Exploring the effect of dairy cow replacement decisions on feed efficiency and sustainability

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Introduction

"Longer productive life (lifetime) is good:"

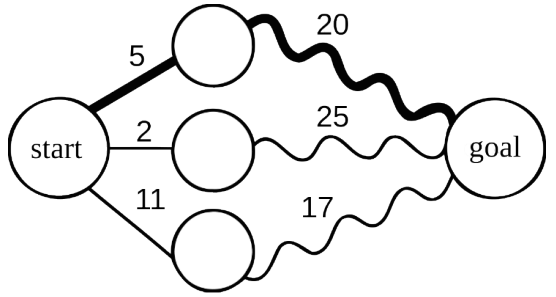
- Consumer acceptance
- Animal welfare
- Profitability
- Sustainability

"Longer productive lifespan is good for sustainability because:"

- Dry matter intake ➔ enteric CH_4
- Fewer heifers needed
- More mature cows
- More milk per kg dry matter intake

How does culling of non-competitive cows (voluntary culling) affect profitability and sustainability?

Materials and Methods



- Markov chain model with millions of cow states, combination of:

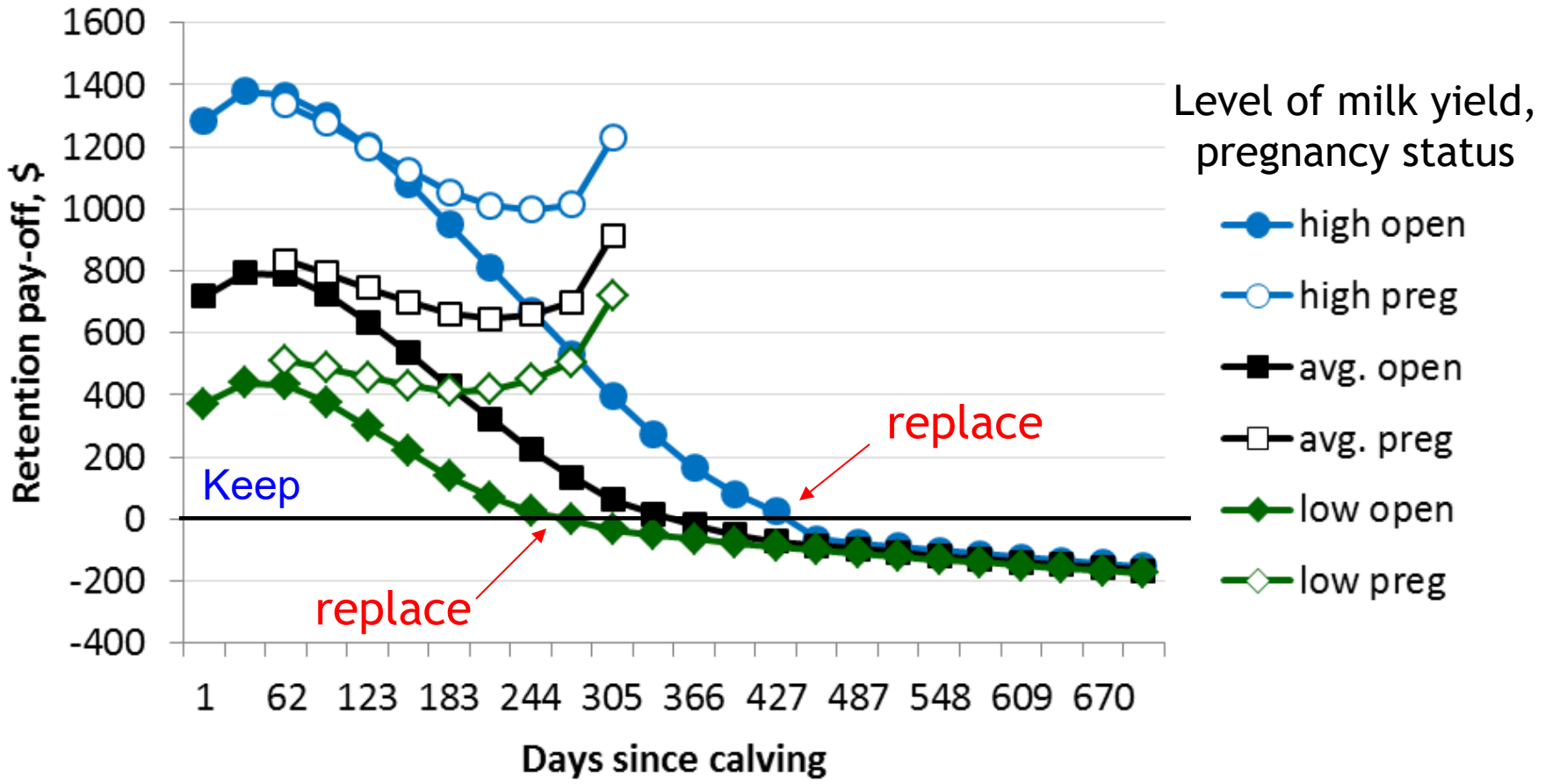
Lactation number (1-10)	Levels of bodyweight (≥ 1)
Weeks after calving (1-120)	Levels of genetic merit $ (≥ 1)
Weeks estrous cycle, pregnant (0-2, 1-40)	Levels of fertility (≥ 1)
Number of inseminations (≥ 1)	Levels of risk of forced culling (≥ 1)
Levels of economy corrected milk yield (≥ 1)	Number of service sires (≥ 1)
Levels of feed efficiency (≥ 1)	

