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Factors associated with profitability in pasture-based systems of milk production

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ABSTRACT

The global dairy industry needs to reappraise the systems of milk production that are operated at farm level with specific focus on enhancing technical efficiency and competitiveness of the sector. The objective of this study was to quantify the factors associated with costs of production, profitability, and pasture use, and the effects of pasture use on financial performance of dairy farms using an internationally recognized representative database over an 8-yr period (2008 to 2015) on pasture-based systems. To examine the associated effects of several farm system and management variables on specific performance measures, a series of multiple regression models were developed. Factors evaluated included pasture use [kg of dry matter/ha and stocking rate (livestock units/ha)], grazing season length, breeding season length, milk recording, herd size, dairy farm size (ha), farmer age, discussion group membership, proportion of purchased feed, protein %, fat %, kg of milk fat and protein per cow, kg of milk fat and protein per hectare, and capital investment in machinery, livestock, and buildings. Multiple regression analysis demonstrated costs of production per hectare differed by year, geographical location, soil type, level of pasture use, proportion of purchased feed, protein %, kg of fat and protein per cow, dairy farm size, breeding season length, and capital investment in machinery, livestock, and buildings per cow. The results of the analysis revealed that farm net profit per hectare was associated with pasture use per hectare, year, location, soil type, grazing season length, proportion of purchased feed, protein %, kg of fat and protein per cow, dairy farm size, and capital investment in machinery and buildings per cow. Pasture use per hectare was associated with year, location, soil type, stocking rate, dairy farm size, fat %, protein %, kg of fat and protein per cow, farmer age, capital investment in machinery and buildings per cow, breeding season length, and discussion group membership. On average, over the 8-yr period, each additional tonne of pasture dry matter used increased gross profit by €278 and net profit by €173 on dairy farms. Conversely, a 10% increase in the proportion of purchased feed in the diet resulted in a reduction in net profit per hectare by €97 and net profit by €207 per tonne of fat and protein. Results from this study, albeit in a quota limited environment, have demonstrated that the profitability of pasture-based dairy systems is significantly associated with the proportion of pasture used at the farm level, being cognizant of the levels of purchased feed.

Key words: dairy system, pasture-based milk production, cost control, profit

INTRODUCTION

The dynamics of global agriculture are constantly changing due to the endless fluctuation of international food markets, coupled with the increased globalization of agriculture, policy changes globally, greater societal expectations, and environmental constraints. All these factors combined force the requirement for resilient sustainable agricultural systems, with the highest food safety standards, capable of withstanding external or internal business shocks, or both. Additionally, it has been estimated that the world will have to increase food production by up to 70% by 2050 to feed its increasing population (FAO, 2009). This will require producers to maximize production efficiencies while minimizing negative environmental effects. Many studies have reported that pasture-based systems of milk production have a distinct advantage over high input systems, with grazing systems associated with greater global sustainability, increased product quality, improved animal welfare, and increased labor efficiency (Dillon et al., 2005; Macdonald et al., 2008; Peyraud et al., 2010; O'Brien et

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al., 2012). However, there are further requirements to increase efficiency and sustainability in pasture-based systems. Increasing efficiency and profitability of a farm business requires particular focus on increasing output through increased pasture growth and use (Shalloo et al., 2011), with previous research reporting major potential for improvement in efficiency within pasture-based systems in Ireland (Creighton et al., 2011; Kelly et al., 2013). This is particularly important where there are constraints of land availability contiguous to the milking parlor (a requirement in pasture-based dairy farming).

The influence of several grassland based traits on costs of production and farm profitability have also been previously investigated internationally, with the relative cost of pasture as a feed source for livestock production compared with grass silage and concentrate, reported as 1: 1.8: 2.4, respectively, as calculated in 2010 (Finneran et al., 2010). Several factors associated with a range of efficiency-based metrics have been identified, including overall pasture use, grazing season length, and overall pasture management, in several previous studies (Shalloo et al., 2004; Macdonald et al., 2010; Läpple et al., 2012; Ramsbottom et al., 2015). However, our study was over a continuous prolonged period of 8 yr (2008 to 2015) using a national representative database, providing more robust outcomes to determine the most profitable strategies for pasture-based systems.

This study quantified the association between pasture use and system parameters, and established the associations with key system parameters on costs of production and profitability across a longitudinal data set (8 yr) of pasture-based dairy farms, albeit in a quota limited environment. All of the outputs were used to develop a set of key performance indicators that, when implemented within the Irish dairy industry, have the potential to increase the profitability of pasture-based dairy systems.

MATERIALS AND METHODS

National Farm Survey Data

The data used in this analysis originated from the Irish National Farm Survey (**NFS**; Hennessy and Moran, 2014), a survey that has been conducted by Teagasc on an annual basis since 1972 and is representative of pasture-based dairy farming in a mild, temperate climate that is heavily influenced by the North Atlantic Drift. The survey is conducted as part of the Farm Accountancy Data Network of the European Union and fulfills Ireland's statutory obligation to provide data on farm output, costs, and income to the European Commission. A nationally representative sample of approximately 1,100 farms from all farming sectors are surveyed as part of the program annually. The NFS classifies each farm into a farming system based on its main farm enterprise, which is calculated on a standard farm gross output basis. The 6 farm system classifications within the NFS include specialized dairying, dairying other, cattle rearing, cattle other, mainly sheep, and tillage. For the purpose of this study, only specialized dairy farms were used for data analysis. A specialized dairy farm is a farm with >60% of the farm gross output originating from dairying. The analysis was conducted on NFS data from an 8-yr period (2008 to 2015), containing on average 257 specialized dairy farms each year and 2,055 surveys in total. The analysis was conducted over this time period in an effort to test the robustness of the analysis across different years (weather conditions) and milk price ranges. The NFS has 8 defined geographical regions (locations), which are Border, Dublin, East, Midlands, Southeast, Southwest, South, and West. Farms within the survey are also categorized into high-, medium-, or low-quality soil types. The outputs from the survey provide a range of physical and financial performance indicators for each farm such as farm details, stock details, product yields, sales, purchases, costs, and profits including full reconciled farm management accounts.

The analysis was completed by first undertaking a series of calculations using Microsoft Excel (Microsoft Corp., Redmond, WA), before being compiled together for full statistical analysis with the SAS 9.3 (SAS Institute Inc., Cary, NC) statistical analysis program. The analysis was completed using specifically the dairy enterprise and its associated stock numbers, land area (dairy forage ha), financial details, and so on, to ensure consistency between farms. Milk yield was measured in kilograms of milk fat and protein per cow and per hectare, with the results expressed per tonne of milk fat and protein. Dairy forage ha was defined as the land area that is specifically apportioned to grazing and silage making for the dairy enterprise. Tables 1, 2, and 3 contain a description of the data set of the dairy enterprise and whole farm, respectively. Whole farm parameters (Table 2) were examined for comparative purposes across years. The whole farm performance measures were calculated using total farm livestock units and whole farm area, with family farm income being total farm income including subsidies and direct payments.

Pasture Use. The pasture use per hectare on each farm was estimated using a back calculation based on livestock energy requirements. The principle of the calculation is livestock energy demand less feed energy