitude.

3,4 External factors of importance for SNG use

3,5,1 Subsidies

Economic conditions are the most common rationale farmers use for explaining their practices. This ties well in with the leverage of subsidies policymakers use to get farmers to graze semi-natural grassland (SNG). The subsidies reduce land costs and/or feed costs for the farmers. It is not surprising that many farmers refer to the economic rationality.

Farmer L: "*So we could get environmental subsidies for the poorer farmland (…) So it was a matter of getting as many subsidies as possible"*

Farmer H: "*I get it for free*"

Farmer G: "*Resowing every five years. I think we need to have new seed grass to have more yield. We have also the rules in EU and Denmark to plow for subsidies*." Farmer G

This result concord with the observations of Stenseke (2006) who concluded that "interviewed farmers expressed the necessity of subsidiary payments for the extra work that is required for having cattle grazing on seminatural pastures instead of on cultivated pastures or in feeding lots. The existing economic measures, paid per hectare to individual farmers for seminatural grassland management, are of importance, encouraging and motivating the farmers to continue their deeds."

3,5,2, Local network and local project

One of the farmer's motivations for starting to use SNG grazing was the dynamics and social aspects of a local project and network (Farmer J). The other farmers we met were not located in an area with a local project related to SNG grazing. Local projects could be a way of getting more farmers interested in this issue as it could be in line with the conception of the farmer as a caretaker of animals. Local social acceptance has been demonstrated to be important factors in studies of agro-environmental schemes (Defrancesco et al., 2008).

3,5,2 Consumer and meat supply chain demand

Farmers' production systems respond to a certain extent to the demand from consumers through wholesalers and slaughterhouse mediation. We observed that marketing outlets were mentioned by farmers as a reason for using SNG grazing (Nordjysk Naturkød) or not using it (Friland Limousine) and also in the decision of which animals should graze on SNG or on CG.

Meat characteristics and quality certainly vary according to production conditions and grazing in nature areas can have an impact on these qualities. Meat quality includes different dimensions, which can be conflicting/exclusive. Animals finished on grass are often older and in relatively poorer shape than animals finished on concentrates. Is there a market for these animals?

Ethical quality and the good story
SNG grazing is part of the maintenance of biodiversity and landscapes patterns. This "good story" is successfully used in marketing in other countries, for beef, in France (Bedoin et al., 2009) and Sweden (Plateryd, 2004) and in the UK for Shetland lamb. Can this "good story" be used in Denmark for selling meat based on SNG production systems?

Farmers selling directly to consumers have the possibility of telling their own story to the consumers and emphasizing different aspects of their production system. In our study three farmers had herds grazing on SNG with direct sales to consumers. All three farmers say that consumers are not really interested in knowing whether the animals have been grazing a nature-protected area or other kind of grassland.

"Of course, we say that the animals are leaving in the nature and so on.. and there is a part of taking care of the nature but actually I don't know what that sells. People's experience on the meat and then the fact that our family are the caretakers of the animals until they are finished that is the most important." (Farmer C.)

"*It is very difficult to get people interested in the story we would like to tell them."* (Farmer A.)

The concept of Nordjysk Naturkød directly acknowledges nature grazing, uses it as a "good story" and pays a higher price for the meat if the animal has been grazing on SNG for at least 150 days. The concept was however stopped in 2011.

This higher price was an important motivation for grazing SNG by two of the farmers we met.

"*because I do this* (SNG grazing)*, I get more paid for every kilo* (meat)*, and it is quite good, about 3.25 DKK for 1 kilo. so it means 1000 up to 1200 for each animal*." (Farmer I.)

The motivation based on a higher price for the meat was also found in a study conducted by Björklund et al. (2009).

Is the story attached to a product not part of consumers' decisions when purchasing meat? This remains a question for future investigation. The overall impression of the consumer demand from a farmer's point of view is that the eating quality is the most important aspect of the meat product and not other quality dimensions.

Demand for young animals finished with concentrates

Friland – a major actor in the Danish market – has developed a concept for the meat of Limousine, Angus and other beef breeds. They focus especially on farm animal welfare and on tenderness of the meat. To ensure tenderness, they only accept animals that are between 8 and 12 months old and the best price per kg is obtained for a 260 to 340 kilo slaughter weight. To obtain this live weight gain, animals need to be finished with energy-rich feed. Farmers typically use commercial concentrates. For the farmers who choose to supply meat under this concept it means that the young animals for meat production will not be on grass the last three to six months before slaughter.

"*No, it is not possible to get a good quality on grass. It is necessary to give them some concentrate. So at the moment we have them inside the last three months*." (Farmer E.)

Grassland will support nursing cows during the lactation stage and during gestation. In our study, we can observe that of the five farms where SNG grazing forms part of the feeding practice of the animals for meat production, none of them sells their animals to Friland Beef. This marketing channel encourages, in fact, systems where grassland (CG or SNG) is not directly part of the production of slaughter animals.

Production systems of young animals slaughtered from concentrates are also stimulated by farmers' perception of a consumer demand for lean meat. Several farmers in direct contact with consumers explained that many of their consumers look for lean meat. (farmer C, A and K).

Farmer C, who sells directly to consumers, slaughters the animals at a young age to meet this demand, even though he knows that it will mean a less developed flavor for the meat.

"But actually our customers they are not from the countryside. We don't sell to our neighbors, because this meat is too expensive. But for the academic, health people [people focusing on being healthy - slim] *in the cities, they are very focused on low-fat meat. Then what I have seen as my chance is to give them recipes, where you focus on that you have to use different spices to prepare this because it can be to neutral in the taste because of the lack of fat. That is the draw-back on low fat meat."* (Farmer C.)

This again leads to production systems where animals for meat production get compound feed and do not graze.

Organic meat and meat from slow-growing breeds
Demand for organic beef meat has increased, even if it remains small for the intern market(3% in value (Pedersen, 2012)). On the organic farms in our study, meat production was based on forage (farms F, J and K). They produce steers, which grow more slowly than bulls and can be finished on grass. Farmers with Limousine breed don't make a direct connection between their use of SNG and CG and the marketing channel (farm F and J), both can produce animals which meet the quality standards of organic beef on SNG or CG. Farmer K uses the Galloway breed and encounters more problems because Friland Organic sells her animals with old milking cows because they don't meet the standards.

"*Our cattle is not big enough to be classified in the good classification. so it is a problem. I think our meat is much too good to be delivered to the supermarket and sold between old milking cows. (…) We are getting very low price. They love Limousine and Angus, the big cows. (…). I think the people in the shops would like to buy it if they had the possibility.*" (Farmer K.)

For slow-growing breeds, the market in conventional chains with supermarkets outlet doesn't give a price which the farmers find to be sufficient. They can however sell their products directly to consumers and experience that consumers appreciate their quality. Farmer H has a small herd and only uses this way to sell his animals; farmer K had previously sold most of her animal directly to private consumers and to restaurants but direct sell represents a lot of work for finding customers and maintaining business relationships and she abandoned it.

Several of the farmers with organic or slow-growing breeds mentioned that grass-fed animals might have a better taste than corn-finished animals.

Farmer H: *"This meat it has a strong taste because they don't get corn, and they eat a lot of things and herbs. and then it tastes different."*

Farmer H's wife*: A little bit sweeter, and I will cook it, it won't reduce, the beef is this size before and after*."

Farmer J: *"A little more flavour in the meat, when they go out there* [in nature area]*. It is a more natural approach (in comparison to young Friland Limousine we had before). I can imagine, that it gives a better quality of the meat. Rather than having animal pressed up in a certain age, like chickens pumped up in 32 days."*

Farmer F: *"I think the meat will be better if it is not on too much grain. I think if they get grass, hay, silage, and not so much grain they will have a better meat. other kind of meat. more tasty"*.

Farmers see opportunities of differentiation of their products with grass-based feeding and SNG feeding but don't use it directly when marketing the meat to consumers.

Consumer and market demand for the meat is a strong driver for the farmers' choice of system. As perceived by the farmers, the biggest market demand is for young animals (less than or around one year old) who have been fed a compound feed after weaning. It corresponds to a product which is easy to handle for the slaughter industry and has a leanness appreciated by the consumers. In these rearing systems, reproductive animals can be on SNG or not, while animals for meat production need to be fed indoors with energy-rich feed. Organic beef cattle and slow-growing breeds, which in our cases were finished on grass, present other meat characteristics and can be difficult to place on the "conventional" market and therefore remain at a niche scale. The ability and willingness of mainstream consumers to pay for the meat and the low-cost focus of slaughterhouses can therefore be barriers for the development of SNG systems. Consumer focus on leanness could be an advantage for SNG-based production systems, because studies have shown that animals that are finished on botanically diverse pastures generally have lower fat contents than animals finished on CG pastures and that this does not seem to affect eating quality (Fraser, et al., 2009). This is however not used yet by the farmers we met as a marketing argument. The "good story" of the meat from nature areas and the preservation of the Danish landscape and biodiversity seem, in the eyes of the farmers, not to work. Efforts could be made in this domain − for example, the possible introduction of the "terroir" concept in Denmark, policy mechanisms to support the promotion of food qualities, market organization and labelling, in line with what was suggested for developing pasture-based systems in Britain (Buller, 2008).

3,5 Farmers' values related to production strategies and SNG use

From the analysis of the 12 case studies we have develop a framework which link farmer's values and priorities with its choice of system including or not the use of SNG. (Figure 3) We have identified 3 dimensions of values related to production strategies, which are important in the case of the 12 farms of this study; they are "Low input – low cost", "productivity – high animal growth" and "care, close relation farmer-cattle". These 3 values cannot be equally strong at the same time for a farmer as it would not make sense in the farming system. We situated the farms in a triangle relatively to each other in relation to these three dimensions.

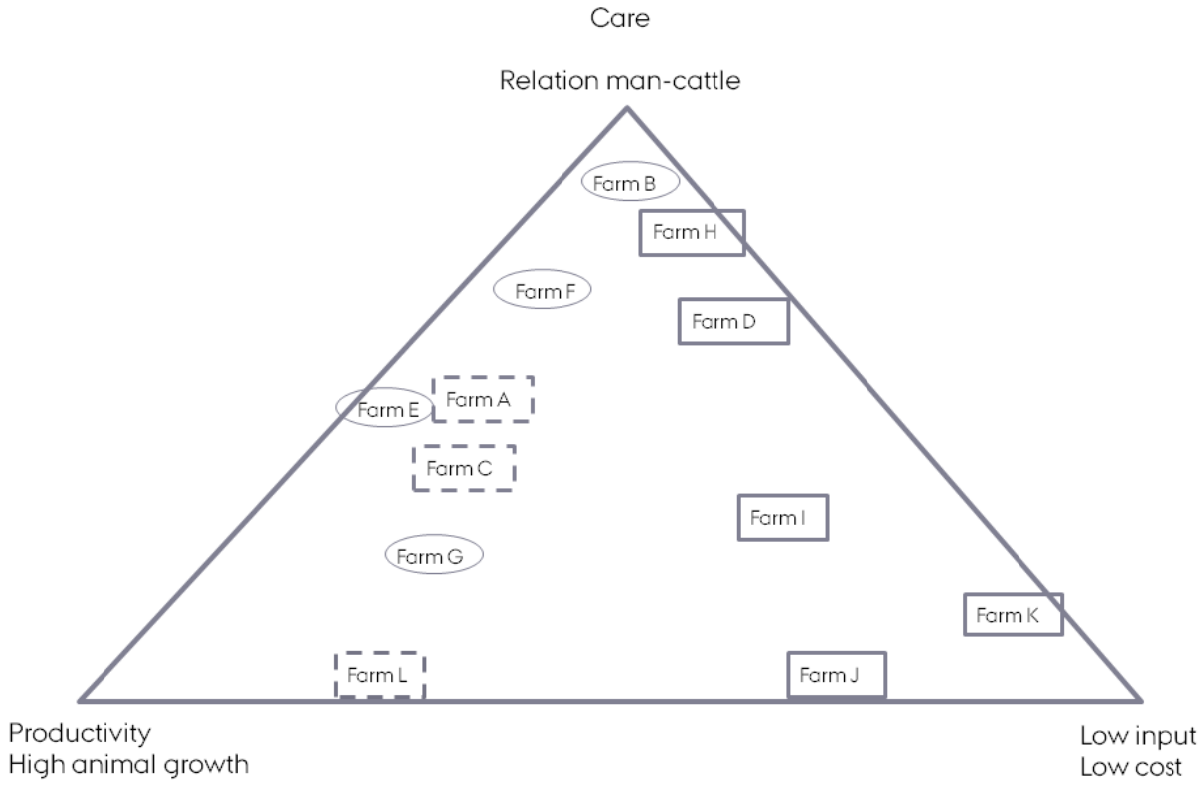

Figure 3: Farmers' values and production logic and their use of SNG

Farms which names are in bold borders' boxes use SNG for all their animals; the ones in dashed boxes use SNG for reproductive animals only; the farms which names are placed in an ellipse don't use SNG (or very marginally).

Farmers who highly value "productivity and high animal growth" manage their system such as obtaining high conformation of the cattle, using energy and protein rich diet. They are calculating the life weight gain of their cattle and comparing it to others' results. In this sphere we encountered several farmers for which breeding is an additional motivation and stimulation in competing with other farmers "*I want to be one of the top 10 breeders in Dk*" (farmer C). For the farmers strongly orientated to the values of "low input – low cost", the ways to obtain profitability of the farming activity are encompassing choices of cheap feedstuffs also if it leads to lower weight gain and carcass conformations. It is for some farmers economically motivated but it is for one of the farmer's linked to her values: "*I think, from the beginning we had an idea of making beef without using soya and all those things you can buy. We would like to feed them in our own grass.*" (farmer K). These two opposite dimensions could be identified on the 12 farms; however some farmers try to have both aspects: searching for the cheapest feedstuffs and reduce input for the mother cows and high growth – high input for the young animals for slaughtering (farm G). We considered their strategy towards animals for slaughtering because it is the category to which strong values are attached. The third dimension called "care and relation man-cattle" reflects our findings and discussion in part 3.3.1 and the fact that for some farmers the contact with their cattle is an essential part

of their production system. It can be considered as a motivation for having the cattle for some farmers. For others it is an important condition for a good work of the farmer for example by knowing well the animals and being able to detect and prevent any problem. On the other hand, for other farmers, this dimension is not of particularly importance or they don't relate to it.

The use of SNG grazing can largely be explained and understood by the position of the farms in this figure. Farmers strongly oriented towards the "care" value (farmers B,D, F and H) are either using SNG for all their herd or not using it at all. Some farmers don't use SNG because they think that there is no SNG close enough to their home (B and F). They feel that having the cattle away from their farm will interfere too much with their relation with their cattle. Some other farmers use SNG for grazing of their herd; for one of them the SNG area is very close to the farm and around it (farm H); for the other one (farmer D) the initial spark to SNG grazing has been the opportunities through the new marketing channel Nordjysk Naturkød which gave a higher price if the cattle had grazed SNG. He keeps about half of the herd around the house and keeps a close contact to them and often visits the other part of the herd in the nature area. Farmers motivated by "productivity, high animal growth" either don't use SNG or use it for reproductive animals only. Feeding animals for meat production with SNG is simply not fitting in their production logic but reducing feed cost of reproductive animals with SNG is acceptable. From the farms of our sample, 2 farmers own SNG land and get subsidies to have it grazed. Another farmer was using SNG because his cattle could graze this area for free, but in agreement with the land-owner he ploughed it a sow it with new and more productive grass the year following the interview. All farmers orientated towards the "low cost – low input" value in this study use SNG for feeding all their cattle (farms I, J and K). For them the possibility of getting cheap feed for their herd through subsidies is important. For one of them a new marketing possibility (Nordjysk Naturkød) was an important driver to start renting a SNG area (farm I). For another one, the local dynamic for land management in his region was also a driver to change his production system including SNG (farmer J).