- Each state has its own revenues, costs, transitions probabilities to other states
- Determine best *insemination* and *replacement* decisions for each cow state
  - Solve by Dynamic Programming. Calculation of Retention Pay-Off and optimal policy
  - ➔ Optimal productive life (1st calving to culling)
- Experiment: force model to have too much or not enough voluntary culling

Example

Value of keeping the cow in the herd

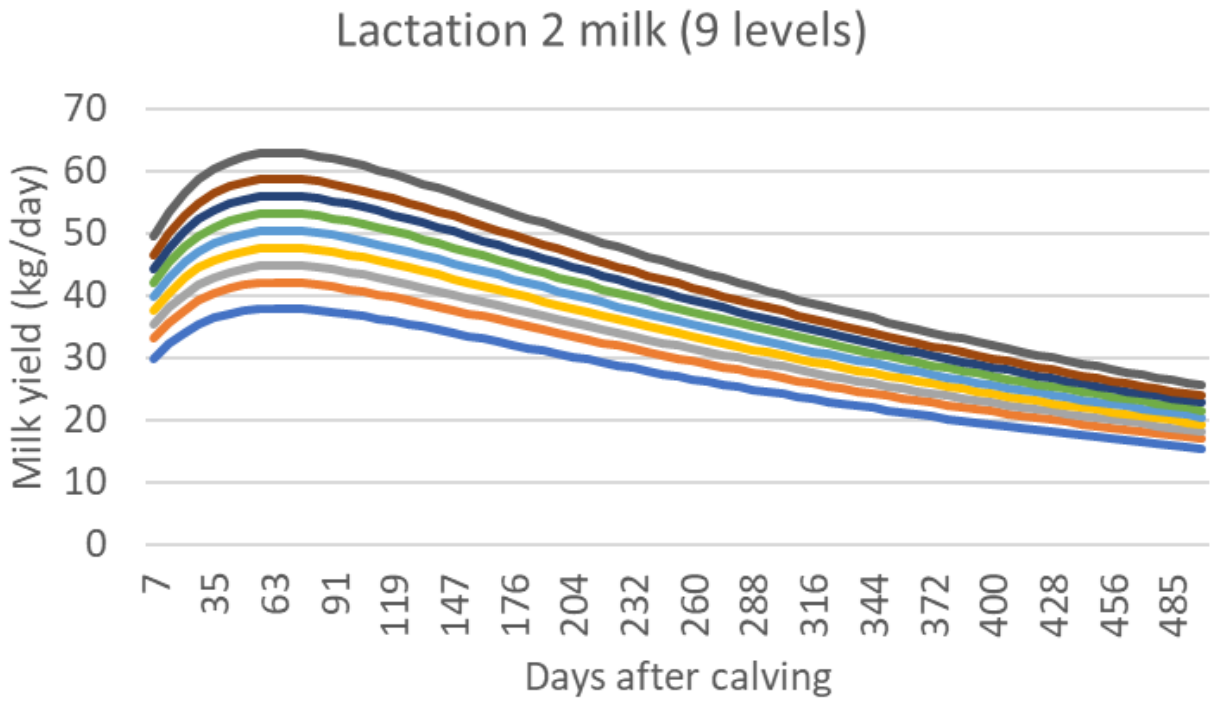
Compared to immediate replacement with a heifer

