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Dutch dairy farms after milk quota abolition: Economic and environmental consequences of a new manure policy

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ABSTRACT

The abolition of the Dutch milk quota system has been accompanied by the introduction of a new manure policy to limit phosphate production (i.e., excretion via manure) on expanding dairy farms. The objective of this study was to evaluate the effect of these recent policy changes on the farm structure, management, labor income, nitrogen and phosphate surpluses, and greenhouse gas emissions of an average Dutch dairy farm. The new manure policy requires that any increase in phosphate production be partly processed and partly applied to additional farmland. In addition, phosphate quotas have been introduced. Herein, we used a whole-farm optimization model to simulate an average farm before and after quota abolition and introduction of the new manure policy. The objective function of the model maximized labor income. We combined the model with a farm nutrient balance and life-cycle assessment to determine environmental impact. Based on current prices, increasing the number of cows after quota abolition was profitable until manure processing or additional land was required to comply with the new manure policy. Manure processing involved treatment so that phosphate was removed from the national manure market. Farm intensity in terms of milk per hectare increased by about 4%, from 13,578 kg before quota abolition to 14,130 kg after quota abolition. Labor income increased by €505/yr. When costs of manure processing decreased from €13 to €8/t of manure or land costs decreased from €1,187 to €573/ha, farm intensity could increase up to 20% until the phosphate quota became limiting. Farms that had already increased their barn capacity to prepare for expansion after milk quota abolition could benefit from purchasing extra phosphate quota to use their full barn capacity. If milk prices increased from €355 to €420/t, farms could grow unlimited, provided that the availability of external inputs such as labor, land, barn capacity, feed, and phosphate quota at current prices were also unlimited. The milk quota abolition, accompanied by a new manure policy, will slightly increase nutrient losses per hectare, due to an increase in farm intensity. Greenhouse gas emissions per unit of milk will hardly change, so at a given milk production per cow, total greenhouse gas emissions will increase linearly with an increase in the number of cows.

Key words: Dairy Act, farm expansion, phosphate quota, manure processing

INTRODUCTION

In 1984, milk quotas were introduced in Europe to address oversupply in the market. The quota policy restricted the amount of milk to be produced by each member state and, consequently, by individual farmers. In April 2015, the European Union (**EU**) milk quota system was abolished in response to the increasing global demand for milk and to agreements on trade liberalization in global dairy markets (EU, 2015). The abolition of the quota system allows farmers to increase their milk production and is expected, therefore, to increase milk production in most EU countries (Lips and Rieder, 2005).

Livestock density in the Netherlands is the highest in Europe. This is due to the central location of the Netherlands in western Europe, where the demand for livestock products is high, combined with easy import of feed due to close proximity to the harbor of Rotterdam. This high livestock density, however, also results in high production (i.e., excretion via manure) of nitrogen and phosphate per hectare, which causes environmental problems such as eutrophication of ground and surface water (Oenema et al., 2005). Moreover, the livestock sector, including dairy production, is one of the main contributors to greenhouse gas (**GHG**) emissions (Gerber et al., 2013). The expected increase in milk production per farm due to quota abolition might increase the environmental impact of dairy production.

To limit nitrate leaching from agricultural production to ground and surface water, the European Nitrates Directive was introduced (EU, 1991), imposing a maximum application of 170 kg of N from animal manure

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per hectare. Within this directive, 7 member states, including the Netherlands, obtained a derogation to go beyond the 170-kg limit, under certain country-specific conditions. One such condition for the Netherlands is a phosphate production ceiling of 172.9 million kg/yr for the entire Dutch livestock sector, including a phosphate production ceiling of 84.9 million kg/yr for the dairy sector. To accommodate this phosphate ceiling, the Dutch government introduced a new manure policy. This "Dairy Act" of 2015 is aimed at supporting the growth of the Dutch dairy sector while limiting increases in phosphate production.