The farmers orientated to these different values differ in the importance that they accord to high performance in terms of animal growth and carcass conformation versus low input and in the importance for them of a personal relationship with the cattle. These differences go across profiles like hobby farmers/professional farmer, organic/non organic farmer: we find hobby farmers, professional farmers and non-organic farmers in the three groups; organic farmers are found in the "care" sphere or in the "low input – low cost" sphere.

The importance of the relationship between farmer and animal has been especially developed within the fields of animal welfare (Dockès and Kling-Eveillard) and farmers work conditions and welfare (Porcher, 2002). Dockès and Kling-Eveillard (2006) developed a typology of farmers based on their own representation of their work. Our sphere of "care, relation man-animal" would correspond to the category: "Farmer for animal: the animal is an important part of his life". In their study, Dockès and Kling-Eveillard conclude by mentioning the link between farmers' values regarding their relation to animals and their choice of production systems regarding welfare elements such as grouping the animals, straw… We have in our study seen that this relational dimension is important for the choice of grazing system. To our knowledge this is the first time that this notion of closeness man-animal is used in the context of SNG grazing.

The work of Girard et al. (2008) focused on farmers practices and feeding strategies in the context of shrub encroachment in French Pyrenees. They found that farmers' priority in labor reduction was an important aspect to understand farmers' practices. In our study in was never stressed by the farmers as an important aspect. The non-mountainous relief of Danish landscape might be an explanation for this difference. In the French context, Girard et al. (2008) also highlighted the importance of marketing choices, but in their context, the seasonality of the sell was crucial; they didn't mention changes in the acceptability of the product linked to different feeding strategies. Girard et al. (2008) focus their analysis on practices and not of values but they mention the importance of conservation of historical farmland

heritage as a motivation for the farmers. In our study this was never mentioned by the farmers. This might be linked to the fact that many of the farmers of our study (7 of 12) have bought their farm in another area or region than the one where they have been raised up and their family comes from; they thus might not have this historical view on farmland.

Our analysis allowed us to identify barriers and potentials to more SNG grazing in the beef farming systems. We see important barriers and potentials in four aspects. (1)Marketing channels have shown to be drivers to the inclusion or exclusion of SNG in farmers' production. Values conveyed by dominant marketing channels, appealing to farmers orientated towards productivity and high growth, are excluding SNG grazing for slaughtered animals. The main channel valuing SNG grazing field has closed down and there is, as for now, little reward to get from the market for the farmers in SNG systems in Denmark. (2)SNG grazing is framed by the government, biologists and diverse experts as a measure for biodiversity and landscape conservation. Most farmers in our study don't relate directly use of SNG with biodiversity conservation. When they want to compromise for better conditions for wildlife on their farms, they develop practices in the field borders and reduced pesticide use. The involvement of farmers in SNG grazing would maybe be assisted if knowledge of plants and grasslands species of farmers was fostered and if the connection between farmers' management skills and environmental outcome were made clearer. (3) Subsidies have contributed to appeal to many farmers through reduced feed costs but this economic argument is not strong enough for some farmers oriented towards care and with some distance between farm and SNG area. Farmers focusing on high animal growth will only use SNG for a reduced part of their herd feed consumption, namely for reproductive animals. (4) The social recognition of what "good" farming practices, including SNG, can be fostered with local projects of cooperation between a group of farmers and authorities; this was important for one of the farmers in our study and this approach could be with advantage developed in other regions.

Our model is an instant picture of the farms and a time perspective could be useful; changing farming system from a high production focus to a low input strategy might be difficult for many farmers but farmers' values can evolve over time though it is a long process; if this should happen, development of marketing channels which valorize SNG grazing and don't focus so much on carcass conformation would be important. Yarwood and Evans (2006) and Burton et al. (2008) have discussed the fact that having "good" looking animals and engagement in breeding are part of the cultural capital of many farmers. Yarwood and Evans (2006) noticed that "efforts (…) to increase and make it fashionable to a wide range of farmers and farming groups and thus integral to their capital" is an asset for conservation of livestock breeds. It might also be the case for SNG grazing.

Our results concerning the importance of farmer – animal relationship are fairly novel and call for more research, especially on exploring whether it is also relevant in other contexts. Our model is based on only 12 farms and should therefore be validated with a higher number of farms. It could also be interesting to investigate the role of this farmer-animal relationship in relations to farmers' participation in agri-environmental schemes of different types.

Conclusion

Semi-natural grasslands (SNG) have been inherited from centuries of agriculture where they were an integrated part of farming systems. Our modern agriculture farming systems are organized around other values and potentials and many SNG have been abandoned. A change to re-integrate SNG into the farming systems could take approach from the model we constructed based on farmers' values related to their production, which allowed us to understand and explain farmers' use of SNG. Our work suggests that the reintegration of SNG in farming systems can not only be led by subsidy incentives; efforts could

be made in facilitating the marketing of the products coming from SNG based systems; farmers' involvement mobilizing their knowledge and management skills could also be fostered.

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Paper II

Some aspects of sustainability of beef production with and without the use of semi-natural grassland.

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Some aspects of sustainability of beef production with and without the use of semi-natural grassland

Abstract:

The grazing of semi-natural grasslands (SNG) is encouraged in Europe for the conservation of biodiversity, but little is known about the farming systems including SNG, which farmers develop. The goal of this study was to evaluate technical results of beef farms with a low or high inclusion of SNG in the herd feed, and identify constraints and possibilities to combine conservation grazing with animal welfare and product quality. It is based on data recordings from ten Danish farms over one year. The size of the herds varied from 5 to 213 suckler cows. We identified four different systems based on type of breed and feeding strategies: (1) a traditional system, which is based on high-growth-potential breeds with summer grazing on cultivated grassland (CG) with no SNG and finish-feeding of young animals for slaughter; (2) a system similar to (1), where SNG was used for summer grazing in complementarity with CG and comprised up to 20% of the feed supply of the herd over one year; (3) a system based on high-growth-potential breeds on CG and SNG, with up to half of the diet deriving from SNG; and (4) a system based on a rustic breed grazing SNG all year round. Systems 1 and 2 produced similar high-quality carcasses (over 8 points on EUROP scale for young males) and growth of the herd (over 200 kg live weight gain per livestock unit over one year) seemed not to be affected by the relatively low SNG content in the diet. Systems 3 and 4 were based almost exclusively on grass for feeding (over 96% of the diet). Our limited sample shows that it was possible to produce a high-quality carcass in system 3 (over 8 points on EUROP scale for young males), with a relative high percentage of SNG in the feed. System 4 produced low-quality carcasses according to slaughterhouse standards, but consumers may attach different quality standards to this more natural scenario. In terms of impact of the systems on conservation of biodiversity, system 4 showed a higher potential in a product perspective (over 100 m^2 of valuable biotopes conserved per kilogram of carcass) than system 3 (20 to 30 m^2), which is itself higher than in systems 1 and 2 (between 0 and 2 m^2). Animal welfare issues were, among other things, linked to confinement (systems 1 and 2) and weight loss in winter (system 4).

Keywords:

Permanent pasture, biodiversity, production system, animal welfare, meat quality, case study

1. Introduction

Pasture-based livestock farming systems in Europe can help satisfy societal demand for the conservation of public goods such as landscape and biodiversity and ethical concerns about food production. Synergies and critical points in these systems have been discussed in a Mediterranean context (Bernués et al., 2011), as well as in a Swedish (Hessle ans Kumm, 2011) and a British (Dawson et al. 2011; Fraser et al. 2009). In these studies, synergies relating to biodiversity, landscape, animal welfare, carbon sink and system resilience were addressed and drawbacks relating to animal productivity, labour productivity, greenhouse gas emissions, consumer involvement and dependence on subsidies.

Semi-natural grasslands (SNGs) are biodiversity hotspots in Europe due to their high richness in plants, invertebrates and birds (De Bello et al., 2010; van Swaay, 2002). In Denmark, a large proportion of the threatened species (63% of the red-listed plants) is dependent on the grassland ecosystem (Ejrnæs, 2009). There is evidence that appropriate grazing practices can help to maintain their high biodiversity levels (Adler et al., 2001; Olff and Ritchie, 1998). Maintaining SNGs is a goal of Danish policies, for which a

target of 40,000 ha has been set for 2020 (Regeringen, 2009). Several policies and funding instruments are in place to support this goal. Despite this engagement, grassland abandonment and encroachment of shrubs and trees remains a major problem, as the most recent report on the status of biodiversity in Denmark points out (Ejrnæs et al., 2011).

In this study, we focus on three aspects of the sustainability of beef production: (1) farm technical results in terms of animal growth, feed use and carcass quality; (2) animal welfare and (3) landscape biodiversity value.

Farming based on SNG has to compete with more intensive systems with a higher level of production efficiency and lower costs. These productions are typically supported by the prevailing research and education systems, while there is a lack of knowledge about more extensive grassland-based beef systems.

In cattle production, its cost-effectiveness is an important parameter for the farmer. Professional farmers need to get an income they can live off, while part-time farmers will also seek "not to spend too much money" (Bedoin et al., submitted). On the other side, actors in the meat industry and especially slaughterhouses wish to receive carcasses of a high conformation and weight because of their better economy and farmers are paid for the carcasses according to muscle size, weight and animal age. From the point of view of consumers, good farm-animal welfare is important. Animal welfare is rated more highly by Danes than by any other European nation (European Commission, 2007). One key perception of what constitutes good welfare for cattle is that they are allowed out on grass in the summer, and systems based on SNG grazing can therefore be expected to infer a higher level of animal welfare for the consumer.

However, these production and welfare aspects of beef farming may be counteractive. Finishing animals on grass can result in a lower carcass weight and conformity and lower tenderness of the meat (Keane and Allen, 1998). Grazing biodiversity-rich pasture can give lower animal growth than grazing cultivated grassland (Fraser et al., 2009). Grazing can give parasitic infections and thus health and welfare problems (Nielsen and Thamsborg, 2005). For the farm economy, out-wintering cattle can be an interesting solution, but there are some welfare issues for animals kept outdoors all winter (Morgan et al., 2009).

Research has been conducted at regional levels (Bernués et al., 2005) or using data from controlled experiments (Casasús et al., 2002; Fraser et al., 2009; French et al., 2000; Hessle and Kumm, 2011). The purpose of this study was to explore these issues at farm level on "real" farms, including the complexity of farming systems. Gibon (2005) stated that the "complexity of the problems, with possible feed-backs and side-effects due to the many interactions involved between ecological processes and grassland management at the whole-farm level" should be taken into account and called for "a detailed understanding of how each particular farming system functions and integrates with the ecological processes". Thus the aim of this study was to identify constraints and possibilities for integrating on the farm conservation grazing, high animal welfare and the production of high-quality meat , based on a case-study approach.

2. Methodology and proposed indicators

2.1. Selection of farms

In Denmark, there are different types of production systems with beef suckler herds: there are specialised farms, where beef is the main activity of the farm; farms where beef is one of several production lines and a majority of farms where the owner has a full-time job outside agriculture and beef production as a secondary activity.

Twelve different farms were chosen for an earlier part of the study based on interviews with farmers and farms visits (Bedoin et al., submitted). The farms and farmers were selected to obtain variation in farming styles and management practices. The second part of the study, which is the object of the present article, was presented to the farmers afterwards and ten of the 12 farmers accepted the invitation to participate.

2.2. Farm registration and data collection

The aim of the registration was to document conditions and the production of the beef herd for one year, from May 2010 to April 2011. Each farm was visited a minimum four times either by the technician working for the project or by the first author: there were two visits for registering the background information and two field/farm visits, one during summer and one during winter.

The following data were recorded: Each farmer filled in a "grazing calendar" during the grazing season with the different pastures used, number and type of animals on each pasture for each period, feeding on pasture if any. Some farmers also recorded grass height at the beginning and at the end of the grazing period. If the grassland was harvested, the time of harvest and quantity harvested were noted. Farmers kept registrations of the background for each animal slaughtered: finish-feeding and reason for slaughter and slaughter results as communicated by the slaughterhouse. Farmers also kept registrations on health problems and treatments of individual animals. We also registered feed use for the year from feeding plans, feed budget for roughage and imported concentrates.

During the farm visit in summer, each grazed field was visited. We monitored plant cover and animal welfare based on system assessment and animal assessment. During the farm visit in winter, we assessed animal welfare based on system assessment and animal assessment. Details of these assessments are given in section 2.3.

Most farmers also gave us access to their obligatory farm data on crop rotation, green accounts, fertilizer planning and animal registration with individual information in relation to reproduction, treatment and turnover.

2.3. Estimations and setup of the indicators

All data were analysed at farm level.

Animal growth

Animal weight at status for each category was estimated from age, body condition scores in summer and winter and standards for the breed. Weight at slaughter was recorded by slaughterhouses. Animal growth at herd level was calculated by taking into account animals sold and purchased during the year corrected by status change in number and weight.

Feed consumption

Feed consumption to meet requirements for maintenance, and milk production or growth was calculated for each category of animals, according to their estimated weight. The calculation was adapted from Danish standards (Strudsholm et al., 1999).

Pasture yield

Daily animal feed consumption, grazing management and the farmers' estimation of harvest yields allowed us to estimate yields of the pastures.

Welfare indicators

Welfare assessment in cattle has mainly been developed for dairy cattle and/or housed cattle (Bartussek et al., 2000; Welfare Quality Consortium, 2009). There is, to our knowledge, no standard for evaluating welfare in beef herds where at least part of the herd is kept outdoors.

We use both system-based and animal-based parameters. System-based parameters describe features of the environment and management, such as space allowance, feeding and drinking facilities, access to pasture. We also use animal-based parameters, which register the state of individual animals.

We constructed indicators by adapting different previously validated welfare assessment methods (Welfare Quality Consortium, 2009), Danish recommendations and regulations for animal husbandry (Anonymous, 2011), and the criteria set up by the Danish Animal Welfare Society for certification of farms achieving "good farm welfare" (Anonymous, 2012). Some of these criteria go beyond the requirements for animal rearing. Criteria were also selected in order to show the variation of conditions between farms.

Table 1 shows the criteria and their weighting for the assessment of system-based animal welfare.

Animal welfare was also assessed by animal condition, once in winter and once in summer. Each group of animals was given a score from 0 to 5 for their body condition, hair density, hair brilliance, cleanliness and lameness. These criteria were assessed as described in Welfare Quality Consortium (2009). We used 2 points for each criterion: no animal is in bad conditions and the average of the animals is over a certain condition. The scores were aggregated and give an indicator of between 0 and 10 points for each farm.

