**The effect of production system and price changes on profitability of dairy farms**

**Application:** The AFBI Dairy Systems Model can be used for the technical and economic analysis of different dairy systems.

**Introduction:** Dairy farming is the largest agriculture sector in Northern Ireland in terms of output and contribution to overall GDP. The majority of milk produced in Northern Ireland is sold as internationally traded dairy products and milk price is, therefore, strongly connected to global dairy commodity prices. This export dependency can leave Northern Ireland dairy farms exposed to the high levels of volatility experienced by global dairy commodity prices. Furthermore, the recent price volatility in major dairy farm inputs such as fertiliser and concentrate has created profound challenges for farmers in their farm planning decisions. However, farm simulation models can be useful to investigate the effects of variations in production, price and policy parameters on farm performance and profitability. This study aimed to determine the effect of production system and price changes on the profitability of dairy farms.

**Materials and Methods:** The model is a whole farm, single year, static, deterministic simulation model that facilitates the technical and economic evaluation of dairy production systems. It operates with a monthly time step and was developed in Microsoft Excel. The model is empirical and uses data from production research experiments to specify coefficients and production functions (e.g. grazed grass dry matter digestibility and energy content, milk yield and the monthly proportions of grazed grass and grass silage in the diet). Where alternative production functions are available, the model structure allows these to be used. The user must define the farm land area owned and the production system choices. Dietary components consist of grazed grass, grass silage and concentrate (which is purchased when required). The model consists of four sub models namely; the farm system, animal nutrition, feed supply and financial. Three different dairy systems were examined in this study - Low, Medium and High. In the Low system, cows calved in the Spring and produced 6,000L per lactation. In the Medium system cows calved in the Autumn and Spring and produced 8,000L per cow. In the High system cows calved all year round and produced 10,000L per cow. Farm size was assumed to be 70ha and stocking rate was set at 170kg organic N/ha. The effects of changing milk, concentrate, contractor, fertiliser and electricity prices and interest rates on the profitability of the three systems was analysed.

**Results:** As shown in Table 1 the Medium system was found to have the highest net profit per farm and cow, the Low system had the smallest net profit per farm and cow. However, net profit per litre was highest for the Low system.

**Table 1.** Profitability of dairy systems using the AFBI Dairy Systems Model

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Low** | **Medium** | **High** |
| **Sales (£/farm)1** | 243,602 | 301,793 | 358,616 |
| Variable costs (£/farm)2 | 105,708 | 151,325 | 215,526 |
| **Gross margin (£/farm)** | 137,895 | 150,468 | 143,090 |
| Fixed costs (£/farm) | 102,881 | 110,956 | 117,397 |
| **Net profit (£/farm)** | 35,013 | 39,512 | 25,693 |
| **Net profit (£/cow)** | 347 | 403 | 270 |
| **Net profit (ppl)** | 6 | 5 | 3 |

1 Milk price 35ppl, 2 Concentrate price £350/t, Fertiliser price £390/t,

As shown in Table 2, all price changes had the biggest effect on the High system and the smallest effect on the Low system, reflecting the level of inputs and milk sales from these systems. Overall in this analysis milk price changes had the largest effect on profitability. A 10% change in milk price caused net profit to change by 62%, 69% and 129% for the Low, Medium and High systems, respectively. Changes in concentrate price had the second largest effect on profitability. A 10% change in concentrate prices caused net profit to change by 15%, 20% and 43% for the Low, Medium and High systems, respectively. Changing contractor prices by 10% caused net profit to change by 9%, 11% and 26% for the Low, Medium and High systems, respectively. Changes in fertiliser prices had a relatively low effect on profitability. A 10% change in fertiliser price caused net profit to change by 5%, 5% and 8% for the Low, Medium and High systems, respectively. Changing interest rates by 10% caused net profit to change by 7%, 8% and 13% for the Low, Medium and High systems, respectively. Changes in electricity price had the smallest effect on profitability. A 10% change in electricity price caused net profit to change by 2.9%, 2.7% and 4.5% for the Low, Medium and High systems, respectively.

**Table 2.** Effects of changing milk, concentrate, contractor, fertiliser and electricity price and interest rates on the net profit of dairy systems using the AFBI Dairy Systems Model

|  |  |  |  |
| --- | --- | --- | --- |
| **Impact on farm net profit (£)** | **Low** | **Medium** | **High** |
| Milk price (+/-10%) | 21,651 | 27,338 | 33,377 |
| Concentrate price (+/-10%) | 5,283 | 7,848 | 11,116 |
| Contractor price (+/-10%) | 3,096 | 4,365 | 6,729 |
| Fertiliser price (+/-10%) | 1,736 | 2,039 | 2,174 |
| Interest rate (+/-10%) | 2,625 | 3,087 | 3,433 |
| Electricity price (+/-10%) | 1,000 | 1,077 | 1,145 |

**Conclusions:** The AFBI Dairy Systems Model has been developed which can be used to analyse how changes in physical and economic factors affect farm performance. Going forward, this will provide an important research tool informing and supporting decision-making at the farm level in Northern Ireland. The application of the model in this study found that the Medium system (autumn/spring calving, 8,000l/cow) was the most profitable. Profitability of the High system was the most sensitive to price changes and the Low system the least.

**Acknowledgements:** The authors acknowledge funding from the Department of Agriculture, Environment and Rural Affairs (DEARA).