Exploitable yield potential of grasslands in the Netherlands

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Abstract

The Dutch dairy sector is leading in production efficiency with research and innovation achieving great improvements by focussing on the cow as the central production factor. Grass and soil, while also being essential production factors, have received much less attention. Recent developments mark a turning point for attention to grass production and grazing. While increased focus on grass production and grazing is generally considered as sustainable development, it is centred around the dimensions of people or planet; the profit dimension is under-represented. This paper builds the economic case for an increased focus on grass production and grazing by modelling the exploitable yield of grass production in the Netherlands. The current dry matter (DM) production is assessed at 6.0×10^6 Mg. The potential production is modelled at 9.3×10^6 Mg, thus leading to an exploitable net yield of 3.3×10^6 Mg. This is over 1.5 times the current grass production. Financially, the additional production implies a gain of 500 million euros when taking into account the market price for grass DM. When considering the feed value profits may rise to 750 million euros.

Keywords: dairy, grassland, grazing, yield gap analysis

Introduction

In the past decades, the Dutch dairy sector has made great improvements in production efficiency. The underlying research and innovation agenda shows a focus on the cow as the central production factor. While the cow is undeniably essential, grass and soil are also essential production factors. Forage is the main feed for dairy cattle and grasslands are predominantly grazed (Van den Pol-van Dasselaar *et al.*, 2012), making grass the major – and if grazed, the cheapest (O'Donovan *et al.*, 2011) – source of raw material for milk production. Despite this, research and innovation agendas gave grass production fewer and fewer attention. In addition, a decline of grazing, a lack of knowledge and craftsmanship especially among young dairy farmers (Reijs *et al.*, 2013), and a stagnant yield of dry matter (DM) (Aarts *et al.*, 2008; Remmelink and Hilhorst, 2013) is seen.

Recent developments mark a turning point; the signing of the Covenant Outdoor Grazing (Duurzame Zuivelketen, 2012) and the introduction of a legislative system after the milk quota abolishment (Eerste Kamer der Staten-Generaal, 2014). While increased focus on grass production and grazing is generally considered as sustainable development, drivers mostly represent the people or planet dimensions of the triple bottom line, but ignore the profit dimension. In other words, the choice for grass production and grazing is made because of social, environmental or ethical reasons, but not for economic reasons. There is a need to build an economic case around grass production and grazing in order to fully attain its sustainability promise. This paper models the exploitable yield gap of grass production based on published data and on expert opinions, and translates this into an economic case.

Actual yield

Aarts *et al.* (2008) calculated an average DM yield of 10.2 Mg ha^{-1}. This figure is represented as a net yield taking into account the uptake of grass by grazing and the exportation of silage. It does not, however, include losses during conservation and feeding of silage. Since on average 72% of grass is used as silage

(Aarts *et al.*, 2008) and over this part losses are 20% (Remmelink *et al.*, 2013) the yield calculated by Aarts *et al.* multiplied by 0.856 leads to a net yield including grazing, conservation and feeding losses of 8.73 Mg DM ha^{-1}. Dutch dairy farms together own 688,331 hectares of grassland [Statline CBS]. Multiplying this with the yield per hectare results in an annual total gross DM production of 7.0×10^6 Mg or a total net DM production of 6.0×10^6 Mg.

Yield potential of grass production and exploitable yield

Crop simulation modelling research performed during the 1960s reports a gross yield potential of 20 Mg ha^{-1} yr^{-1} under optimal conditions (Alberda and Sibma, 1968). More recently, gross yields of up to 18 Mg ha^{-1} were reported in research the authors are involved in. Van Ittersum *et al.* (2013) argue that crop simulation modelling is the most reliable way to estimate yield potential in the context of a specific crop within a defined cropping system. However, since the Netherlands has a wide variety of growing conditions, and since the recent data reflect data covering a variety of conditions, the method of maximum farmers' yield (Van Ittersum *et al.*, 2013) is chosen. The maximum gross yields reported are 18 Mg DM ha^{-1} yr^{-1}, which is a net yield potential of 15.4 Mg DM ha^{-1} yr^{-1}.

This potential indicates a maximum, which will not be achievable on the whole area of grassland due to local growth defining, limiting and reducing factors. Based on expert opinion, the total area of grassland in the Netherlands is divided into five types:

- G1: grassland for cultivation of cow feed and thus with optimal conditions, estimated at 50% of total land area (TLA) and a potential of 100% of exploitable yield (EY);
- G2: grassland under fertilization restrictions, 12.5% TLA and 90% EY;
- G3: grassland under drought limitations, 12.5% TLA and 80% of EY;
- G4: grassland with poor drainage conditions, 12.5% TLA and 70% EY;
- G5: grassland that serve other purposes next to agricultural production, 12.5% TLA and 60% EY.

Exploitable yield gap

Table 1 shows the net exploitable yield of grass production in the Netherlands at 9.3×10^6 Mg. Given the current yield of 6.0×10^6 Mg, the net exploitable yield gap is 3.3×10^6 Mg.

Feed values

The extra DM production represents additional feed value. Grazed grass represents 0.938 kVEM (net energy lactation (NEL) according to Dutch standards) and 0.083 kDVE (true protein digested in the small intestine according to Dutch standards), whereas silage represents 0.891 kVEM and 0.062 kDVE (Vermeij, 2013). Since about 72% of grass production is used as silage (Aarts *et al.*, 2008), one kilogram DM (gross) represents 0.904 kVEM and 0.068 kDVE. Thus, the total gross exploitable yield gap of 3.8×10^6 Mg DM represents 3.5×10^6 kVEM and 2.6×10^5 kDVE.

Table 1. Total exploitable yield of grass production in the Netherlands.

Type	Land area proportion[1]	Gross exploitable yield		Net exploitable yield	
		(Mg ha^{-1})	(10^6 Mg)	(Mg ha^{-1})	(10^6 Mg)
G1	0.5	18.0	6.2	15.4	5.3
G2	0.125	16.2	1.4	13.9	1.2
G3	0.125	14.4	1.2	12.3	1.1
G4	0.125	12.6	1.1	10.8	0.9
G5	0.125	10.8	0.9	9.2	0.8
Totals			10.8		9.3

[1] Estimated proportion of the total 688,331 hectares of grassland.

Financial impact of exploitable yield gap

Current market value of grass (gross) is € 0.13 kg^{-1} DM (Vermeij, 2013). The financial gain for the dairy sector based on this alone would be almost 500 M €. If, however, we focus on the feed value of the extra production, the profits would be higher. One kVEM is worth € 0.13 and one kDVE € 1.03 (Vermeij, 2013). If farms produce this themselves, they would not need to buy it externally, leading to a potential cost savings of a little over 750 M €.

Conclusions

Based on modelling of current and potential grass production, this paper concludes that dairy farmers in the Netherlands can potentially produce over 1.5 times of current grass production. Financially this would imply a gain of 500 to 750 million euros. While this is an enticing prospect, it entails quite a challenge. It implies the need bring and keep grass and soil at the attention of farmers and on research and innovation agendas. This would need coherent and collectively directed interventions in terms of awareness building and education, management modifications, precision fertilization, genetic improvements and innovation.

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