Nature and biodiversity

For these indicators we used two different sources of information − one based on estimation of plant cover in the pastures and one based on air photos and administrative registrations of land with important nature elements.

Each grazed pasture was visited in August and plants were observed in five different patches of the pasture and the percentages of cover of cultivated grass, clover, natural grass and perennial plants and bushes were estimated.

Air pictures analysis used topographic maps including nature elements (one meter resolution) created by the Danish administration based on air pictures from 2010 (40 x 40 cm pixel resolution). We have selected hedgerows and isolated trees as markers of landscape biodiversity, as for example done by Geneletti (2007) and chose the ones with intersections with fields used for cattle production that were within 5 meters of the field borders. Valuable biotopes were grouped for the areas recorded as "heath", "forest" and "wet areas" and that intersected with the fields used for cattle production. The area covered by these valuable biotopes within the grassland areas was calculated using ArcGIS.

Table 1: Assessment of system-based animal welfare

Animal welfare criteria	Indicators	Points	Source
Winter			
Sufficient space to allow free movement and satisfactory environment	I: Space allowance in $m^2$100 kg^{-1} animal, light, access to an outdoor area	0-5	BLBR – DB and WQ
	O: Muddy areas around the feeding tables and in the field in general; wind and rain shelters		
Comfort of lying area	I: Presence of straw bedding and cleanliness of the bedding	0-2	DB
	O: "dry" place to rest		
Access to clear water	Cups or length of open water/head and water cleanliness	0-2	BLBR – WQ
Access to feed	Length of feed place/animal and cleanliness of the feed	0-2	BLBR –DB
Rest area for calves only	I: Space per calf	0-2	BLBR – DB
	O: considered as always fulfilled		
Achievable rating winter		*0-13*	
Summer			
Grazing	Access to outdoor area and access to pasture for the different animal categories	0-4	Own
Sun and wind protection		0-2	BLBR
Access to potable water	Cups or length of open water/head and water cleanliness	0-2	BLBR
Stockmanship	Quality and frequency of inspection	0-3	TD
Achievable rating summer		*0-11*	

I: indoor-housed animals in winter
O: out-wintered animals
DB: recommendations of the Danish Animal Welfare Society (Anonymous, 2012)
BLBR: Danish recommendations and rules for cattle herds (Anonymous, 2011)
WQ: Welfare Quality® recommendations (Welfare Quality® Consortium, 2009)
TD: paper from Turner and Dwyer (2007)

3. Results

3.1. Brief overview of the farms

The ten farms of this study present a high variability in farm size, organization and feeding strategy. **Table 2** gives an overview of some of these characteristics. Meat production is the main output from these farms and for some of them the sale of livestock for breeding is also an important source of income. The Limousine breed is used on the majority of farms (A, B, C, E, F, J and L), either as a pure breed or as a dominant trait in crossing with other breeds. Farm G uses Angus breed, farm H uses Highland Cattle and farm K Galloway. Animals of the last two breeds are relatively small and with long-haired coat (rustic breeds). Six farms produce bulls for slaughter at an age of about 12-18 months while four farms (F, J, H and K) produce steers aged 20 months or older at slaughter. These four farms are either organic (F and J) or have rustic breeds (H and K). Heifers are kept for reproduction or sold for meat production or breeding. The reproduction is mainly natural with one or several bulls on the farm. Insemination is also used, especially for heifers. Calving and slaughtering occur at different times of the year and vary from farm to farm. We were not able to discern any seasonality pattern between the farms. The calving season can be short (2-3 months) on some farms, while others spread it over half a year or have calving all year round.

In terms of the number of suckler cows, herd size varies from five to 213, with most herds numbering between 30 and 60 cows. The total farm area, also including farming activities other than beef farming, varied from 8 ha for the smallest farm to over 300 ha for the largest farm. Most of the farmed area was occupied by grassland, either as cultivated grassland (CG) or semi-natural grassland (SNG). Cultivated grassland (CG) is grassland with a maximum of 4 years of ley in rotation with cereals. The stocking rate on the farms also varied from 0.23 ha grass per LU (livestock unit, 1LU = 500 kg live weight) (farm B) to 1.48 ha grass per LU (farm H).

For a broader description of the farms including farmers' motivations and history of the farm activity, see Bedoin et al. (submitted).

Table 2: Overview of the main characteristics of the farms

Farm	E	G	B	F	L	A	C	J	H	K
Number of suckler cows[a]	58	50	12	26	213	34	45	100	5	92
Number of LU[a]	148	114	28	73	464	72	104	291	12	254
Farm area (ha)	66	51	8,2	58	181	33	70	338	29	277
CG (%)	66%	90%	56%	68%	46%	39%	48%	25%	0%	0%
SNG (%)	0%	4%	20%	7%	36%	27%	51%	63%	61%	100%
Type of SNG		Dry meadow	Marshland	Meadow	Wet meadow	Wet meadow	Heath, meadow, marshland	Meadow and marshland	Salted meadow	Heath, meadow, bog
Stocking rate on grassland ($ha.LU^{-1}$)	0.29	0.42	0.23	0.59	0.32	0.30	0.66	1.01	1.48	1.09
Calving season	August to March	mostly February to May	April - May	all year round - most in spring	January to April	Summer	October - April	all year round	March to May	February to July
Slaughter time for young cattle	August to April	B: spring H: autumn	Autumn	all year round	March to July	summer and autumn	July to March	mostly November to June	November	October to December

CG: cultivated grassland, SNG: semi-natural grassland (or permanent pasture), B: bulls, H: heifers, LU: livestock units (1 LU = 500 kg live weight)

[a]: average for the year

3.2. Weight gain and output of the herds

The live weight gain over one year varied between the farms from 96 kg live weight gain per livestock unit (farm K) to 298 kg (farm F) (see **Table 3**). Converting it to a daily basis, this corresponds to a daily gain of between 264 g and 815 g per livestock unit per day, at herd level. This live weight gain is the result of a combination of slaughtered animals, dead animals, animals sold or purchased alive and the growth or decrease of herd size. Some farms had considerable variations in herd size between the beginning of the study year and its end: farms G and K decreased considerably their herd, while farms E and H increased their herds. For farms B, A and J herd size did not differ much between the beginning and the end of the year. Most of the output from the herd was in the form of animals for slaughter, representing up to 244 kg per LU; only one farm (farm H) slaughtered very few animals this year. Mortality was relatively low in weight terms, below 20kg LW/LU for most of the farms , but was high at, respectively, 50 and 46 kg dead LW/LU for farms F and C. Sales of animals for breeding was important for farm G, which sold a maximum of young animals for breeding, and for farm L which did not finish-feed heifers itself but sold them to another farmer for finishing.

The average growth of young males from birth to slaughter was estimated using information on slaughter weight and slaughter age. For farms A,C, E, G and L, daily gains of young males between birth and slaughter was between 1.1 and 1.4 kg per day, for farms B,F and J between 700 and 900g per day and for farms H and K between 200 and 400 g per day.

Table 3: Growth and production output of the herds over one year in kilogram live weight per livestock unit per year.

Farm	E	G	B	F	L	A	C	J	H	K
Change of the herd : weight end – beginning (*x*)	109	-167	4	45	-72	4	84	17	148	-120
Slaughtered (live weight) (*y*)	124	244	196	222	201	223	103	125	36	192
Dead (live weight) (*z*)	4	11	5	50	13	12	46	18	0	19
Breeding (live weight)[a](*w*)	-11	173	33	-19	76	-2	21	-9	-75	5
Live weight gain[b] (*x*+*y*+*z*+*w*)	225	262	237	298	217	237	254	151	109	96

[a] : positive values indicate that there was more live weight sold than purchased, negative values that there was more purchased than sold.

[b] : including calves born.

3.3. Quality of the slaughtered animals

Evaluation of the quality of beef cattle is carried out by the slaughterhouses based on slaughter weight, carcass shape, carcass fatness and colour and age of the animal. In Denmark, the best quality beef is considered to come from – and higher prices are paid for - animals aged between 12 and 42 months, with a slaughter weight of between 230 and 340 kg , a shape >8 (on the EUROP scale) and a fat and colour score of 3 or 4.

Farms with Limousine-based breeds (farms A, B, C, E, F, J and L) obtained average slaughter weights of between 280 and 350 kg (**Table 4**). The farm with the Angus breed (G) obtained similar results. The two farms with rustic breeds (H and K) had slightly lower slaughter weights and also poorer carcass shape.

In contrast to the relatively homogenous slaughter weight, there is a high variation between farms with Limousine-based breeds in the shape of the average carcass, scoring between 7.3 and 11.8 for the herd average. Part of this variation can be explained by some farms, such as farm A, only slaughtering "finish-fed" cows and reaching an average of 10.2 for the shape of cows slaughtered, while other farms, such as farm G, sell the cows without any kind of finishing and obtain an average of 3.9 carcass shape for the cows. Young males, which are the principal focus of farmers for meat production, have a higher slaughter weight and carcass shape for farms A, B, C, E, F, G,J and L (**Table 5**).

At farms F, J, H and K, most of the animals slaughtered have been on grass in the summer or fed roughage in winter; they have a relatively poorer carcass weight and shape than from farms L, A and C that finish-fed almost all their animals with concentrate or grains.

Colour was rarely a problem: only 1% of the 480 animals recorded had too dark a colour, all the others achieved a result of 3 or 4. Fatness was more variable: 2% of the animals achieved a score of 1 , 21% a score of 2 and 4% scored 5; the majority (73%) had a satisfactory fat cover with a score of 3 or 4.

Prices paid for the animals without premiums reflect slaughter weight and carcass shape. Premiums are important for organic farms F and J and add more than 20% to the kilo price . The prices presented here do not include meat sold directly by farmers to consumers, were the prices are slightly higher.

Table 4: Animals slaughtered: repartition, carcass quality, price and feeding before slaughter.

Farm		E	G	B	F	L	A	C	J	H	K
Number animals slaughtered		31	47	8	28	162	27	19	69	2	106
Average slaughter weight (kg)		334	314	282	290	328	348	340	298	187	241
Average carcass shape [b]		9.1	6.7	7.5	7.3	9.8	11.6	11.8	8.8	md	5.7
From (%)[a]	Cows	36	32	28	29	31	44	0	3	0	1
	Raising males	46	62	62	42	61	32	85	52	50	73
	Heifers	17	7	11	29	7	23	15	45	0	26
Income											
Price based on animal results (€/kg SW)		3.3	3.0	3.2	3.1	3.3	3.4	3.6	3.2	2.0	2.3
Price including premiums (€/kg SW)		3.5	3.1	3.2	3.8	3.4	3.4	3.6	4.0	2.0	2.6
Feeding before slaughter											
Pasture [a]		16%	37%	0%	41%	0%	8%	0%	33%	100%	21%
Roughage (excl. pasture)[a]		24%	5%	28%	49%	0%	5%	0%	67%	0%	79%

[a]: in % of total slaughter weight

[b]: on EUROP scale from 0-15, where 0 is the poorest shape and 15 the highest one.

m.d.: missing data, SW: slaughter weight

Table 5: Young males slaughtered, age, live weight and carcass shape; mean values.

Farm	E	G	B	F	L	A	C	J	H	K
Young males slaughtered (number)	15	27	5	10	98	9	16	34	1	75
Age at slaughter (years)	1.1	1.1	1.4	1.8	1.2	1.0	1.2	1.9	2.4	4.1
Slaughter weight (kg)	315	311	277	318	329	336	343	315	187	249
Carcass shape[a]	10.9	8.1	8.2	8.0	11.2	13.0	12.2	9.6	m.d.	5.8

[a]: on EUROP scale from 0-15, where 0 is the lowest score and 15 the highest.

m.d.: missing data

3.4. Feed supply

We can distinguish three different management and feeding strategies of the herds (**Table 6**):

- On farms A, B, C, E, G and L, cows, calves and heifers for reproduction are kept outdoors and graze for five to seven months in the summer, while young animals for meat production are kept indoors and given a feed based on silage (grass or maize silage) and purchased feed. During winter, cattle are kept mainly indoors and fed silage and purchased feed.
- Farms F and J are organic farms, where animals get almost exclusively homegrown, grass-based feed, in the form of grazing during summer and in the form of silage and hay during winter.
- On farms H and K, the animals are outside all year round; they graze and get a supplement of conserved grass during winter. Both of these farms purchased an important part of the conserved grass they need for winter feeding.

Grass was an important feed for all herds with 32 to 98% of net energy (NE) deriving from grassland, and of the total diet 29 to 77% of net energy came from pasture grazing. Cultivated grass is for all farms, except H and K, a major contributor to the diet, either from grazing but especially as conserved grass for winter feeding. Semi-natural grassland is marginal for farms E,G,B and F. For farms L, A and C SNG is used for summer grazing of suckler cows with calves and of heifers for reproduction. Farm J uses SNG for grazing of the whole herd during summer and for harvesting of hay. Farms H and K have their herd on SNG all year round.

Table 6: Feed intake from different sources, proportion of the total diet over one year expressed in % of net energy.

	E	G	B	F	L	A	C	J	H	K
Home-produced feed	**70**	**58**	**63**	**98**	**82**	**83**	**76**	**99**	**71**	**82**
SNG	0	1	3	5	14	14	18	46	71	82
CG	51	57	29	93	44	67	56	53	0	0
Maize	19	0	31	0	25	1	2	0	0	0
Imported										
Grassland (CG or SNG)	0	8	0	0	3	0	0	0	25	15
Other roughage (straw, carrots, mash)	0	16	0	0	0	0	0	0	4	2
Corn and finishing aliment	30	17	22	2	15	17	24	1	0	0
Grassland										
Total	51	65	32	98	60	81	74	99	96	98
Grazed	28	44	29	53	37	29	38	45	55	77

3.5. Land use, land productivity and contribution to nature and biodiversity conservation

Farms manage and use their cultivated (CG) and semi-natural (SNG) grasslands with different strategies and results (**Table 7**).

Production and use of CG and SNG

CG covers a range of different management practices: grass-clover sown every four to five years with little fertilization as well as grass-clover included in rotation with cash crops and barley or wheat for whole-crop silage and grazing. This diversity explains partly the variation in net yields from cultivated grassland, which ranged from an average of 31000 MJ NE/ha for farm G to 50000 MJ NE/ha for farm F. The variability between fields within a farm was also high; for example on farm E some fields produced about 22900 MJ/ha and others 63000 MJ/ha. We observed no apparent differences in yields between organic and conventional farms.

Compared to yields of CG, yields of SNG were about two to four times lower, but also exhibited a high variability between and within farms. At field scale, the variation ranged between 5500 to 29300 MJ/ha for farm J.

In general, cultivated grassland is used for one or two silage cuts in combination with grazing. Semi-natural grassland is used mainly for grazing and/or cut for hay on some farms.

For farms E, G, B and F, SNG plays a minor role in feed supply. Farm E does not use it, farm G has 3 ha which is used for grazing only, farm B has 2 ha cut once for hay, and farm F has 4 ha for grazing in the summer. For these farms CG is the major source of grass, both for summer grazing and for harvesting for winter feed.

Table 7: Use of grassland, management, yields and contribution to biodiversity conservation.