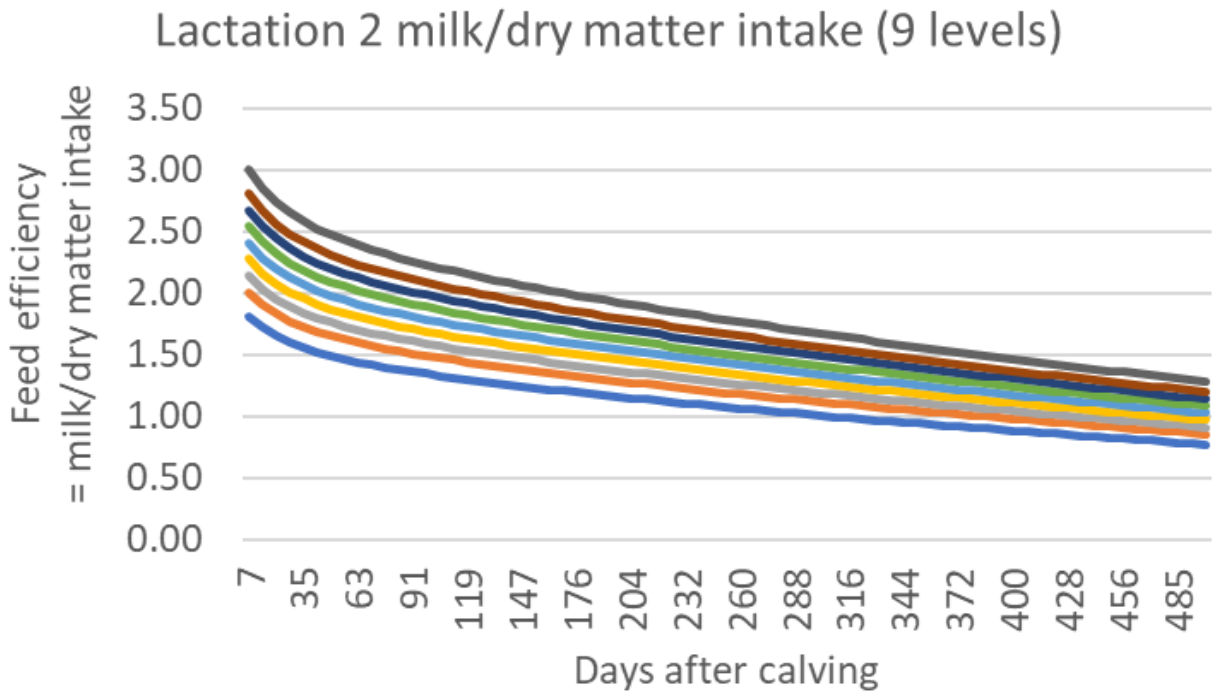


Higher milk yield and pregnancy protect against culling

9 levels of milk yield and feed efficiency

(lactation 2 shown)

