Effect of milking efficiency and herd size on energy efficiency

Fergal Buckley[1,2], Ryan Prendergast[1,2], Michael D. Murphy[2] and John Upton[1]

[1]Teagasc, Animal & Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork;
[2]Munster Technological University, Rossa Ave., Bishopstown, Cork

Summary

- Farms using rotary milking systems in this study achieved higher energy efficiency than the farms using herringbone milking systems.
- Annual energy costs of farms using herringbone and rotary milking systems in the largest 25% of herds were €497 and €1,412 lower respectively, than the smallest 25% of farms for equivelent milk production volumes.
- The annual energy costs of farms using herringbone and rotary milking farms in the highest 25% of herds, in terms of milking efficiency, were €464 and €4,793 lower respectively, than farms in the lowest 25% of herds based on their milking efficiency for equivelent milk production volumes.

Introduction

Increased dairy herd size since the removal of milk quotas in 2015 has led to increased energy demand and improved levels of milking efficiency (cows milked per hour) on Irish dairy farms. Energy efficiency was defined as the amount of Watt-hours consumed per kg of milk sold (Wh/kg_{Milk}). The objective of this study was to examine the effect of herd size and milking efficiency on energy efficiency and energy costs (€/year) on Irish dairy farms across herringbone and rotary milking parlours.

Materials & methods

Energy data were recorded using energy meters installed on 26 dairy farms (16 herringbone, 10 rotary). The energy meters were installed for two distinct seven-day periods of observation coinciding with peak and late lactation. The milking procedure was observed via video recordings and these data were subsequently analysed to extract the milking efficiency key performance indicators (e.g. the number of cows milked per hour, cows/h). In addition, surveys of the energy-consuming infrastructure on these farms were undertaken to identify the parlour technologies in place. Milk production and herd data were acquired for each farm from the ICBF database.

These data allowed the energy efficiency and milking efficiency of the farms to be determined. The energy efficiency of the first quartile of the farms (Q1), was then compared to the fourth quartile (Q4). Where $Q1_h$ = smallest 25% and $Q4_h$ = largest 25% by herd size. Similarly, the energy efficiency of Q1 and Q4 farms by milking efficiency was determined, where $Q1_m$ farms represented the lowest 25%, and $Q4_m$ farms represented the largest 25%, by milking efficiency. This comparison was used to investigate if farms with larger herds were more energy efficient than smaller herds and whether energy efficacy was affected by milking efficiency. Results of this analysis are presented in Table 1.

Table 1. *Average energy efficiency (Watt-hours consumed per kg of milk sold; Wh/kgMilk) and energy costs of Q1 and Q4 groups, in terms of herd size and milking efficiency (cows/h), for farms using herringbone (H) and rotary (R) milking systems*

Parlour Type		Ranked by herd size				Ranked by milking efficiency		
		Herd Size	Wh/kg Milk	€/1000kg Milk		Milking Efficiency (cows/h)	Wh/kg Milk	€/1,000kg Milk
H	$Q1_h$	113	32	4.33	$Q1_m$	56	33	4.31
	$Q4_h$	314	29	3.92	$Q4_m$	126	29	3.92
R	$Q1_h$	297	27	3.67	$Q1_m$	113	38	5.25
	$Q4_h$	551	20	3.01	$Q4_m$	192	20	3.01

Results - infrastructural survey

Herringbone

The average herd size for the herringbone group was 193 cows ($Q1_h$ = 113 cows, $Q4_h$ = 314 cows). The herringbone farms achieved an average milking efficiency rate of 82 cows/h ($Q1_m$ = 56 cows/h, $Q4_m$ = 126 cows/h). The average number of milking clusters was 18 units, (range 6 to 36 units).

Rotary

The average herd size for the rotary group was 404 cows, ($Q1_h$ = 297 cows, $Q4_h$ = 551 cows). The rotary farms achieved an average milking efficiency of 152 cows/h ($Q1_m$ = 113 cows/h, $Q4_m$ = 192 cows/h). The average number of milking clusters was 50, (range 44 to 64).

Results – energy efficiency

The farms using rotary milking systems achieved higher energy efficiency (30 Wh/kg_{Milk}) than farms using herringbone milking systems (33 Wh/kg_{Milk}). The average milk production of the herringbone milking systems was 1.2 million kgs of milk annually. Annual energy costs for herringbone milking systems were €497 less with the largest herds ($Q4_h$) than with the smallest herds ($Q1_h$) equivelent milk production volumes. Similarly, annual energy costs were €463 less for the farms using herringbone milking systems with the highest rates of milking efficiency ($Q4_m$) than the farms with the lowest milking efficiency ($Q1_m$) equivelent milk production volumes.

The average milk production of the farms using rotary milking systems in this study was 2.1 million kgs of milk annually. On farms with rotary milking systems annual energy costs were €1,412 less for the largest herds ($Q4_h$) than the smallest herds ($Q1_h$) equivelent milk production volumes. Similarly, annual energy costs on farms using rotary milking systems were €4,793 less with the highest rates of milking efficiency ($Q4_m$) compared with the lowest rates of milking efficiency ($Q1_m$) equivelent milk production volumes.

Conclusion

Farms using rotary milking systems achieved higher energy efficiency (30 Wh/kg_{Milk}) than farms using herringbone milking systems (33 Wh/kg_{Milk}). The annual energy costs of farms using herringbone and rotary milking systems in $Q4_h$ were €497 and €1,412 lower respectively, than farms in $Q1_h$ equivelent milk production volumes. Similarly, annual energy costs of farms using herringbone and rotary milking systems in $Q4_m$ were €464 and €4,793 lower, respectively, than farms in $Q1_m$. Therefore, farms with larger herd sizes and higher rates of milking efficiency achieved the best levels of energy efficiency.