	E	G	B	F	L	A	C	J	H	K
Cultivated grassland										
Ha	58	50	5	93	101	14	36	83	0	0
Estimated yield – net energy (1000 MJ/ha)	37,4	31,6	40,9	50,0	44,0	48,0	49,6	34,3		
Age of ley average (years)	2,1	2,1	1,5	1,4	2,6	1,0	1,9	1,6		
Utilisation:										
% grazed	50	70	100	47	54	27	31	28		
% silage	34	30	0	31	46	73	69	72		
% hay	17	0	0	2	0	0	0	0		
Biotopes (% of area)	0	7%	0	0	0	0	5%	0		
Hedgerows, (m/ha)	46	56	56	37	13	171	15	14		
% clover	7	24	16	49	10	26	m.d.	21		
% perennial plants (<1m)	4	2	5	1	2	2	m.d.	2		
Semi-natural grassland										
Ha	0	3	2	4	65	12	59	236	18	304
Estimated yield – net energy (1000 MJ/ha)		8.7	11.8	22.7	15.4	22.6	13.3	13.4	13.3	10.9
Utilisation:										
% grazed		100	0	100	91	78	100	62	74	93
% silage		0	0	0	0	22	0	0	0	0
% hay		0	100	0	9	0	0	38	26	7
Biotopes (% of area)		0	2%	4%	8%	0	55%	27%	69%	46%
Hedgerows (m/ha)		51	0	17	13	105	5	3	32	5
% clover		m.d.	m.d.	9	2	1	1	2	3	3
% perennial plants (<1m)		m.d.	m.d.	28	24	43	6	17	7	12

Farms L, A and C use SNG for grazing cows with calves and other animals kept for reproductive purposes. These farms only make marginal use of SNG for harvesting grass for feed . Cultivated grassland is typically used for harvesting in spring/beginning of summer and grazed at the end of the season.

For farm J, the share of SNG in the feed supply is higher, as the area is used for grazing for all animals, including cattle for meat production. Some parts of SNG are also harvested for hay production. CG is used mainly for harvesting of feed, but also for grazing in the early and late summer season.

Farms H and K do not use cultivated grassland on their farms. They use SNG primarily for grazing but also part of it for cutting. This harvested grass is not enough to meet winter feeding requirements and they both purchase conserved grass for winter feeding.

Management

Cultivated grassland is fertilized on all farms, either with artificial fertilizers, farmyard manure from the herd or with slurry. The doses applied range from 90 to 220 kg total-N/ha.

SNG is, in general, not fertilized. Only farm G applies similar doses as on CG, and some pastures are fertilized on farm H with 55 kg N/ha.

Some farmers clear SNG of undesirable plants once a year by topping.

Nature and biodiversity

Most of the SNG used by the farmers for cattle production is protected as part of a conservation scheme (Natura 2000 and national Danish schemes for nature protection). Part of the CG is also protected for its value for nature and water quality (Danish schemes).

Valuable biotopes and nature areas were rarely present on CG. In contrast, they were important on the SNG of farms C, J, H and K (from 27 to 69% of the area). Length of hedgerows around the fields was very variable between and within farms, from none to 60 m hedgerow/ha for all farms, except farm A, which has over 100 m hedgerow/ha both on CG and SNG. The average length of hedgerow/ha for all farms was higher on CG than on SNG.

We did not include the results of isolated trees as they were very rare on all farms.

Botanically, the CG sward had more clover and less perennial plants and bushes than SNG: the percentage of cover with perennial grasses and bushes was maximum 5% on CG and between 6 and 43% on SNG. The proportion of clover ranged between 7 and 49% on CG and was under 9% on SNG.

3.6. Animal welfare and animal health

Animal welfare and health were generally good on the farms of this study and with higher scores in summer than in winter (**Table 8**).

Table 8: Results for the welfare of cattle– standardized ranking to a 0-10 points scale for each criteria with 0 being very poor and 10 very high welfare.

Farm	E	G	B	F	L	A	C	J	H	K
Winter										
System-based	6	8	7	5	8	7	5	7	8	9
Animal-based	9	8	4	10	10	10	4	10	8	8
Summer										
System-based	8	8	7	9	7	8	8	8	10	8
Animal-based	10	10	10	9	10	10	9	10	7	10
Average	8.6	8.4	7.2	8.8	8.7	8.2	6.6	8.7	8.2	8.8

Most problems were found for system-based welfare during winter. For housed cattle, space for resting (minimum 1 m^2 per 100 kg live weight) for all animals was only accomplished on two (farms G and L) out of eight farms with animals indoors. Space for resting was insufficient for at least half of the animals on four out of eight farms. Access to water (in terms of animal unit per water cup) did not reach the standards on seven of the eight farms concerned. The other parameters such as light, cleanliness, rest area for calves and feed access were generally not a problem. For out-wintered cattle, the results were also very farm-specific with some parameters being achieved at some farms and not at others. None of the farms achieved our criterion of "a fairly dry place for resting for all animals" , the area being not dry enough or not large enough for the whole herd to use it.

During winter, animal-based registration was satisfactory on most farms, but revealed problems on farms B and C where the animals were dirty and had a lacklustre and irregular coat, possibly because of the high stocking density on both farms. On farms H and K, where the cattle spent the whole winter outdoors, the animals were considered too skinny.

Condition-based scores in summer reflect that on farms A, B, C, E, G and L, young animals for meat production do not graze during summer. Other problems identified were the lack of shadow or wind shelter on some pastures.

During summer, animal-based registrations show very few problems; only Highland Cattle appeared to have experienced too high temperatures.

Criteria for stockmanship included "farmer can get close (about 10 m) to animals, without them running away", "farmer can 'easily' separate a few animals from the herd if needed for treatment" and "visiting the animals minimum every other day". All farms achieved full points, except farm K which achieved 1 of 3 points for these criteria.

Medical interventions were very rare on most farms: on seven of the ten farms, less than 5% of the animals needed treatment. On average, 7.8% of the animals were treated by veterinarians for health problems during the year of the study. Farm F had 12.7% of the animals treated, mostly due to calf scour. At farm C, 38.2% of the animals needed treatment, due to problems with calf scour and a flock of cattle being infected by liver fluke. At farm L, 11.8% of animals needed medical intervention over the year, due to calf scour, lameness and respiratory disease. Overall, 36% of the interventions were for calf scour, 23% for parasitic infections (liver fluke and other worms), 18% for respiratory diseases, 15% for lameness, 4% for udder-related problems and 5% for other health matters. Calving was not a cause of veterinary intervention at any of the farms during the study year.

Mortality was relatively low at most farms, but high for farms F and C with, respectively, 50 and 46 kg dead LW/LU. Calf mortality (defined as animals that died within the first six months) ranged between 0% and 13% for the farms, with an average of 5.7%; farms G, H and K had zero calf mortality. Cow mortality was between 0 and 9% per farm with an average of 3.1%; farms E, B and H had zero cow mortality.

4. Discussion

In this study, we identified four production systems that included SNG in the feeding of the herd in combination with the type of breed used. These groups were:

- 1: Breed with high growth potential, almost no SNG in the feed (farms B, E, F and G)[1]
- 2: Breed with high growth potential, SNG for suckler cows and other reproductive animals (farms L, A and C)
- 3: Breed with high growth potential, use of SNG for all animals (farm J)
- 4: Rustic breed, use of SNG for all animals (farms H and K)

4.1. SNG grazing and animal growth

We observe that live-weight gain per livestock unit at herd level is negatively related to the inclusion of feed from SNG in the diet (**Figure 1**). Growth of cattle is mainly influenced by feed, breed, sex and age (Jarrige and Auriol, 1992). The differences observed in growth between farms can be due to the structure and dynamics of the herd, i.e. age of the animals and how long the animals are kept before slaughter, as growth is highest in the first six months of the animal's life (Jarrige et Auriol).

To this end, we can compare the farms with "high-growth breed, almost no SNG in the feed" (farms E, G, B) with the farms having "high-growth breed, SNG for suckler cows" (farms L, A, C), which for many aspects are fairly similar systems. Our results show that a low inclusion of SNG (10 to 20% of the yearly diet of the herd) for summer grazing of reproductive animals seems to have no effect on herd growth in comparison to herds that do not graze on SNG.

[1] Farm B uses the Aberdeen Angus breed. We included farm B with the intensive breeds, as the farm uses a genetic for high growth and gets similar slaughter weight and carcass shape for young bulls as some of the Limousine-based farms (Table 5).

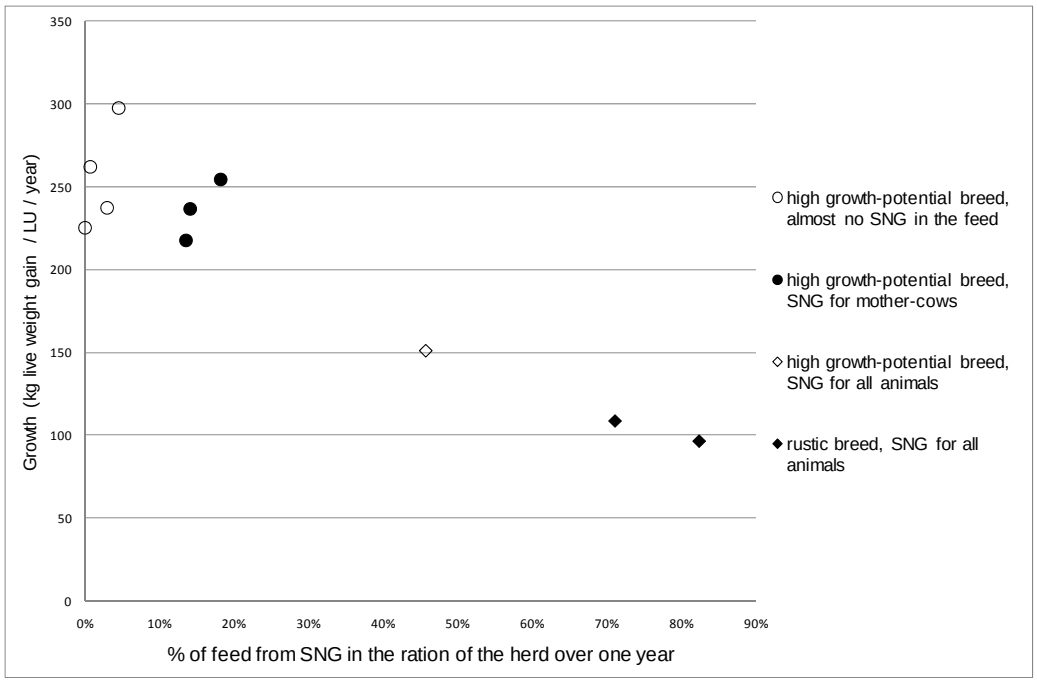

Figure 1: Growth of the herd and use of semi-natural grassland (SNG) for each farm
LU: livestock unit of 500 kg live-weight

Comparison at the level of individual animal growth (for young males) with a heavier use of SNG shows the same tendency of a negative relation between the inclusion of SNG and daily gain. However, where SNG is used for summer grazing of cows and calves and makes up less than 20% of the diet of the herd, there is no effect on herd growth.

Daily weight gain for males in our study was calculated from birth to slaughter, whereas it has been calculated from weaning to slaughter in the work of Hessle et al. (2011), but the results in their experimental study can give an idea of the performance of the herds in comparison to results in other experimental setups. Hessle et al. reported a 1.72 kg daily gain for bulls in systems fairly similar to the systems used by farms E and G, that achieved daily gains of around 1.2 kg (from birth to slaughter). For the production of steers, Hessle et al. studied three different systems and measured a daily gain of 0.93 kg for "high" steers, 0.72 kg for "medium" steers and 0.60 kg for "low" steers from weaning to slaughter (with different degrees of feed intensity and different slaughter age). This compares with the daily gain of around 0.75 kg for farms F and J, but the animals in our study were not fed barley as they were in the experiment of Hessle et al.

Fraser et al. (2009) measured growth of cattle during summer grazing of improved pasture or SNG. The breeds used were Charolais crosses (comparable to the breeds with high growth potential in our study) and Welsh Black (comparable to the rustic breeds of our study). Fraser et al. recorded higher growth for Welsh Black on SNG and improved pasture than for Charolais crosses and similar growth of both breeds in two other experiments. Similarly, Casasús et al. (2002) could find no breed x pasture interaction in experiments conducted in Spain. Our results contrast with these experiments with a lower growth on farms with rustic breeds (farms H and K) than with the Limousine breed (farm J). This might be because our values include the whole life cycle of the animals, both before weaning and during winter. The low condition scores of the animals recorded on these two farms during winter suggest that animal growth in this period is nonexistent or even may be negative. The low gain for these two farms reflects the choice of system by the farmers.

4.2. SNG and carcass quality

Carcass weight and shape are usually lower with SNG grazing than with improved pasture grazing (Fraser et al., 2009) or with a silage-barley diet (Hessle et al., 2011). This is also the case for farm K in our study, but not for farm J (**Figure 2**). For the other farms that that made less use of SNG, there seems to be no direct link between the inclusion of SNG in the diet and the quality of the carcass sold.

The rustic breeds of farms H and K that are kept on SNG all year round reached a slaughter weight and carcass shape that are not considered high quality. If sold to a commercial slaughterhouse they would therefore get a lower price for their animals. Both farmers are convinced that they produce "quality meat" which is appreciated by consumers due to its low fat content, its flavor, and the fact the animals have only been eating grass (Bedoin et al., submitted), and they sell part (farm K) or all (farm H) of their production directly to consumers. The definition of quality is thus relative, depending of the criteria taken into account in the different sales outlet.

Farm J gets an average score for carcass shape of over 8 on the EUROP scale, which is thus considered as a good quality. This score is higher than the average score obtained on farms G, B and F which do not use SNG. Farm F like farm J feeds its herd almost exclusively on grass and both farms get similar results in terms of carcass weight and shape. The example of this farm shows that there it is thus possible to produce carcasses of high quality in systems with a high proportion of SNG in the feed (46% of herd feed from SNG).

Farms L, A and C that finish almost all their animals on concentrates and silage obtained a high average score of over 9.5 for carcass shape , while the the sale of skinny cows (farm G) or the use of corn without using protein supplement for finishing (farm B) reduced their scores (**Figure 3**).

Weight and shape are used for assessing carcass quality at the slaughterhouses, but other meat quality parameters may also be important for consumers (but beyond the scope of this study) such as meat composition in terms of "healthy" fatty acid content, higher concentration of n-3 PUFA and less n-6 PUFA. For these parameters, SNG-finishing can give a higher quality than CG-finishing (Adnøj et al., 2005), which in turn is better than finishing on cereals (French et al., 2000).