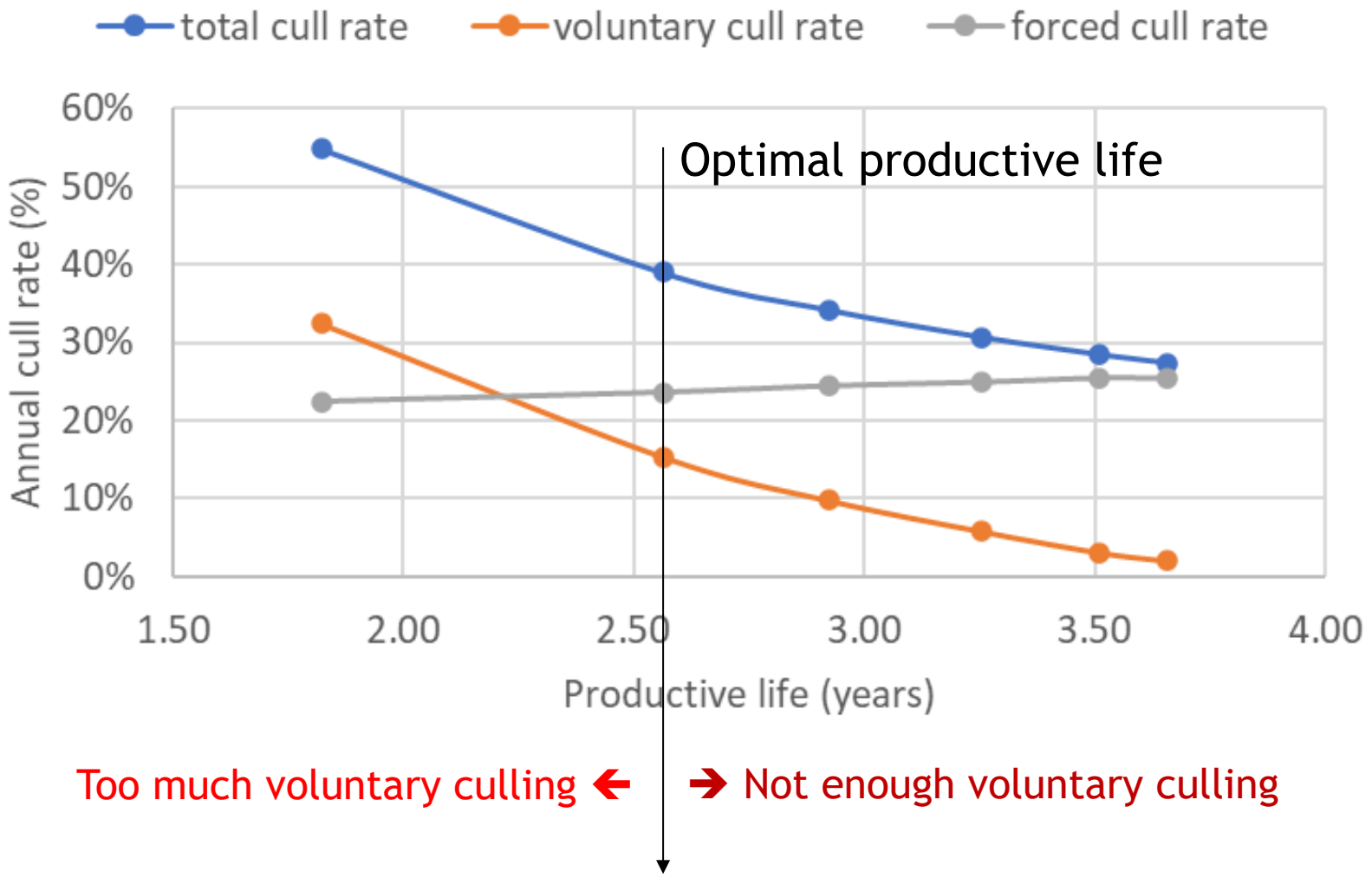




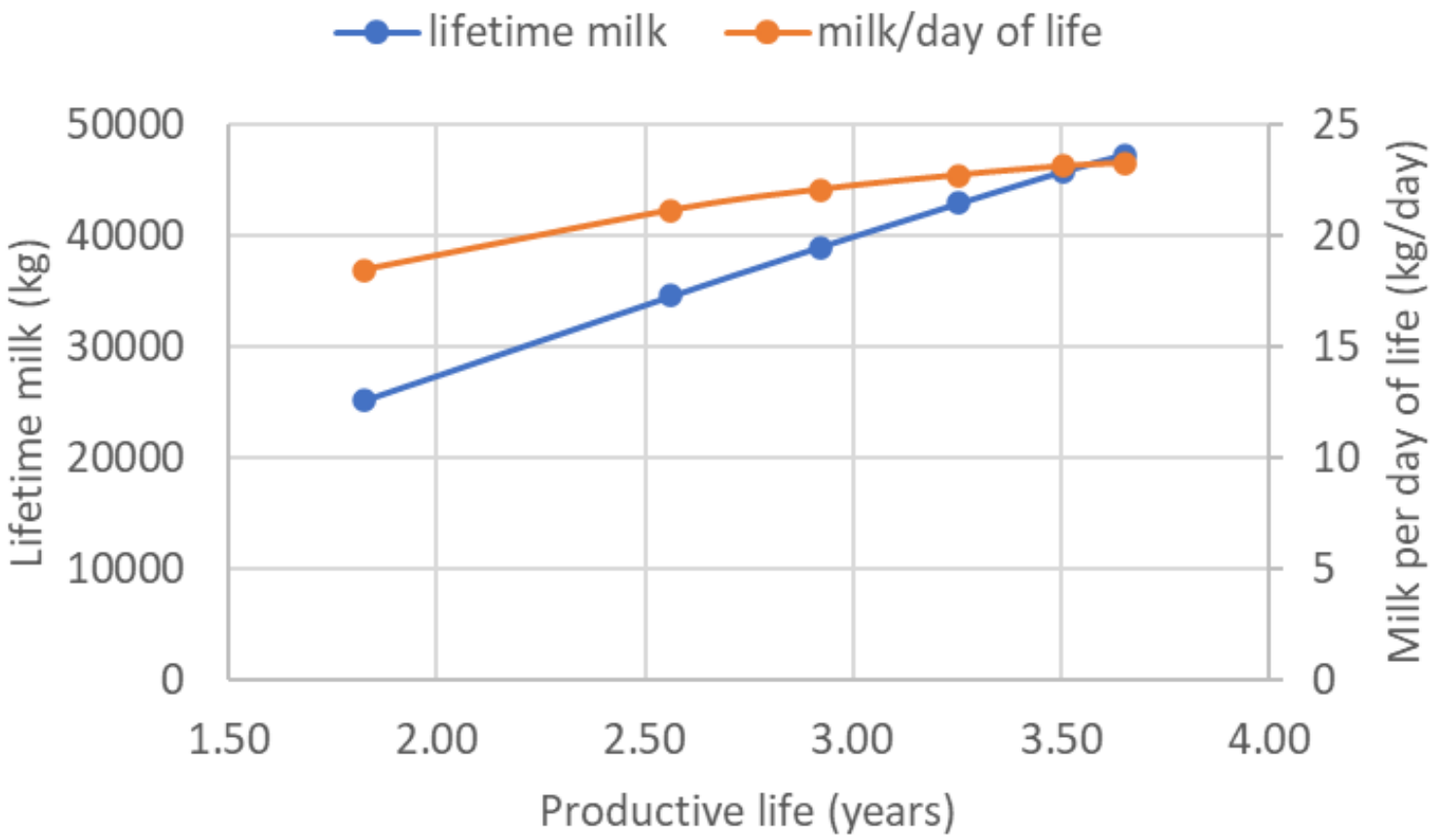
For example, model may cull cows with low levels of milk yield

