

# Tradeoffs between herd turnover rate and milk production for marginal cash flow and enteric methane intensity

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## Introduction

Longevity, productive lifespan, and culling are discussion topics among veterinarians, farmers, milk buyers and third parties such as NGOs. Further, the number of heifers to be raised as replacements is also of industry interest. It is sometimes proposed that having less replacement heifers and thus a lower herd turnover rate can lead to higher cash flow and lower enteric methane intensity associated with dairy production.

Recently, some investigators have reported that cow culling decisions are made for farm investment decisions as opposed to poor health status (Owusu-Sekyere et al., 2023). Some European workers (Grandl et al., 2019) have investigated the association of length of productive life with greenhouse gas emissions and profit but included milk yields below what is observed on many U.S. dairy farms.

There are likely trade-offs between replacing less productive cows with younger cows that possess greater potential for herd cash flow and enteric methane production at commonly observed or advocated turnover rates and milk production levels. Therefore, the objective of this work was to produce a mathematical model using typical market prices, milk production levels, and turnover rates observed currently in the U.S. that examines these trade-offs.

## Materials and methods

A model was produced where 2 dairies were compared over 15 years. In Farm 1 the annual turnover rate was fixed at 33% and 88 lbs of energy corrected milk per cow day, while in Farm 2 the base model included a 20% turnover rate and 66 lbs of energy corrected milk per cow per day. A sensitivity analysis was performed to explore the impact of varying Farm 2 milk production ranging from 60 to 90 lbs per cow per day.

Assumptions in the model involved many things being equal between the 2 herds including: reproductive performance, fixed costs (e.g. barn, milking center), age at first calving (22 months at 85% maturity), cost of heifer raising, cull revenue per cow, sold calf revenue per calf, mature cow feed cost per pound of DM, and milk price paid per pound of ECM.

## Results

Over the 15 years of the model, Farm 1 had 4 springing heifers (and their costs) enter the herd per slot on the dairy while Farm 2 had 2 springing heifers enter the herd per slot. Farm 1 sold 11 cross bred calves while Farm 2 sold 13 cross bred calves.

In the baseline comparison, Herd 1 (33% turnover and 88 lbs/c/d) had an annual marginal cash flow of \$2500/cow, while Herd 2 (20% turnover and 66lbs/c/d) had \$1800/cow. Herd 1 had an enteric methane intensity of 0.017 lbs CH<sub>4</sub>/lb of milk produced while Herd 2 had an enteric methane intensity of 0.019 lbs of CH<sub>4</sub>/lb of milk produced.

In a sensitivity analysis, compared to Farm 1, breakeven CH<sub>4</sub> intensity at 20% replacement rate was 75 lbs/c/d in Farm 2. However, in Farm 1, each slot produces 2 “enteric methane free” market beef cows per 15 years per slot. Including the protein produced from beef raised in Farm 1 in addition to the milk, the breakeven CH<sub>4</sub> intensity milk production in Farm 2 was found to be 80lbs/c/d with 20% replacement rate.

The sensitivity analysis for marginal cash flow resulted in Farm 2 (20% turnover) equaling Farm 1 when producing 84lbs/c/day.

## Significance

There are too many specific farm and market nuances to manage to a herd-turnover rate or moreover have one imposed by groups outside of local advisors when aiming to optimize marginal cash flow per spot on a dairy and to minimize enteric methane production. While it is possible to have higher cash flow and lower enteric methane intensity with lower herd turnover rates, the highest cash flow and lowest enteric methane intensity was found at higher milk production in this model. If replacing lower producing animals with higher producing ones, the cost (both financially and methane) of raising marginally more heifers is offset by more milk production per slot on the dairy among lactating cows under current and expected market conditions for cost of feed, cost of replacements, milk revenue, and cull revenue.