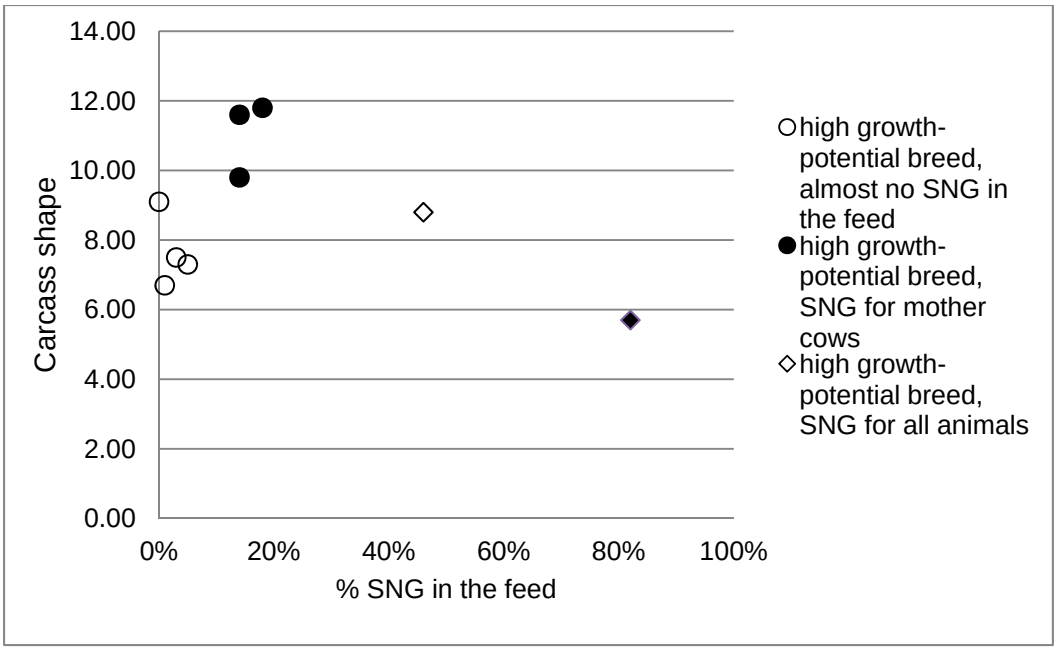

Figure 2: Carcass quality in relation to SNG grazing (EUROP scale).

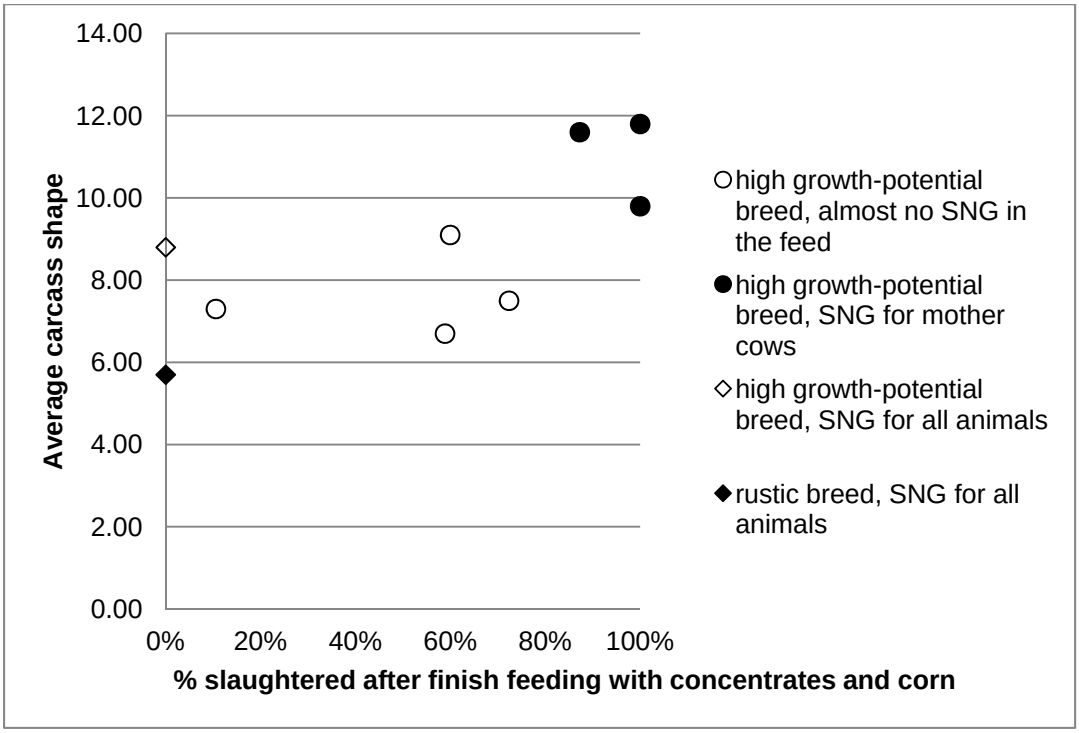

Figure 3: Carcass quality in relation to finish-feeding.

4.3. Welfare and SNG grazing

Different parameters affect the welfare of animals and we cannot report a direct effect of SNG grazing on welfare. However, some parameters can be discussed.

Grazing wet marginal areas such as SNG can give parasitic infections and thus health and welfare problems (Kristensen et al., 2006; Nielsen and Thamsborg, 2005). In the ten farms of this study, only one farm experienced problems with lever fluke during the 2010 grazing season, the other farms were not affected or possibly not detected.

We had set up as welfare criteria that cattle outdoors should have access to shelter from wind and sun. This was not the case for several farms. Farmers could in many cases plant trees in field borders, but in protected areas, which SNG areas often are, tree-planting is not allowed; farms L and J face this dilemma between animal welfare and nature grazing. However , the necessity of wind shelter can be discussed as sheltered pastures have been shown to have more problems with flies which are potential transmitters of summer mastitis (Jensen et al., 1993; Nielsen, 2001).

Expressing a natural behaviour and having a good human-animal relationship are both considered important criteria for good animal welfare (Tuyttens et al., 2010). Some natural pastures like heathland or coastal marshes include bushes and trees where cattle can develop a different behaviour than on pure grassland by, for example, hiding. This can make it difficult for the farmer to detect disease or other problems and animals can become feral with less human contact. The Galloway cattle at farm K that were kept outdoors all year round on a large heath and moorland area were very “shy”, but the farmer thought this a positive trait since the area is open to the public for hiking and it is better that the cattle do not get too close to the public. Another farmer saw grazing in nature areas as positive in that the cows could be said to be in their natural element in this environment (Bedoin et al., submitted).
SNG grazing does not always equate with feral animals and difficult human-animal contact, as for example for farm H, where the animals – similar to farm K – are outdoors all year round. An important difference between the farms is the size of the herd and thus the associated grazing area: 12 LU for farm H and 254 LU for farm K. Herd size might be a contributing factor to difficulties of stockmanship of extensively reared herds. Petherick (2005) highlighted the need of good stockmanship in the context of extensively reared sheep herds.

Another welfare issue for beef cattle is one of the UK Farm Animal Welfare Council's five freedoms − “freedom from hunger”. In our case, this is an issue in winter both for herds kept outdoors (farms H and K) and for indoor reproductive animals (farm E). Weight loss and poorer body condition are commonly part of beef farming in situations when there is seasonal scarcity of forage. Animals can cope with it to a certain extent, but there is some discussion how much this should be. Dwyer (2009) wrote : “It seems reasonable to assume, however, that an animal losing both weight and condition, whilst making futile attempts to find food, is not in good welfare, particularly when this semi-starvation can end in death.” There were no deaths due to identified undernourishment in this study, but some low body condition scores were recorded in winter.

Finding suitable places for resting during winter was a challenge for both out-wintered herds, with insufficient dry lying areas, and for many housed herds the space allowance per head was below the legal requirements. Is it really a problem? We could not see it on the animals when assessing their condition. The indicator for indoor-housed animals does not take into account the fact that many farmers let the cattle go outside during the day when the weather allows.

Mortality in the herd was not linked to SNG grazing in this study, but was surprisingly high on some farms: up to 13% calf mortality (before six months) and up to 9% cow mortality over one year. Calf

mortality was similar to the overall figure for Denmark of 7% mortality from birth to 180 days. The average figure for suckler cow mortality in Denmark was between 2 and 3% per year in the last decade (Thomsen, 2006). Cow mortality in Canada as reported from a study of 203 commercial farms was an average of 1.2% per year with a value for the 95th percentile of 3.1% (Waldner et al., 2009). We do not have explanations for the high cow mortality on some farms in our study as we did not investigate it, but it would be an issue to consider for future studies. In the Canadian study by Waldner et al. (2009) hardware disease, cancer, calving-associated injury, bloat, myopathy, and pneumonia were the most frequent causes of death that could be determined.

Taking into account all parameters used in our indicator, global welfare was neither positively nor negatively affected by SNG grazing. Systems based on SNG have fewer of the problems related to housing, but face other challenges instead; however, we don't consider these as critical.

4.4. Nature care

We have used four different indicators to estimate the biodiversity on the different grasslands. SNGs show either a high proportion of valuable biotopes or of perennial plants. Some CGs can make an important contribution to biodiversity due to the presence of hedgerows, but only a few of the farms had hedgerows. Generally, it is important that agri-environmental indicators are useful in farm management in the sense that they enable farmers to react to them and thus influence future results (Noe et al., 2005). It is also important that the indicator values reflect differences in farm management. The extent of the uncultivated biotope area may vary between farms as a consequence both of the natural conditions and topography on the farm and of the farmer's (and previous farmer's) interest in nature and wildlife. However, even on farms without woods, bogs, and ponds it is possible for the farmer to create hedgerows and other biotopes if wanted (farm A). Noe et al. (2005) also suggested using easily identifiable flowers or butterflies as indicators, which farmers can monitor and observe the impact when they make changes.

From the different information collected on the farms we calculated the conservation effect of meat production in a product perspective (**Table 9**). This kind of information could, for example, be used as a label of quality when marketing the meat or as a communication tool for the farmer. One kilo of meat (slaughter weight) corresponds to about 200 to 300 m^2 SNG "conserved" for farms H and K, where SNG is the basis of feed production. Farms with SNG grazing for cows with calves and fattening the young animals indoors correspond to 9 to 22 m^2 SNG per kilo slaughter weight. This contribution is much lower per kilo output, but at a landscape level these systems also contribute to grassland conservation. In contrast, productivity in terms of energy in the feed necessary to produce one kilo slaughter weight is higher on farms without SNG or with SNG limited to 20% of herd feed.

These indicators do not take into account the whole impact of beef production on biodiversity as imported feed is not included. Guerci et al. (submitted) give an example of the inclusion of imported feed in biodiversity scores of milk production based on a life-cycle approach.

Table 9: Indicators of farm land use, value of nature at the farm and production efficiency in a product perspective.

	E	G	B	F	L	A	C	J	H	K
SNG[a] m^2/kg SW[b]	0	2	6	3	11	12	37	95	269	236
Grassland[a] m^2/kg SW[b]	31	33	20	82	29	26	59	128	269	236
Hedgerows[a] cm/kg SW	14	19	8	30	4	37	5	8	86	12
Perennial plants[a] m^2/kg SW[b]	1	m.d.	m.d.	2	3	6	m.d.	16	18	29
Valuable biotopes[a] m^2/kg SW[b]	0	2	0	0	1	0	21	26	186	109
Productivity net energy MJ/kg SW	153	149	180	161	153	112	163	217	486	306

SNG: semi-natural grassland, LU: Livestock unit, 500 kg liveweight, SW: slaughter weight

[a]from the farm, excluding grass from imported feed

[b]produced over one year

5. Conclusion

These case studies based on data from ten farms suggest that grazing of semi-natural grassland (SNG) by cows with calves has no negative impact on animal growth and herd production in comparison to systems without SNG; these systems have similar conversion rates of feed into meat and achieve similar or higher carcass quality. Both systems (no SNG or SNG for cows and calves only) face the same challenges in terms of animal welfare, mainly related to confinement. In a product perspective (per kilogram meat) the impact on wild nature of the SNG system for cows and calves is limited, but might be considered as important at a landscape and local level.

Systems with steer production based exclusively on grass (Limousine breed) gave a high carcass quality and relatively good productivity. These systems might be more resilient than the systems mentioned above, as they are self-sufficient in feed. Of these, the system based exclusively on cultivated grass (CG) does not contribute substantially to wildlife conservation but could reduce its impact by the planting of hedgerows. Results from the system with almost half of the feed deriving from SNG show that it is possible to combine conservation grazing with a satisfactory meat production on the farm and with good animal welfare. This last system might be considered as performing very well in the goal of combining conservation grazing, animal welfare and product quality.

Systems based on rustic breeds and a high share of SNG have a high conservation potential and good welfare results, but weight loss in winter is a challenge. Meat production is low compared to the other systems, but then the feed is produced on land which is not appropriate for human food production. Carcass quality does not satisfy the requirements of the meat industry, but their quality could also be considered as good if using different quality criteria and if marketing the meat in “alternative” outlets.

SNGs are very variable in terms of type of ecosystem, plants and expected yield and different meat production systems might be locally more suitable to some types of SNG than others. For further research, it would be interesting to validate and complete this study with a larger sample of farms and broaden the assessment including other criteria for sustainability.

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Paper III

Bridging the gap between farmers and consumers: value creation and mediation in “pasture raised beef” food networks.

Bedoin F., Kristensen, T., Noe, E.

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BRIDGING THE GAP BETWEEN FARMERS AND CONSUMERS: VALUE CREATION AND MEDIATION IN "PASTURE-RAISED BEEF" FOOD NETWORKS

Florence Bedoin[2], Troels Kristensen, Egon Noe

Abstract

The aim of this article is to explore how different quality dimensions (safety, aesthetics, ethics and rooted ness) are created in food networks; how these qualities are transferred until the consumers; and how this process is supported by the organisation of the food network.

Our postulate is that combining the quality and organisation dimensions and exploring the link between them will provide an interesting perspective for improving the sharing of values in food networks.

This framework is applied to five case studies of "pasture-raised beef" food networks in France, representing a diversity of organisations such as public label scheme, cooperate owned brand and direct sell from farmer to consumer. The results highlight the importance of the role of certification and personal commitment for the creation, and also for the mediation of added-value.

Key words: Grassland, meat quality, sustainability, food labeling, case study

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Introduction

Recently there has been a wealth of papers reviewing the emergence of "alternative" food networks and their diverse ways of attempting to reconfigure relationships between food producers and food consumers (Marsden et al. 2000; Sage 2003). Furthermore, short food chains, environmentally friendly production and consumption systems and other "alternative" food networks are seen as potentially more sustainable than the "mainstream" ones because of their focus on "quality", "place" and "nature" (Goodman 2003). In their paper from 2006, Laura Venn et al. reported that they had found 56 published articles in the area of "alternative food networks" that included140 empirical case studies (Venn et al. 2006). From this abundant literature emerge several questions that invite further research. Some of them relate to value communication and dialogue in food chains: for example: "At the same time, researchers should aim to analyse the process of meaning creation in food production, consumption and marketing, also evaluating how operations vary with changes in meaning" (Brunori et al. 2008); "methods for improved communication and sharing of values in global and long-distance food chains on the basis of negotiation between equal partners [should be investigated]" (Niggli et al. 2008).

In this paper we will explore the link between the organisation of the food network and the quality construction and mediation within the food network. This exploration is here done in the context of the beef market, and especially the identified "pasture-raised beef", where the meat comes from cattle that have been grazing, at least part of their life.

In comparison to "mainstream" meat, which comes from young bulls fattened indoors or culled dairy cows, "pasture beef" farmers can claim that their production systems have some added-values concerning animal welfare, rural landscape, environmental impact, meat flavour, and healthiness of the meat, depending on the characteristics of the farm and transformation practices. Meat-based food networks are characterised by the segmentation of the products that each actor works with: animal, carcass, muscle or meat cut. Each of these steps has its own features and its quality is appreciated in different ways. The quality of the final product depends on all of them. Our hypothesis is that it is an organisational challenge to link the qualities of each stage and for this to be reflected in the quality of the final product.