Results. Longer productive life through less voluntary culling

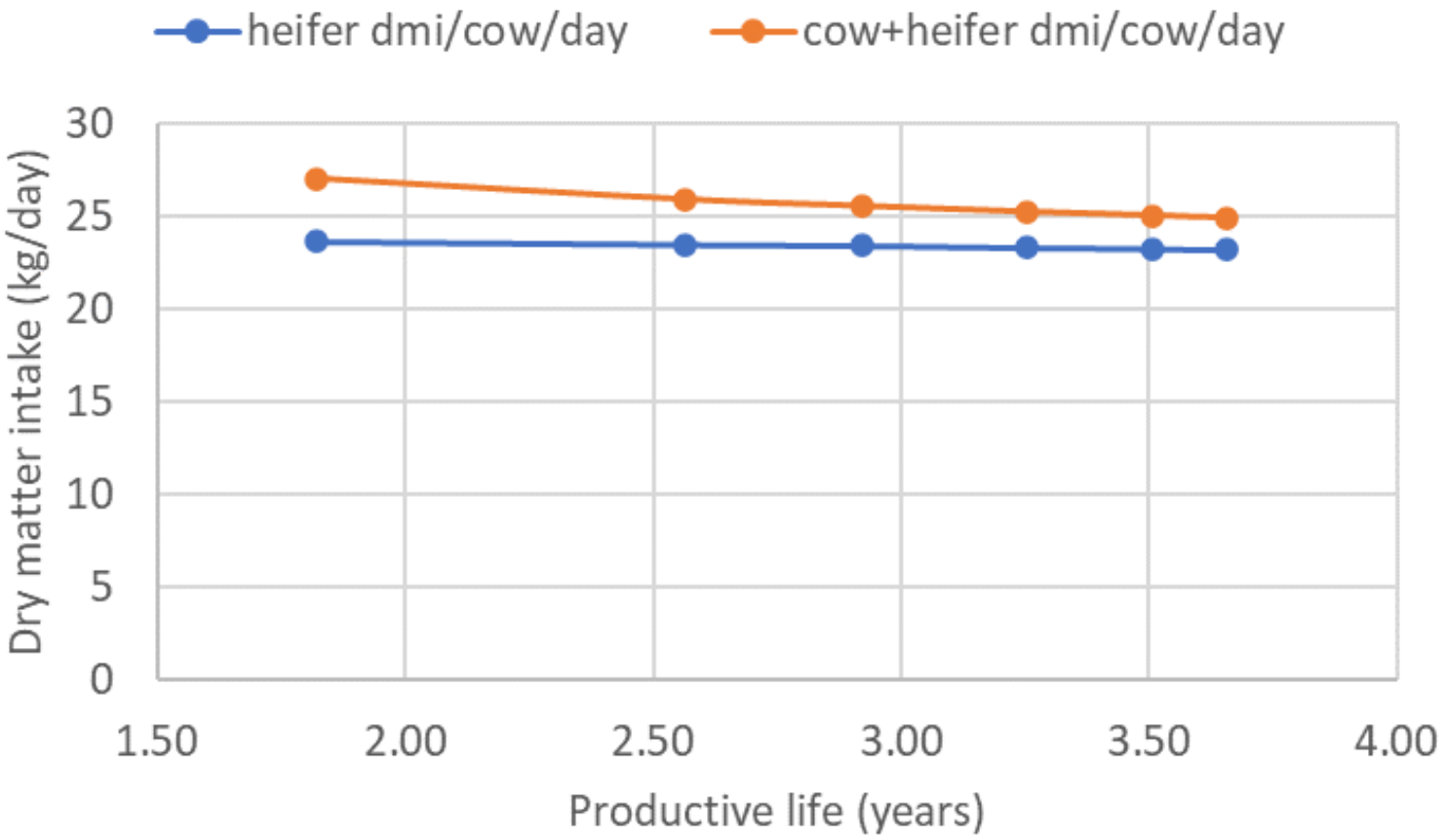
- Forced culling: unavoidable
- Voluntary + forced cull rate = total cull rate
- Productive life = 1/total cull rate



