The productivity of organic dairy herds

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ABSTRACT

Organically managed ruminant systems place particular emphasis on maximising production from forage. Therefore, it is important that efficiency measures take full account of forage inputs. The Livestock Production Efficiency Calculator (LPEC) calculates the total metabolisable energy (ME) required by livestock and estimates forage inputs as the difference between total requirement and that supplied by other measured feeds. Productivity is expressed in terms of output (£) minus other valued inputs (£) per unit of forage ME. Estimates of production parameters were used to produce productivity indices for thirteen organic dairy herds. The productivity of herds was compared, and sensitivity analyses were conducted to examine the potential impact of a number of economic and production scenario. The relationships between yield, fertility, culling and herd productivity were examined. The advantages of this productivity analysis of organic production systems is that full account is taken of the most important input i.e. grazed and conserved forage and that all of the determinants of productivity and their interactions are considered.

Keywords: organic milk production; productivity; forage; feeding

INTRODUCTION

Meaningful analysis of the productivity of organic livestock systems requires full consideration of the principles and standards in both methodological approach and the interpretation of results. This paper will use analyses of the efficiency of a system to examine specific issues associated with organic dairy management. The efficiency, or productivity, of a system can be considered to be a measure of the relationship between inputs to the system and outputs from the system (James and Carles, 1996). The advantage of using system efficiency measures allows changes in single inputs to be related to the efficiency of the whole system. However, since the most important input to organic herds (and for most non-organic herds) is grazed material, which is not easily measurable, using useful productivity indicators becomes a problem.

The Livestock Production Efficiency Calculator (LPEC) (James and Carles, 1996) calculates the total metabolisable energy (ME) required by livestock, based on measured production, and then estimates forage inputs as the difference between total requirement and that supplied by other measured feeds. Productivity is estimated as the economic margin per unit of forage input. The productivity indices are estimated at the herd level, and therefore include inputs to all categories of livestock, including calves and replacement stock.

LPEC-generated productivity indices are used to examine the relationship between these and key production parameters for thirteen organic dairy herds. The sensitivity of the efficiency of the herds to a number of organic production scenario is examined.

MATERIALS AND METHOD

Estimates of livestock production parameters obtained from a study of thirteen organic dairy herds (Hovi, 2001) were used to generate herd productivity indices from the LPEC herd model. Those production data required which were not available from the herd records were taken from Lampkin and Measures (2001) and applied as a standard across all herds.

Productivity indices are expressed in terms of the value of output (£) per unit of feed intake. Feed input is expressed in terms of a carrying capacity unit (CCU), which is defined as the feed supply providing 100MJ of metabolisable energy (ME) per day throughout the year. Regression analyses were conducted on the thirteen productivity indices in order to examine the effect of key parameters such as milk yield, calving interval and culling rate.

The LPEC model estimates the average daily ME requirement for all classes of livestock. Sensitivity analyses were completed on an average herd (using average estimates of production parameters for all herds) in order to examine the impact of fluctuating forage inputs and calving rate. These analyses were examined under conditions whereby purchased concentrates (assumed at 86%DM and 12.5MJ/kg DM) was valued at £0.02 per MJ ME. A milk price of £0.30 per litre has been used. Analyses were completed on output per cow, estimated from output per CCU and herd structure.

RESULTS

The average estimates of key production parameters and productivity indices for the thirteen herds are shown in Table 1. The productivity indices do not include any feed costs, and therefore reflect output per unit feed ME.