Methodology and theoretical framework

This study is based on a multiple case study analysis. We use a case study analysis because we think that we can learn from the diversity of food networks. A case study is a good tool for learning from real-life phenomena. (Yin 2003; Stake 2000)

The idea is not to directly compare the cases but to gather a diversity of the strategies in this context – investigating how particular organizations allow (or not) farmers to reveal and communicate the quality of their practices and of their products.

Case selection

Our criteria for selecting the food networks were:

- Diversity of distributors (butchers, restaurants, supermarket, catering, direct to consumer)

- With or without certification scheme

- Farmers owning or not the means of transformation (i.e. meat transformation plant)

- Collective or individual initiative

The case studies were not intended to be representatives of different types of food networks, but to illustrate the heterogeneity of the approaches encountered during the initial exploration. The selected cases claim a "special" quality of their products relating it, more or less explicitly, to grazing practices.

We concentrated our study in the centre of France and especially in the Allier department and neighboring areas. This region has the oldest Label Rouge certified beef food network and an important diversity of other food networks. In our search for more diversity we also chose two other food networks located in neighboring areas.

Data collection and processing

Information for the case studies was obtained in three main ways:

- Qualitative open-ended interviews of 22 stakeholders to gather an in-depth account of their experiences, conducted in February and March 2009. We asked questions about production, process, procurement and marketing practices, certification and regulations, communication and coordination among the actors. We did not interview consumers, but we interviewed actors in the chain who are in direct contact with consumers and we asked them about their perception of consumer demand. The interviews were conducted by the first author and, with three exceptions, were taped and transcribed.

- Analysis of documents

We gathered relevant documents from the organizations, especially documents for communication with customers, prices and services

- Observations

While doing the interviews we visited the firms and farms and developed the questions according to observations.

Those multiple sources of information were triangulated to reduce the likelihood of misinterpretation. Triangulation is usually used by qualitative caseworkers and is generally considered as "a process of using multiple perception to clarify meaning (…)"(Stake 2000).

The challenge of quality definition

Quality of meat includes both (1) the objective dimensions i.e. traits that can be measured on the samples and is dependent on the biological basis, but independent on the user this includes microbiological measurements, as well as colour and tenderness of the meat, and (2) the subjective dimension, based on the perceptions of the users i.e. their preferences, in terms of the value they attribute to various type of information (Edwards and Casabianca 1997). this includes consumer perceptions of the method by which the meat was produced and its perception of the flavour.

We had established a typology of the different quality dimensions based on literature (Brunori 2007; Niggli *et al.* 2008; Conner *et al.* 2008; Edwards and Casabianca 1997; Morris and Young 2000) that can be embedded in a beef meat product in a consumer perspective. These ranged from objective to subjective dimensions:

- Safety (sanitary quality, freshness)
- Health (presence of healthy micro-nutrients, fat)
- Aesthetics (flavour, juiciness, tenderness)
- Ethics (animal welfare, pollution, landscape, supporting family farming)
- Rooted ness (connection to traditions, culture, the food is produced by someone, somewhere)

This framework has been used for analysing quality creation and mediation in the case studies.

Brief presentation of the cases

Case A: Label Rouge Charolais du Bourbonnais

About 130 farmers own a cooperative slaughterhouse and meat-processing plant. They supply mainly butchers, but also restaurants. The beef is sold under a Label Rouge, which is the name of a collective mark owned by the French Ministry of Agriculture. The Label Rouge guarantees a superior quality of the final product in terms of flavor in comparison to standard meat. They also got the European PGI (Protected Geographical Indication) label which is the European mark for foods that are authentically linked to the area where they are produced.

Case B: Supermarket Label

This is a certification scheme initiated by one of the biggest French supermarket chains in 1996. They work together with farmers' cooperatives in different French regions. They require a "traditional" way of production with several months of pasture for the animals. The production and process requirements are controlled by an independent control firm.

Case C: Nature park certification

This is a cooperative of 42 farmers producing Salers beef in a mountainous area of the Massif Central. They have their own meat processing facilities, employ a butcher and sell their vacuum packed products to restaurants and private households. They use the regional nature park trademark. This means that farmers

have to comply with requirements for environmental and landscape friendly production systems. The region is touristy, with typical landscapes.

Case D: Farmers' collective shop

This is a farmers' shop which opened in 2002. Ten farmers of the region sell their products in the form of vegetables, wine, cheese, meat, etc. The farmers commit to be themselves present at the shop. One of the farmers has beef cattle on grass and employs a butcher for the carving. The shop sells around an equivalent of half a beef carcass per month.

Case E: Farm box scheme

This is an 110-ha farm with suckler cows of the Charolais breed. The animals are slaughtered at a slaughterhouse and the carcasses are then sent to a meat processing plant where they are cut and packed. The meat is delivered by the farmer to private households in big cities and in his region.

Results and discussion

What is quality to the consumers? Perceptions of the other food network actors.

Asking the actors about their perception of consumer requirements, we got the following results: tenderness is the most frequent requirement of consumers; sanitary safety is often taken as given; but, following the BSE crisis, there are still preoccupations with what the cattle have been fed. Concerning flavor, there is a broad diversity of consumer preferences; some prefer a strong taste while others prefer a mild one, but it is an important feature for all. Regarding production conditions the fact that the animals can go outside is considered as very positive. Some consumers also look for a direct contact with the farm or the farmer and also for a product "story" that they can relate to.

Of the five quality dimensions defined in the Methodology section, the healthiness of the product (micronutrients and fat content) was the only dimension never mentioned by the interviewees.

How do qualities emerge from the practices and conventions of the food network? (Figure 1)

In terms of quality creation, we can observe that there is a large diversity between the five cases:

The Label Rouge CB, focuses the efforts of the actors on aesthetical aspects, involving farmers and meat processing practices, especially a long dry aging on bones.

The supermarket label focuses on farm practices. The meat processing practices, aging and carving, don't give any added-value because they are similar to the mainstream meat production.

For the nature park label, the certification focuses on the regional identity and environmental considerations. However the practices responsible for flavour, which have emerged from the negotiation between the partners, make it an important feature of this food network.

The two food networks working with direct sale between farmer and consumer are mainly selling young bulls of age 16 to 24 months, which are supposed to give a milder taste but very tender product.

It is also interesting to note that at the beginning of four of these food networks (excluding the nature park label) you can almost have the same animal, from the same farm. At the end you can end up with very different product attributes because of the processing practices and the organisation of the food network.

A farmer delivering animals to case B, case E and to a food network similar to case A (fcE):

"For me they [my animals] *don't have a different quality: the animals are from the same group, have been fed in the same way, with the same feedstuff and have more or less the same shape. I think the quality of the meat in relation to tenderness and flavour is achieved by the aging on bones. That is the critics I make towards one of these food chains…"*

Figure 1 - Practices for adding value to the product and actors involved in the creation of these values

		Label Rouge CB	Supermarket Label	Nature park label	Farmers' shop	Farmer Box scheme	Who is involved?
Safety							
Traceability		*RR*	*RR*	RR	RR	RR	All
Microbiological		*RR*	*RR*	RR	RR	RR	All
Long-term potential effect on health or environment	Limited list of allowed/forbidden feedstuffs	*RR++*	*RR+*	*RR*	RR	RR	Farmers
	Limited medicine intake of the animals	*RR+*	*RR+*	*RR*	RR	RR	Farmers
	GMO in the feedstuff	discussed	nm.	*Forbidden*	Not using	Not using	Farmers
Aesthetics							
Tenderness:	Maximum age of the animal	*96 months*	*144 months*	120 months	70 months	? Young	Farmers
	Reduced stress of animal	*Yes*	*Yes*	nm.	nm.	nm.	Farmers + transport
	Minimum aging on bone	*10 days*	*7 days*	Adapting	Adapting	14 days	Abattoir /meat processing.
	Butcher adapting to the diversity for cutting	Yes	Yes	Yes	Yes	Yes	Distributors
Flavor, juiciness, no cooking loss	Breed	*Charolais*	*Charolais*	*Salers*	Limousine	Charolais	Farmers
	Minimum age of the animal	*28 months*	*28 months*	26 months	16 months	16 months	Farmers
	Pasture based alimentation	*Yes*	*Yes*	*Yes*	Yes	Yes	Farmers
	Aging of the carcass on bone	*Yes*	No	Yes	Yes	Yes	Abattoir /meat processing
	Providing cooking advice to the consumers	Yes	nm.	Yes	Yes	Yes	Distributors
Color	Selection of carcass by color	*Yes*	No	No	No	No	Abattoir/ meat processing

Italics: indicates that the feature is mandatory in the food network (certification) nm.: Not mentioned

RR : Respect official Rules and legislation scheme + : further rule, added to the requirements of the certification

		Label Rouge CB	Supermarket Label	Nature park label	Farmers' shop	Farmer Box scheme	Who is involved?
Ethics							
Animal welfare		*RR++*	*RR++*	*RR++*	RR+	RR+	Farmers + transport
Limit negative environmental impact	Limit polluting emissions Respect biodiversity Recycling	RR	RR	*RR++* *++++* *+*	RR	RR	Farmers Farmers Farmers
Care of landscape		Care hedges	nm	*+++*	nm	Care hedges	Farmers
Rootedness							
Regional identity	Region of production identified Region of process identified Local consumption	*Yes* *Yes* No	No No No	*Yes* *Yes* Partly	*Yes* *Yes* *Yes*	Yes Yes Partly	All
"Traditional" practices	Reference to the history of the farming activity and handicraft	Yes	Few	Yes	Yes	Yes	All

Italics: indicates that the feature is mandatory in the food network (certification) nm.: Not mentioned

RR : Respect official Rules and legislation + : further rule, added to the requirements of the certification scheme

Most of the quality dimensions identified - safety, aesthetics, and rootedness - implicate several actors of the food network, from farm to distributor. Each quality can only be realised if all actors contribute to it. This coordination for the creation of quality is realised through a negotiation between the actors, for example, about the method chosen for aging the meat. The result of the negotiation is either formalised by a certification or just part of a business relationship based on stability and trust.

Ethical qualities such as animal welfare and limited environmental impact were only related to farm practices and did not involve the other actors. They were in general not considered important qualities to develop compared to aesthetical or rooted ness qualities, alt*hough, some farmers would like to transfer these qualities to the consumer.*

Transmission of the values embedded at farm level along the chain and to consumers

In the five food networks presented here, we found that the values embedded at farm level are transmitted to the consumers in two main ways (Figure 2):

- a direct farmer-consumer contact where there is a possible discussion between farmers and consumers
- through posters showing some aspects of the farm/animals. This communication is allowed by the certification. It does not need the involvement of the meat processing/sales actors.

Communication by other actors, like restaurants and butchers rarely takes place. We found two reasons for that:

- they communicate mainly about their work, the choice of the pieces, and the preparation for the restaurants.
- in general there is a lack of knowledge of butcher and chefs about what is happening on the farm

Butcher (b1cA): *"What I want is that farmers raise their animals as they want. What I want is to have a good merchandise. (…) How farmers raise their animals, what the animals eat, I don't know…"*

In the "nature park label" food network, restaurants' chefs sometimes talk about the animals and the farms because there is a real demand from the tourists, but it seems that it remains a cliché rather than information:

Cook (r2cC): *"[When the clients ask] I say: it comes from animals like this beautiful cow; we have a nice picture, there"*

This lack of knowledge/interest has been identified in the Label Rouge CB case, and the farmers' cooperative is about to organize farm visits for the butchers.

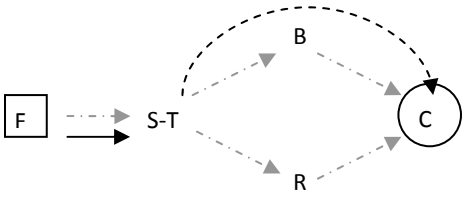
The importance of the type of distributors

From the four selection criteria, the variety of the distributors turned out to be very important in the choice and transfer of quality:

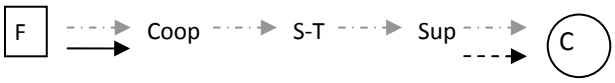
- Butchers and restaurants focus on the flavor and tenderness for their consumers and lack knowledge about farms and animals production.

- Direct farmers/consumers sales enable a communication by the farmer about the conditions of production on farm and the locality.
- In the supermarket case we observed an efficient communication about farm practices through certification. But in comparison to the other food networks, the more “industrial” processing practices don’t convey as much added-value.
-

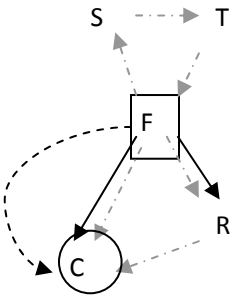
Figure 2: Sharing of knowledge about the specificity of farm practices and their potential added-values



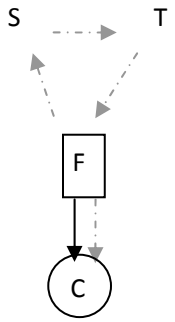
Label Rouge CB



Supermarket Label



Nature park label



Farmers’shop

F: Farmer(s) - Coop: Cooperative S: Slaughterhouse - T: Meat processing plant - B: Butcher -

Product flow

Sharing of knowledge about the specificity of farming practices and their potential added-values through direct contact

Sharing of knowledge about the specificity of farming practices and their potential added-values with posters and advertising material through certification

Concluding remarks

Because some of the values are created by a contribution of several actors of the food network (such as the aesthetical ones), creation and mediation of these values are closely linked. Institutionally-based certification is a way of formalizing this link but stable, inter-personal relationships are also used in some food networks.

Qualities that are exclusively created at farm level (in these cases, ethical qualities) are transmitted directly from the farmer to the consumer either by direct contact or through posters, which are made possible by certification. The involvement of other actors in mediating "farm only" based qualities is limited. However actions to this end are undertaken.

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Paper IV

Communication of farm-based qualities from farmer to consumer: case studies of Danish beef chains

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Communication of farm-based qualities from farmer to consumer: case studies of Danish beef chains

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Key-words: short food chain, communication, sustainability, meat quality

Abstract

Animals coming from extensive grazing systems are not valorised as quality meat in Danish main retail chains. The article examines how different meat qualities based on farm practices, such as biodiversity and landscape conservation and animal welfare, are chosen and communicated in food chains. It is based on six case studies with three rather long chains with supermarket outlets and three short chains with maximum one intermediate between farmer and consumer. We observed that the content of the message to the consumers is not really different between short and long chains and is mostly very simple. Chains attempt to connect to consumers' ethic but rarely convey more factual information. In chains where agricultural practices affect organoleptic qualities and make the meat slightly different from conventional meat, as in the case of animals from extensive grazing systems, more communication might be needed. Consumers' involvement in the food chain, as illustrated by the grazing association, can allow the valorisation of this "alternative" meat.