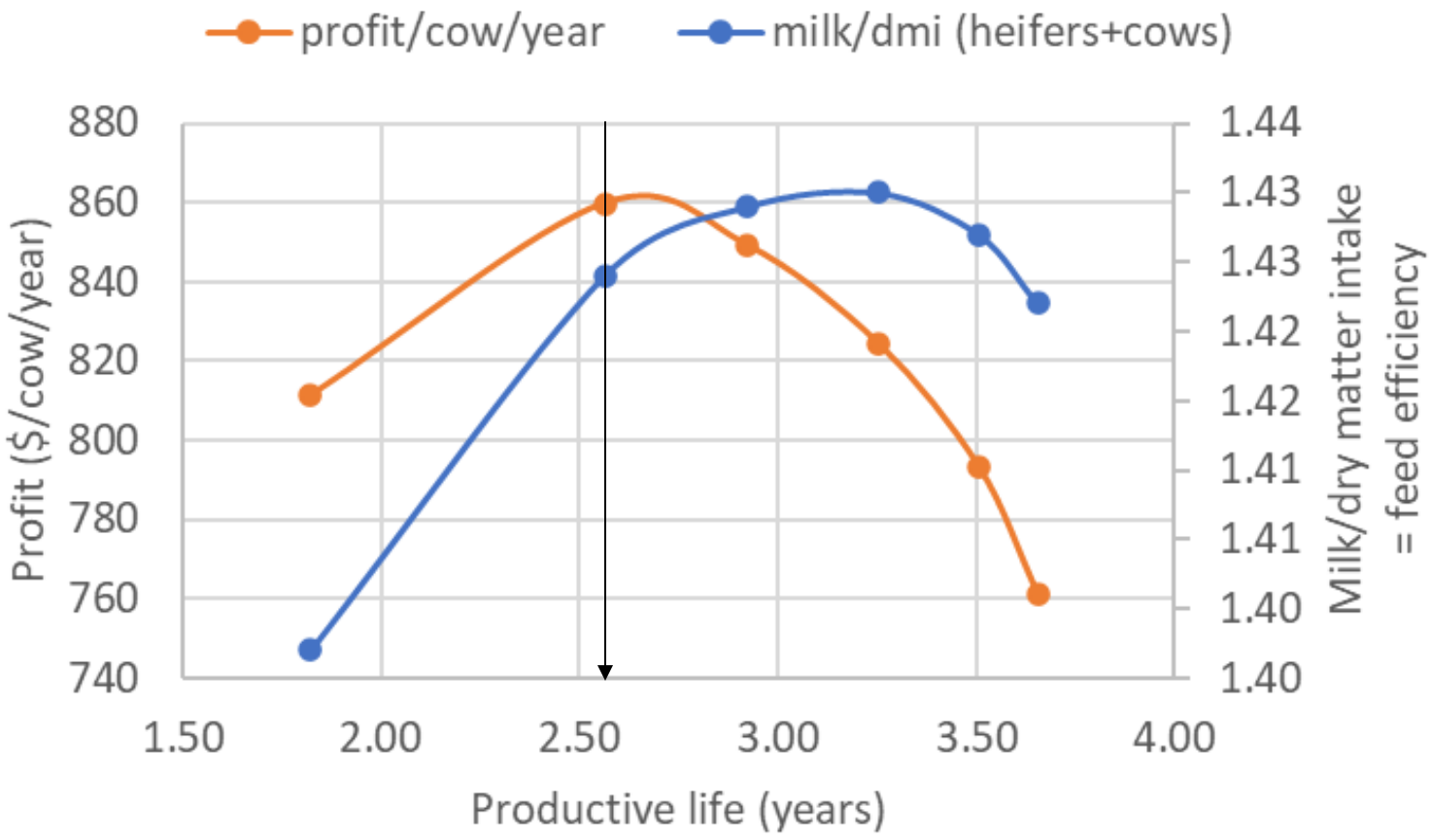
Lifetime milk and milk/day of life increase with greater productive life