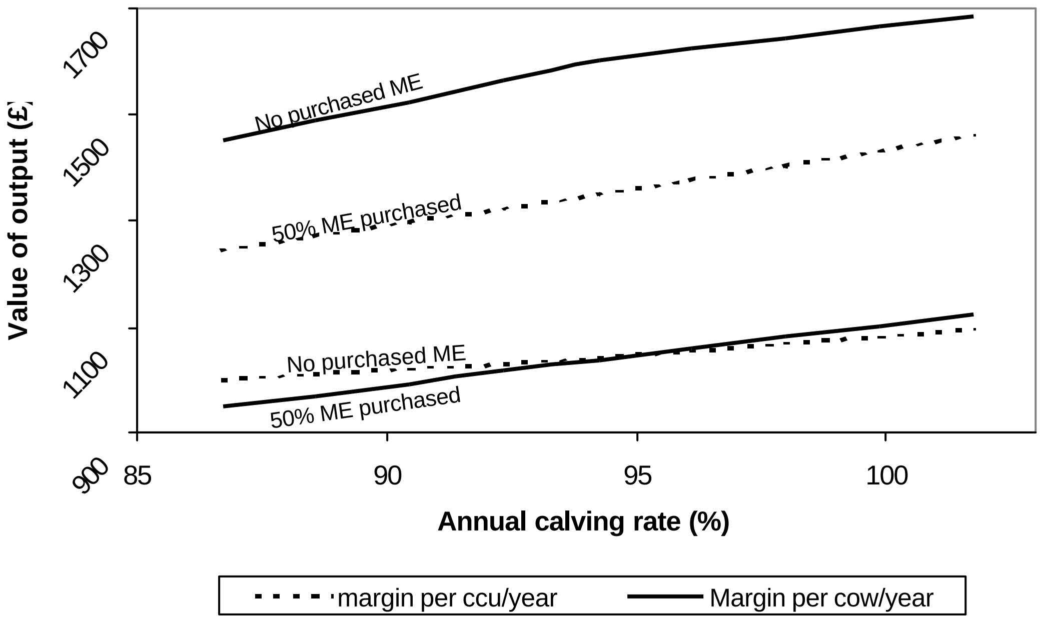
A least squares regression analysis of the production index against yield and calving rate showed that the production index was closely and independently associated with yield (R^2 = 0.43; p=0.014) and calving rate (R^2 = 0.43; p=0.014). Culling rate was not independently associated with the production index (R^2 = 0.08; p = 0.914) but once calving rate and lactation yield are taken into account, culling rate also becomes a significant factor. The three together explain even more of the variation in production index (R^2= 0.99; p<0.001).

Table 1. Estimates of lactation yield, calving rate, culling rate and productivity indices for thirteen organic dairy herds

	Lactation yield (kg)	Annual calving rate %	Annual culling rate (%)	Herd productivity index (£/CCU/year)	Output per cow (£/year)
Average	**5874**	**94**	**17**	**1031**	**1567**
Standard deviation	**548.3**	**9.9**	**6.4**	**72.0**	**221.1**
Minimum	**5127**	**79**	**7**	**898**	**1166**
Maximum	**7031**	**108**	**29**	**1127**	**1818**

Figure 1 shows the sensitivity of output per cow (output minus purchase feed costs) and output per 100 MJ ME forage feed to fluctuations in calving rate for two feeding scenario. The first scenario describes a purely hypothetical situation whereby all feed ME is supplied by forage. The second scenario describes a situation whereby 50% of ME supply is purchased.

Figure 1. The relationship between calving rate, productivity and purchased feed



DISCUSSION

Although herd productivity is closely associated with output per cow, an efficient lactating cow does not always mean that the herd is operating efficiently. For example, high culling rates would require large replacement rates, resulting in replacement animals consuming feed without any immediate production benefits. The analysis described above also demonstrates that a 10% improvement in calving rate can result in an improvement in output per cow of more than 8%.

Productivity indices were estimated for two scenario of forage feeding. Although a 100% forage diet is used in the analysis, this situation is obviously not feasible as this would exceed an animal's dry matter intake (DMI) limits at the observed production levels. Current organic standards stress a requirement for at least 60% of total dry matter to consist of forage or roughage. The analysis described in Figure 1 shows the impact of purchasing concentrates on economic efficiency. The analysis could have been extended further to model the current situation in the organic sector, where the premium price per litre of milk has dramatically reduced, whilst producers are still having to pay a large premium for organically produced concentrate feeds.

The concentrate price used in the analysis has been calculated from that provided by Lampkin and Measures (2001), adopting the quality measures described earlier. Under current organic standards, producers are permitted to feed small proportions of non-organically produced feeds, which would reduce the impact of price on economic efficiency. The model can be used to test the sensitivity of input price on efficiency.

Since the LPEC productivity index of £ per CCU refers to forage ME only, then it seems obvious that reducing amount of forage used will increase output per CCU. Output per cow has been used as a better illustration of the impact of adjusting forage inputs. The example demonstrates that as reliance on forage declines, so does the economic margin; and that models of this type can be used as a management tool to optimise herd efficiency. The example also shows how sensitivity analyses may be applied to demonstrate critical levels of production e.g. calving rate, at various inputs or other production scenario.

Organic principles and standards stress a requirement for livestock to be fed from home-produced sources. In situations where non-forage, home-produced feeds are used, the productivity indicators can reflect output per unit of all home-grown feeds, or the cost of production (or other appropriate values) of non-forage feeds could be incorporated to reflect output per unit of forage.

The advantage of using this approach in the analysis of livestock systems is that it takes full account of the entire feed input to the system, including forage. It is thus particularly relevant to organic herds, given the emphasis on production from forage. The LPEC approach is also comprehensive, in that it takes account of all determinants of productivity and their interactions and is also particularly relevant to closed herds breeding own replacements. The LPEC generated indices could also be utilised to examine the potential impact of changes to systems before an intervention is implemented, by including costs of intervention and assumed values of production post-intervention.

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