Introduction

Consumers in developed economies are increasingly disconnected or distanced from producers and this has allowed producers and retailers to sell food which is increasingly damaging for human health and the environment (Eden et al., 2008). A solution commonly proposed is to reverse this distancing, to reconnect consumers with producers through education and information provision about systems of food production, so that consumers will avoid food coming from such damaging systems and instead favor food from more beneficial systems. Information is then supposed to raise consumer awareness about the consequences of the products that they buy (Eden et al., 2008). In the past decades new forms of consumer-producer cooperation in food networks have emerged that are increasingly documented under headings such as 'Short Food Supply Chains' and 'Alternative Food Networks'. Many of these initiatives represent attempts to (re-) build connections between rural producers and urban consumers. They are seen as potentially more sustainable than the "mainstream" ones because of their focus on "quality", "place" and "nature" (Goodman, 2003). They can therefore be drivers for sustainable food and farming systems of the future.

This study deals with beef meat food chains in Denmark and emerged through the analysis of semi-natural grassland based production systems. In Denmark, conservation of semi-natural grasslands (SNGs) is one of the priorities set by the government for maintaining biodiversity (Regeringen [Danish government], 2009). Many areas of SNG are abandoned and growing into shrubs; one way of conserving them is by using grazing cattle. SNG areas have usually lower quality of forage than cultivated forages (Buttenschön, 2007) and cattle growth is usually slower than in other more intensive systems (Hessle, 2007). During cases studies on Danish beef farms it was shown that animals from SNG-based systems are considered as of "bad" quality by the slaughtering industry and large food chains (table 1). SNG-based production could be considered as a "high quality" production due to its multifunctionality among others related to animal welfare, biodiversity and landscape conservation. One of the questions we try to answer here is whether SNG-based beef production can be acknowledged as giving a "quality" meat in food chains? And whether "short food chains" could be drivers of this acknowledgment.

Table 1: Examples of beef production in Denmark and valorisation of their products in the meat chain. (Bedoin and Kristensen, 2012)

Farm	**Breed**	**Feeding**	**Animal produced**	**Slaughter weight (kg)**	**Carcass shape (EUROP)**	**Price to farmer** [a]	**Retail sell**
K	Galloway	Permanent grassland	Steers and heifers 3 to 4 years old	200 to 280	O	2,3	Sold as minced meat
E	Limousine	Cultivated grassland and concentrates	Bulls 12 months Heifers 15 months	Around 320	U	3,3	Sold as premium quality

[a] (€/kg slaughterweight)

The literature often offers a dualistic characterization of "alternative" foods as being somehow uniquely "ethical" while conventional foods are "non ethical", as discussed by Holloway et al. (Holloway et al., 2007). It is not always clear what "alternative" in the literature stands for in comparison to "conventional". Authors have drawn attention to different economic, geographical and sociological structures (Watts et al., 2005). In the case of beef meat in Denmark, we identified chains which claim they have a special "quality" product, where the qualities relate to farm based practices; some chains with a close contact farmer-consumer and others based on a long chain with supermarket outlet. We concentrate this study on chains which propose to the consumers a product arguing of differentiated qualities, based at farm level and we don't take position on whether these chains are alternative or not. In this study we explore different beef

food chains which claim to have a product with a high quality based on on-farm practices. We investigate the way these chains inform consumers and how the quality claims are build. We compare “long” and “short” chains in their ability to convey the message on farm quality to consumers. “Short” chains are characterized by a close contact farmer-consumer with maximum one intermediate between them and “long” chains are more extended in space and number of actors, typically with supermarket sells. Our hypothesis has been that “short” chains, with a “face to face” contact farmer-consumer allow a better communication about farming than “long” chains and that they therefore can promote products whose quality is linked to farming practices, such as conservation grazing and animal welfare. The questions were then: Do “long” and “short” quality food chains reconnect the consumers and the farmers in the same way? What is the potential for these different organizations to improve the communication between farmers and consumers? Can SNG-based beef production be acknowledged for giving a “high quality” meat? Can “short food chains” be drivers of this acknowledgment?

Background

Danish beef production

The actual beef meat production in Denmark is coming from different types of farms, producing different animals. Most of the animals slaughtered are an outcome of milk farming (82% of the slaughtered cattle (live weight) estimated from (Danish cattle federation, 2010)) and suckler systems represent a minor part. Beef coming from milk production is composed of culled milking cows and heifers and calves (mostly 8-10 months and maximum 200 kg slaughter weight, feed based on concentrates). They represent the majority of domestic beef production; they are commercialized without quality claims, and represent the “mainstream” Danish meat. Organic steers and heifers from milk herds are an exception and are sold together with the organic steers and heifers from suckler systems. From the suckler systems can be found on the market: young animals (10 to 20 months) finish fed with concentrates; organic produced (and mainly grass-fed) heifers and steers at about 2 years age and steers and heifers from rustic breeds between 2 and 5 years old produced on grass.

The animal produced in these systems vary widely in terms of animal age, breed, body condition and fattening level. This gives rise to large variation in carcass and technological quality characteristics for meat production.

Traditional logic of quality

Traditionally definition of meat quality and therefore quality of animals for meat production has been determined by consumers, cooks and butchers. The palatability (pleasantness of taste of food) for the consumer is a central aspect. It depends among other things, on the juiciness, tenderness, fat content and meat taste. These factors are influenced by the animals characteristics (age, bred, feeding), the transformation process (cut, maturation techniques and time) and the cooking processes. See also (Lebert et al., 2003) for more details.

Meat quality aspects are translated into rules for the farmers, who will get their animals paid according to certain criteria, which influence to some degree the quality of the meat: age of the animals, slaughter weight, conformation of the carcass in muscle size and in fat amount. Farmers are paid for the animals according to 3 main factors for a given category: slaughterweight, conformation and fatness of the carcass. Conformation score reflects the shape of the animal, and particularly the distribution of muscle in the body. A good conformation refers to a lot of muscle in the areas that are worth the most; these areas are the hindquarters (round steak and roasting beef) and the back (Sirloin, rib - roasts and T-bone steaks).

In the Danish context young animal (below 18 months) finish with concentrates is traditionally considered as the one delivering “high quality” meat.

New dimensions of quality in meat

In the last decades, consumers have added new dimensions in their perceptions of meat quality to the traditional quality cues mentioned above. They have often developed in reaction against scandals covered by the media: animal mistreat and contamination or against more diffuse impacts of the industrialization of agriculture and of the food chains: worry for human health and uniformity of the landscapes for example. These preoccupations have allowed new quality cues to emerge on the market: “animal welfare friendly”, “organic” and “from natural pasture, framing biodiversity and traditional landscapes” are some of the examples found in the Danish context. Danish consumers place animal welfare as an important ethical quality, regarding to food production, as it had already been noticed by Delavigne in 1999 (Delavigne, 1999). These new claims are carried by various chain organizations at the initiative of farmers, butcher, public administration or consumers themselves.

Meat processing sector

The meat industry has evolved over the last decades towards a concentration of the slaughter and processing industries and of the retail sector. In Denmark, Danish Crown, which is a cooperative slaughterhouse, slaughters 60% of the cattle in Denmark, seven medium-sized slaughterhouses slaughter 35% and the remaining 5% are slaughtered at small slaughterhouses that process less than 50 heads per week (Anonymous, 2012b). The same structure usually also transforms the carcass into packed meat for consumption. Danish Crown is the owner of Friland A/S, which is a major player for “quality beef” in Denmark since the 1990s and has developed concepts based on quality beef products such as organic beef and young cattle from beef breeds. In the retail sector there is also a high concentration as 89% of the market is in the hands of three supermarket chains (Anonymous, 2011). There are no statistics on the number of butchers in meat marketing, but there are only about 400 butchers left in Denmark (one butcher per 14000 Danes). The meat which can be bought mainly originates from dairy cows and dairy young bulls. In a supermarket, there is usually very little differentiation of the beef other than in the price. The list over authorized beef meat outlets (Anonymous, 2012a) shows that the elements of differentiation of the meat are tenderness of

the meat, breed and country of origin; few claims are related to on-farm production methods for 2012, and there are three certified segments: organic, animal welfare and use of nature grazing.

Methodology

Case selection, data collection and methodology

We have chosen to study a diversity of beef food chains in Denmark. The criteria of selection were that we should, at the end, have a broad coverage of types of organizations: both in length of the chain and number of actors involved, but also chain-owner (farmer-driven, butcher-driven…). We also chose them in order to have a broad coverage of the quality cues they are branding their products under.

We have interviewed 11 beef farmers about their farming practices and their experience in marketing their products and conducted 12 semi-structured interviews with other food chain actors: people from slaughterhouse, butchers, cooks, a person in a certification body, a responsible for buying meat in a supermarket. These interviews cover 7 different food chains. There is some overlapping because some actors are involved in several chains. The interview guideline included: background of the person and of the activity, practical organization of the daily work, relations with supplier and clients, information and reaction on consumer demand, handling of meat quality. We took part to a supermarket event were a butcher had organized a talk and a degustation with his customers. We also conducted content analysis of the publicity material and website of the different chains.

The analysis of all this information has been done focusing on meaning creation around quality, negotiation of quality between the actors and the links between organization and the mediation of quality.

Quality definition

We share with Noe and Alrøe (noe and Alrøe, 2011) the understanding of qualities as aspects of the empirical relation between actor and object. Thus, as claimed by convention theory, there is no universal understanding of quality and quality is cognitively evaluated in different ways depending on which normative broad is invoked. (Ponte and Gibbon, 2005)

Quality of meat includes both (1) the objective dimensions i.e. traits that can be measured on the samples and is dependent on the biological basis, but independent on the user this includes microbiological measurements, as well as colour and tenderness of the meat, and (2) the subjective dimension, based on the perceptions of the users i.e. their preferences, in terms of the value they attribute to various type of information (Edwards and Casabianca, 1997).

We have established a typology of the different quality dimensions that can be embedded in a beef meat product in a consumer perspective based on literature (Brunori et al., 2008; Conner et al., 2008; Morris and Young, 2000). They are:

- Safety (sanitary quality, freshness)

- Health (presence of healthy micro-nutrients, fat)
- Convenience (packaging, easiness to handle and to prepare)
- Organoleptic (flavour, juiciness, tenderness, colour)
- Ethics (animal welfare, contamination, landscape, biodiversity)
- Rootedness (connection to traditions, culture, the food is produced by someone, somewhere)

These dimensions have been used for analysing quality creation and mediation in the case studies. The 2 last dimensions are so called “credence” attributes (Ponte and Gibbon, 2005) and cannot directly be verified by the consumers when buying or consuming the product. They thus need to be communicated to the consumer.

Results and discussion

Presentation of the cases

Table 1 gives an overview of the cases in terms of claims to the consumers and ownership of the concepts.

We also studied a conventional chain, with no quality claim based at farm level that we use as a reference in the analysis.

Table 1: Overview of some characteristics of the chains studied

Chain name	Main claims for quality to the consumers	"owner" of the concept	Actors implicated and main outlets
"Long" chains			
Friland Beef	Animal welfare (certified by the Danish Animal Protection Association) For some of the products, name of the farmer, localization of the farm and brief description of the animal's life For some of the products : conservation grazing Tender and tasty meat Danish	Danish cooperate slaughterhouse	Slaughterhouse, cutting plant and packaging is common with "conventional" chains Supermarket outlet
Friland Organic Young Beef	Certified Organic: animal welfare, less risk of residue of medicine in the meat, natural, no GMO in the feed. Tender and tasty Danish	Danish cooperate slaughterhouse	Slaughterhouse, cutting plant and packaging is common with "conventional" chains Supermarket outlet and catering
Nature Meat (Nordjysk Naturkød)	The animals have been grazing natural pasture in a specific region and thereby contributed to landscape and biodiversity preservation Locality – wild nature Animal welfare Fair for the farmers Tender and tasty	In start local public administration, then private medium-sized slaughterhouse	Medium sized slaughterhouse also implicated in "conventional" chains Private butchers outlet and supermarkets **Notice :** **The concept was stopped in 2011**
"Short" chains			
Slagter Sørensen	Traditional handicraft and know-how Organic meat: animal welfare Tasty and tender From an identified region and 5 identified farmers The animals have been grazing natural pasture in a specific region and thereby contributed to landscape and biodiversity preservation	Butcher	The butcher get the carcass from the slaughterhouse after agreement with the 5 farmers; he matures and cuts the meat and sell directly to the consumers via his webshop + sell to restaurants
Grazing association	Local Taking care of the local landscape and biodiversity You can see yourself that the animals have a good life	Consumers – citizens	Members of the association take decision about grazing the area, help in the practical work and commit to buy a quarter of animal each year. They use the service of a local butcher for preparing the meat.
Farmers direct farm sale	Diverse from farm to farm (5 cases) Proximity and animal welfare are common to all For two of them: Organic For one of them: grazed in wild nature Fat content of the meat Tasty and tender	Each farmer	The farmer gets a small private slaughterhouse to slaughter the cattle and cut it down. The consumers come and buy the meat at the farm.

Reconnecting consumers with farming with emotions and knowledge

In the case studies we identified 3 levels of communication of farm based qualities with consumers:

- Telling a simple story, use images. This is used for catching people in their emotions and meeting them in their global ethical dispositions

- Inform about practical aspects of farming and positive actions for environment and animals welfare. Consumers can understand part of food production and this knowledge can fit with their ethical dispositions
- Explain more complex link between conditions of production and food quality in order to educate consumers so that they will accept differences with products they are used to in conventional market, for example seasonality, difference in flavor, texture of the meat.

We will here analyze the communication with the consumers in the different food chains: the ways of carrying the message to the consumers and then the content of the message and which level of communication with consumers are intended. We will finally conclude with the impact of these different organizations on farming systems.

Supports of communication of farm-based values

We observed different ways for “bridging the gap” between farmer and consumers and getting the consumers informed about farming.

Certification and private band

Long chains selling in the supermarket use certification and labelling. The certification is materialized by a logo on the etiquette of the product and a slogan. The two institutions standing for certification are trusted by consumers, the Organic certification is certified by the Danish state; the certification for animal welfare is certified by the Danish Animal Protection Association. Certification is only used in long chain with retail or butcher outlet. Farms which are certified and who sell part of their production directly to consumers rarely use their certification as a marketing argument for their direct customers.

Direct contact farmer-consumer

Farmers selling directly their meat have a direct contact to consumers. Direct contact farmer consumer is mostly, of course, practiced in short chains but long chains also use it. In a longer chain (Friland Beef), some farmers have been implicated in events where they go in a supermarket and speak there with consumers.

Information to the butcher about farm conditions

Besides certification, those chains try to give more information to the consumers by capacitating the butchers who have direct contact with consumers. In Friland Beef and in Friland Organic, butchers of two supermarkets chains get courses about animal welfare and some of them went out to visit farms.

Internet conveying the voice of the farmer to the consumer

Internet is used by short as well as long chains. It allows the actors of the chains to tell more complete story of the product than the etiquette on the meat package for example.

Friland Beef had a website (sporditkod.dk) were consumers can go in and by entering the number of the meat package get information about the animal, classification of the carcass,

information about the farm were the animal is coming from with a picture of the farmer with his animals and a little text where the farmer is describing his farm. Slagter Sørensen has a website where consumers can see a video presenting his work and see the animals grazing on pasture. He has also a page where he quotes the farmers speaking about their farms, conservation grazing and the good welfare of their animals. The Nature Meat chain had also a web-site where the farmers presented themselves and their farms. Three of the farmers selling directly their meat to consumers (farmers F,G and J) have a website presenting their farms.