Abolition of the milk quota and introduction of the Dairy Act might change the Dutch dairy sector. Changes in farm structure and management can affect a farmer's income and the environmental impact of dairy production. Several studies have analyzed the effect of quota abolition on the economic and environmental performance of the dairy sector, most using macroeconomic models and analyzed effects at region or country level (Lips and Rieder, 2005; Kempen et al., 2011). Kempen et al. (2011), for example, predicted a loss in overall agricultural income, and an increase in environmental effects (e.g., nitrate leaching and methane emission) related to an expanding dairy herd in large parts of Europe, especially the Netherlands. To our knowledge, however, the effect of the quota abolition in combination with the introduction of the Dairy Act is unknown. Moreover, we found no studies that took a farm-level perspective and considered changes in farm management in response to changes in policy.

The objective of this study, therefore, was to evaluate the effect of quota abolition and introduction of the Dairy Act on the structure, management, and labor income of a Dutch dairy farm. In addition to these effects, we also considered changes in environmental impact (i.e., nitrogen and phosphorus losses, and GHG emissions). To determine the economic and environmental impact, we combined a whole-farm linear programming model with a farm nutrient balance and life-cycle assessment. We have illustrated strategies for an average Dutch dairy farm on sandy soil. To understand the current political context, we first describe milestones in Dutch environmental policy.

MATERIALS AND METHODS

Milestones in Dutch Environmental Policies Before Quota Abolition

Since about 1980, policies have been aimed at regulating the environmental impact of Dutch agricultural production, including dairy production (Oenema and Berentsen, 2005). A first milestone in environmental policy was the introduction of phosphate application standards in 1987. These standards were based on fixed phosphate excretions per type of animal and set limits on the application of phosphate from animal manure per hectare of grassland or crop land (Berentsen and Tiessink, 2003). Farmers exceeding these standards had to pay a levy. Introduction of phosphate application standards, however, barely reduced nutrient losses from agriculture, because application standards and levies were so generous that dairy farms were essentially unaffected (Berentsen et al., 1992).

A second milestone occurred with the introduction of the European Nitrates Directive (EU, 1991), aimed at reducing the negative effects of nitrogen surpluses on water quality. This directive shifted the focus from phosphate to nitrogen. To ensure compliance with the nitrates directive, the Netherlands introduced the mineral accounting system (**MINAS**) in 1998; MINAS was based on a farm-gate balance approach, using farm-level inputs and outputs to determine a farm-specific surplus of nitrogen and phosphate (Oenema and Berentsen, 2005). Nutrient surpluses at the farm level that exceeded levy-free surpluses were charged. The MINAS system was considered a step forward in environmental policy, because nutrient surpluses are better indicators of nutrient leaching than manure application standards, and because MINAS gave farmers the autonomy to determine how to reduce their surplus.

A judgment of the European court (EU, 2003) about MINAS's lack of compliance with the nitrates directive, in combination with other practical reasons such as increasing administrative burdens and possibilities of fraud, led to the abolition of MINAS in 2006 and the introduction of 3 fertilizer application standards—the third milestone. The first standard comprises a maximum application of 170 kg of N from animal manure per hectare of land. Several member states, including the Netherlands, obtained a derogation to go beyond the 170-kg limit, under certain country-specific conditions. Derogation is specific for these member states because they have a high proportion of grassland and a relatively long growing season, justifying a higher nutrient uptake (EU, 2010). Current derogation regulation in the Netherlands prescribes that farms with at least 80% grassland are allowed to apply, depending on soil type and region, 250 kg of N from animal manure per hectare on all of their land. Farmers who receive this derogation are not allowed to use synthetic phosphate fertilizer. To receive derogation for 2014–2017, the Netherlands must comply with a phosphate production ceiling of 172.9 million kg/yr and a nitrogen production ceiling of 504.4 million kg/yr for the entire Dutch livestock sector. The second standard comprises a maximum application of nitrogen fertilizer per hectare