Heifer dry matter intake is a small part of total dry matter intake

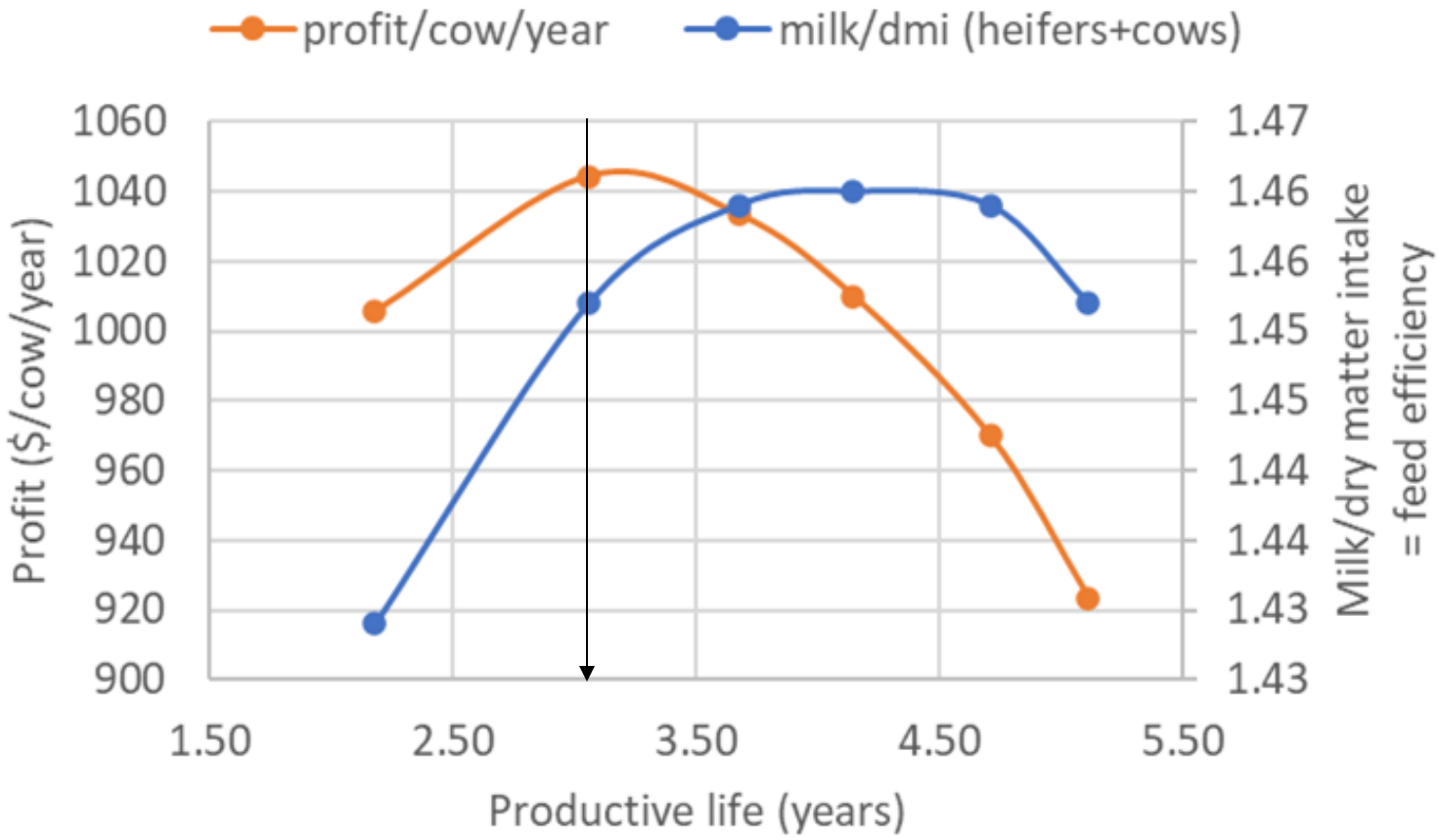


Productive life for maximal profit is shorter than for maximal herd (=heifers + cows) feed efficiency *(≈enteric CH_4/kg milk)*



50% less forced culling

Optimal productive life greater for profitability and herd feed efficiency



Summary

1. Assumption: feed efficiency ≈ enteric CH_4/kg ≈ sustainability
2. Replacing non-competitive cows may increase profitability but not sustainability. Trade-off.
3. Sold culled cows and calves not included in sustainability
4. Results preliminary

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Comments?

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