Consumers direct implication in the decision of production

In the case of the grazing association, consumers are part of taking farming decisions for the meat produced. They get directly informed and involved in farming.

Face-to-face interaction is characteristic from short chains either in real-life meeting or in internet-based relationship. Communication in “long” chains uses mainly certification and pictures at the buying place but they have also develop strategies with face-to-face interaction between farmers and consumers and informed-butchers and consumers. Internet offers “long” chains as well as “short” chains possibility to communicate with consumers.

We observed the use of these 5 different support of communication about qualities originating from farm-level. What are their consequences on the content of the messages?

Claims for quality and content of the message

The overall message is similar in the different chains

The analysis of the claims conveyed by the different chains shows that the arguments used for marketing are very similar in short and long chains.

Concerning qualities rooted at farm level, the same positive values are praised:

- Animal welfare, a good life for the animals
- A certain harmony to nature, animals grazing in green grass, eventually nature conservation grazing
- Identification of the region and eventually of the farm of origin of the animal
-

We did not identify difference in the overall message between short and long chains. However the complexity of the message they convey is more or less detailed and informative.

Example of a message to consumers: information on cattle grazing

Grazing cattle in green grass is the image commonly used in all the cases for marketing the meat to the consumers. This representation of grazing has also been coming very often in the interviews with chain actors. It is an image which is accepted and acknowledged by all partners.

Most products use pictures of the animals outside in a green field, grazing. The words "*nature*", "*natural*", "*quiet*", "*freely*" are often present on the packaging, leaflets and websites. This "easy" message is the one conveyed on the packaging of the meat for the meat sold in supermarkets and by the pictures used in the shops and on the websites. Some farmers and organizations remain in this idyllic image for the consumers and "hide" – don't mention other aspects of farming, like finish feeding indoors with feed based on concentrates. On one website can be read: "*the herd is grazing the whole summer in the very nice valley*". In the farm reality, it is only partly true because the mother cows with calves graze in summer, but animals for slaughtering are in the stable during 4-5 months. Another farmer described his communication with the consumers at a supermarket where he simplified and "idealized" again the feeding of the animals : "*. as I also say to the customers,(…) And the cows are going on grass, you don't put pesticide on grass. It is nature pure that the cows eat. So they can just be the best and most lean food you can buy* !" It was also the representation of a cook buying Friland Beef meat for almost 20 years: when he described the farm and animal life, he said: "it has been going outside, chewing grass; it has been going with it offspring. It has had a good life out on a green pasture".

Idyllic image of grazing cattle is maybe catching the interest of consumers, but getting those information, most consumers will think that the animals have been living from grass most of their life, although they have been getting silage and concentrates in the last 4-5 months of their life.

This idealization of animal life is present in different chain organizations: Friland Beef as well as farmers selling their meat directly to consumers. Danish farmers and meat industry seem reluctant to tell to the consumers that they finish-fed their animals with concentrates. In contrast, we did a similar study in France (Bedoin et al., 2009), where in the case of the Label Rouge, farmers were praised for their capability of finish-feeding, choosing the feed which will give the perfect muscle development and marbling at the right time on the animals' life. Finish feeding with concentrates is necessary to get the characteristics in muscle size at a defined age which the meat industry require in the long chains and the meat consumers are used to consider as quality meat (clear color, not much fat and tender); though the knowledge about this aspect is not present at butcher and probably neither at consumer levels.

If we consider all the chains studied, except the grazing association, we can see that the message used for selling quality meat is an idyllic representation of animal life. One explanation for this "easy communication" could be that the consumers are not interested in it. Farmer A "It is very difficult to get the consumers interested in the story we would like to tell to them" and "when we make open doors events at the farm, there are not many coming". Certification means that expert and specialist have taken choices about what is "best" for example for animal welfare and animal feeding and consumers rely on this certification and don't necessarily need to make an effort in understanding what is behind the certification. It is surprising that even when there is space for a communication farmer consumer (either by direct contact or through internet) this space is not used to give to the consumers a nuanced view of the farms.

In the cases studied, storytelling is the most important axes for communication. It remains often quite superficial and can lead to misinterpretation by consumers, as we showed here in the case of cattle grazing and we could also illustrate it in relation to animal welfare.

Information of consumers and impact on farming systems

In this study we encountered several chains with a communication only/mainly based on "story telling" (Friland Organic Young Beef, Friland Beef and Nordjysk Naturkød). They adopt the traditional qualities (high tenderness, low fat, color) which are used as quality marker in the "mainstream" meat market. Our interpretation is that within a set of ethical rules, they try to make a meat which is as close as possible to traditional standards of quality in "mainstream" market. Farmers in those chains have then to respect rules about age of the cattle and its size. This decision has an economical rationality because the same procedures and facilities can be used in the slaughterhouse, cutting plant and by the butcher as in the "mainstream" other animals. However it excludes farming systems, which also have a "good story" but do not meet the standards. For example organic produced Galloway cattle, which have been living only from grass in the heath slaughtered at 2 to 5 years are sold as minced meat by Friland because they do not fit in with the age and weight definition of Friland Organic Young Beef. The farmer said: *"Our cattle are not big enough to be classified in the good classification. So it is a problem. I think our meat is much too good to be delivered to the supermarket and sold between old milking cows".* Actors in the Friland beef concept are conscious about this standardization and opened the concept to different breeds and therefore more diversity; they have a website with an educative purpose to explain the specificity of the different breeds. However the differentiation remains on breeds and does not include divers ages and thus feeding strategy.

Meat from alternative" production systems, which does not fit in the traditional requirements, can be valorized and also become a "quality" product but this requires different processes in the transformation for maturation and cut, which can be of a higher cost. It also requires a part of education of the consumers and butchers about the link between farming systems, feeding and meat quality in order to accept a meat which is different from the one they are used to (in color, size, texture, flavor, marbling). In the cases we studied this process is being tried in the grazing association and by the butcher selling on the Internet (Slagter Sørensen) and by 2 farmers selling their meat directly to consumers. In the grazing association, consumers themselves have been trying different strategies and chosing the age of slaughter and the feeding of the animals which give the best quality for them, and they have chosen a product which would be considered as "bad" quality in a "conventional" chain. Slagter Sørensen praises his traditional craftsmanship in maturing and cutting the meat. From his website: "*A happy cow (…) which has lived a free life, tastes just better. They move naturally and grow slowly, which contributes to ensure a good marbling and taste in the meat. (…) Good craftsmanship makes also a difference. I am hanging the meat for maturation as in old Danish traditions; and I am handling the meat with care when I am processing it – it contributes to ensure that we deliver the best quality – each time*"

A cook who buys from both types of meat from Friland Beef and from Slagter Sørensen said: "*They are very good, both. They have a different character; (…) one is light and the other is darker and stronger (…) I will not prepare the same dish with them. It also depends of the*

season." Interviewees with direct contact with consumers explained that consumers are mainly not prepared to deal with this diversity and it is then a necessity for the food chains to inform them of the reasons for this variety and "educate" them in dealing with it, for example with appropriate recipes and different meat cuts.

Perspectives

For communicating ethical values from farm to consumer, it seems that there is not much difference between short and long chains: the use of internet and of certification help telling a story to the consumers in the long chain, which is similar to the story, which is told in short chains. Traceability also allows to identify the farm, the meat is coming from in the supermarket and tell its story to consumers. However in both long and short chains, these "stories" can be so idealized that it deforms "reality". From these cases it seems that the chains aim more at "telling a nice story" than at informing consumers about practical farming. The complexity of information transmitted to consumers in the food chains studied was very limited, farmers selling directly to consumers stated that consumers were not interesting in more knowledge The importance of information in consumers' choices is discussed in the literature: Eden et al. (Eden et al., 2008) argue that consumers don't change their behavior simply in response to information from assurance schemes. While scholars have shown that product information is important for heavy organic buyer in Danmark (Elbrønd and Bjerg, 2012) and Greece (Krystallis et al., 2006) There are different types of consumers with different requirements in term of involvement in food production. For some consumers, trust in the label or in an identified farmer might be more important than the actual information about farming conditions.

Within many of the chains studied, short as well as long, farmers and processors produce a meat which has similar organoleptic characteristics to "traditional" meat, within some ethical rules. More "alternative" farming systems with for example rustic breeds, no concentrate feeding need dedicated actors for processing the meat in a different way in order to reach a high – but different quality. In this study, we only found it in short chains.

This study points towards the relevance of consumers' implication for the valorization of SNG-based meat as illustrated by the grazing association where consumers tried different options for raising the animals and chose SNG grazing without finish-feeding system for the quality of its meat; which would have been considered as of "bad" quality in a long chain. The importance of consumer implication for development of new sustainable food production systems has been analysed by Markus Schermer during the same session of this IFSA Workshop and he highlighted their role as pioneers for changes in food regimes.

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Poster

Value creation and transmission in "pasture based beef" food networks, a case study approach.

Bedoin F., Kristensen, T., Therkildsen, M., Noe, E., Ingrand, S.

Presented at the 1st Nordic Organic Conference, 18th -20th May 2009, Gothenburg, Sweden.

Value creation and transmission in "pasture beef" food networks

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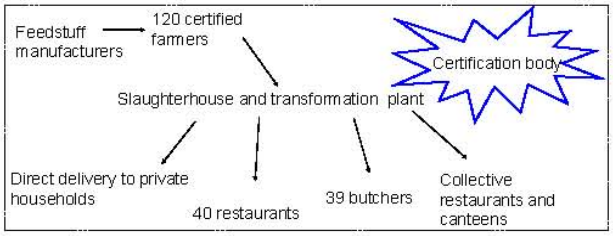
Case A

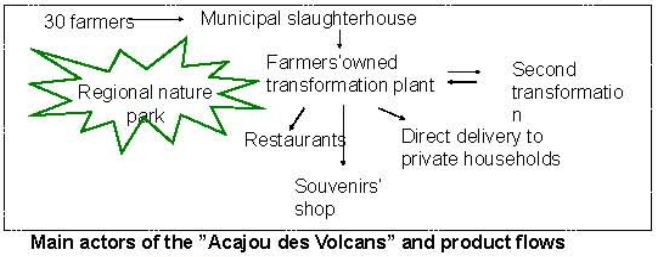
The Label Rouge Charolais du Bourbonnais is a regional label that exists since 1974. There is a certification of the stakeholders' practices and a state garantee of a superior gustative quality product. The distribution is primarly done by butchers as traditional actors for high gustative quality meat



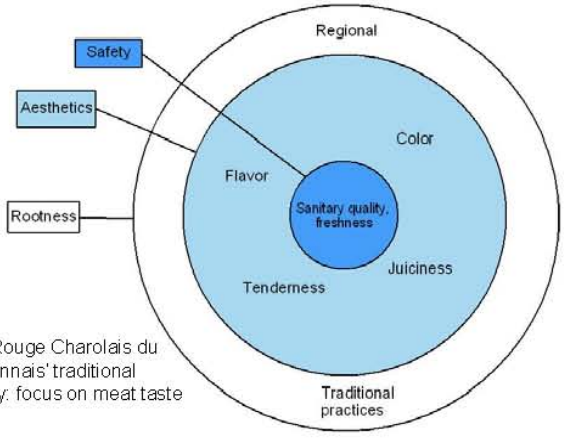
Main actors of the "Charolais du Bourbonnais" and product flows

Case B

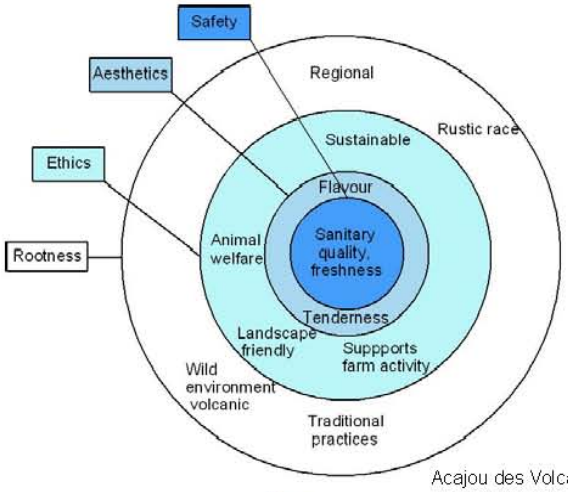
In the year 2002 a group of farmers decided to produce slaughter animals from their Salers cattle. They are situated in a regional nature protected area. They can use the trade mark of the park because they respect requirements for an environmental friendly production. The area and the cattle breed have a positive image, related with volcanos and wild nature.



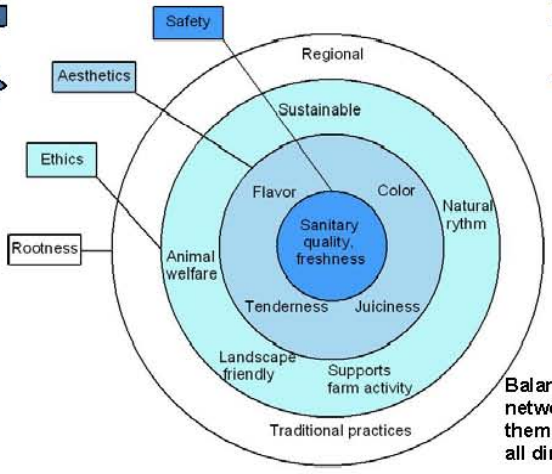
Main actors of the "Acajou des Volcans" and product flows



Label Rouge Charolais du Bourbonnais' traditional strategy: focus on meat taste



Acajou des Volcans : focus on the image of wild nature and rustic animals



Include ethical dimension:

These aspects are already included at farm level but there are obstacles in mediating them until the consumers: butchers and chief cooks don't feel concerned about the production conditions on farm.

Posters are now done by the farmers'organisation in order to advertise about this ethical dimension.

Reinforce aesthetical aspects:

The actors are conscious that farmers should get better skills for produing animals with the best potential meat taste. Therefore are farmers getting training courses.

The cut and presentation of the meat could also become better for fullfilling aesthetical criteria.

Balanced situation : both food networks are trying to develop themselves in order to include all dimensions

Quality dimensions of a product in a consumer-meat perspective: What do the actors of the food network communicate to consumers about the product?

Discussion and perspectives

The aim of case A is to produce a high gustative quality product; while the aim of case B is to offer a product taking advantage of the good image of the natural conditions and of the cattle breed they use. They both do it very well and reach specific consumers within those scoops. The purpose of increasing the quality dimensions of their product is a way to secure the loyalty of the consumers and to try to reach new markets, but at the same time, without losing their identity. Both food networks would not become the same: it would rather reinforce their differentiation in the overall market.

Transmission of the values in the food network seems to be very related to the stakeholders involved and their own values. On the other hand, the organisation of the actors is also important: if a butcher is employed by the farmers who produce and sell the product or if farmers sell to an independant butcher, the construction and transmission of the values are very different.

These two cases are part of a larger study of 6 food networks in France and several others in Denmark. The aim of the study is to examine how qualities are mediated between producers and consumers and how this process is supported by the organisation of the actors. The results will be used to provide indicators that can facilitate the sharing of values in "pasture beef" food networks in Denmark.

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