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Sustainability of grassland-based beef production – Case studies of Danish suckler farms

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ABSTRACT

The grazing of semi-natural grassland (SNG) is encouraged in Europe for the conservation of biodiversity, but little is known about the farming systems including SNG which farmers develop. The purpose of this study was to explore and evaluate at farm level the (1) technical results in terms of animal growth, feed use and carcass quality, (2) landscape biodiversity value, based on case study of ten Danish suckler beef farms with data recording over one year. Herd size varied from 5 to 213 suckler cows. The main conclusion was that an increasing proportion of SNG (up to 45% of net energy in a year diet at herd level) did not obviously imply low technical performances. However, when SNG was used as the entire feed to all animals all year long (over 80% of net energy in a year diet at herd level), performances were lower and meat quality did not fit the requirements of the meat industry, but were considered in alternative market chains. This last type of management (rustic breeds kept permanently on SNG) had the highest use of grassland (one suckler cow and her offspring for roughly every 3 ha SNG) and thus the highest biodiversity conservation potential.

1. Introduction

Until the mid-20th century (and more recently in some areas) semi-natural-grasslands (SNGs) played an important role in livestock production systems and thus represented an important part of the agricultural area in Europe. 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.

It is well acknowledged that SNGs generally host a high biodiversity and provide important environmental services for farmers and society. 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). Conservation of SNG is therefore part of the Common Agricultural Policy of the European Union with agri-environment schemes which support non-market functions of grassland farming. In Denmark, conservation of SNG is one of the priorities set by the Danish government for maintaining biodiversity. Despite this engagement, SNGs of high biodiversity are threatened ecosystems in many parts of Europe; the main threats are transformation to arable land, intensification (re-seeding, heavy fertilizer use) and abandonment with subsequent shrub encroachment (Condé et al., 2010), the later part being the subject of this paper.

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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 the global concerns, related to beef production including environment, climate change, food security and consumers' requirements (Bernués et al., 2011; Hocquette and Chatellier, 2011; Stilmant et al., 2011). Synergies and critical points in grazing beef systems have been discussed in different contexts (Mediterranean, (Bernués et al., 2011), as well as in a Swedish, (Hessle and Kumm, 2011) and a British (Dawson et al., 2011; Fraser et al., 2009) context). In these studies, synergies were addressed relating to biodiversity, landscape, animal welfare, carbon sink and system resilience which can be higher/better than in conventional cereal-fed systems. Drawbacks of grassland-based systems are related to low animal productivity and carcass quality, labour productivity, greenhouse gas emissions and dependence on agri-environmental payments. 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 et al., 2011; Isselstein et al., 2007). These experimental studies have investigated the effect of breed, type of animal and different grazing managements on animal performance and biodiversity outcome. 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".

In this study, we explore these issues at farm level on "real" farms, including the complexity of farming systems with focus on two aspects of the sustainability of beef production: (1) farm technical results in terms of animal growth, feed use and carcass quality; (2) landscape biodiversity value. These two aspects were chosen for their relevance in the Danish and European context and because they give important insight for assessing sustainability of production systems in a social, economic and environmental perspective.

(1) Grazing biodiversity-rich pasture can reduce animal daily growth compared to grazing cultivated grassland (Fraser et al., 2009) and finishing animals on pasture might result in a lower carcass weight and conformity and lower meat tenderness than finishing with concentrates (Keane and Allen, 1998). The meat industry and especially slaughterhouses wish to receive carcasses of a high conformation and weight. There may therefore be a conflict between use of SNG for the herd feed and the production results for individual animals.

(2) Appropriate grazing practices are a major element to maintain high biodiversity levels of SNGs (Adler et al., 2001; Olff and Ritchie, 1998). Maintaining SNGs and their biodiversity is a goal of Danish policies, for which a target of an additional ha under the Natura 2000 scheme has been set for 2020 (Regeringen [Danish government], 2009). Several policies and funding instruments are in place to support this goal. Despite this engagement, grassland abandonment and encroachment of shrubs and trees remain a major problem, as the most recent report on the status of biodiversity in Denmark points out (Ejrnæs et al., 2011). Identifying and describing beef production systems which can contribute to conservation grazing can facilitate discussion with involved stakeholders, encouraging the emergence of new solutions.

These two aspects are interrelated within the complexity of each farming system. The purpose of this study is thus to give a deeper understanding of some of the feed-backs and side-effects due to the interactions involved between herd management and grassland management at the farm level.

2. Methodology and proposed indicators

2.1. Selection of farms

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

2.2. Farm registration and data collection

The aim of the registration was to document conditions and production results 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 week and amount (kg dry matter (DM)) and type of feeding on pasture if any. If the grassland was harvested, the quantity harvested was calculated based on size of storage (m^3) and density (DM/m^3) from feeding values and standard tables. 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 veterinary treatments of individual animals. We also registered feed intake by group of animals from feeding plans, feed budget for roughage and imported concentrates.

During the farm visit in summer, each grazed field was visited and plant cover monitored. Animals' body condition was assessed both in summer and in winter using a 0–5 scale, calibration was ensured by taking pictures of animals in each group.

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.