

Feed Efficiency Depends on the Clock

Alvaro Garcia, DVM, PhD

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A broiler may complete its productive life in about six weeks. A dairy cow may remain productive for three lactations or ten. Yet we routinely describe both animals using the same concept: feed efficiency. In both cases, we are asking how effectively feed is converted into an economically valuable product. The biology behind that conversion, however, is quite different.

For the broiler, feed conversion ratio is naturally a lifetime measurement. Feed consumption begins with the growing bird and ends at slaughter. Commercial and experimental broiler performance is therefore commonly expressed as cumulative feed conversion over a defined growing period, often around 42 days, although production cycles can extend beyond that depending on market objectives. Modern broiler research routinely reports cumulative feed conversion from placement to 42, 48, or later days of age.

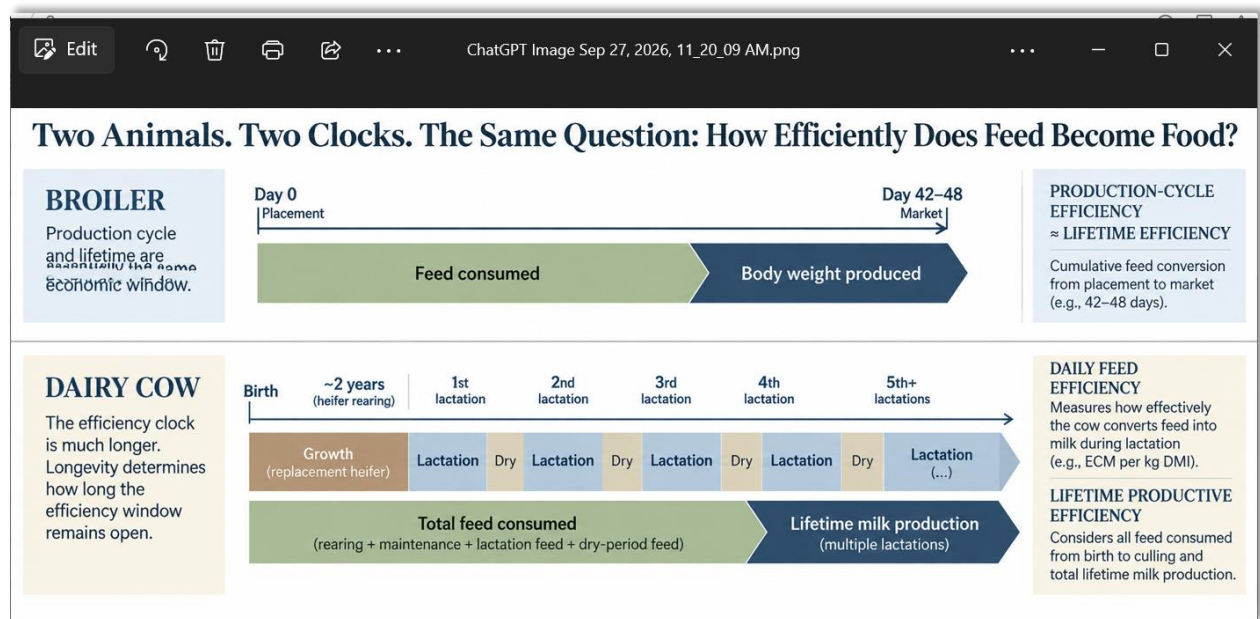
The dairy cow presents a very different problem. Feed efficiency is commonly evaluated during lactation as milk or energy-corrected milk produced per unit of dry matter intake. That is an important measure of how efficiently the cow converts today's ration into today's milk. But it captures only one portion of the feed consumed during her lifetime. Before producing her first kilogram of milk, the replacement heifer has already consumed feed for approximately two years. After entering the milking herd, she alternates between lactation, pregnancy, dry periods, and subsequent lactations until she leaves the herd.

This raises a simple question: if we want to compare biological efficiency across animal-production systems, when should the efficiency clock start and when should it stop?

Same Concept, Different Biological Clock.

Broiler production illustrates why the time boundary matters. Genetic and nutritional progress have produced remarkable improvements in growth and feed conversion. A classic comparison of commercial broilers from 1957, 1978, and 2005 reported cumulative feed conversion ratios to 42 days of 2.88, 1.90, and 1.67, respectively. The entire productive cycle was captured within those measurements.

With dairy cows, the measurement is usually much shorter than the biological cycle. Feed conversion efficiency can be expressed as energy-corrected milk relative to dry matter intake, and this is extremely useful for nutritionists evaluating diets, grouping strategies, feed costs, and cow performance. Research has also examined residual feed intake and other measures intended to separate production from the amount of feed required to achieve it. The limitation is not the measure itself. It is how we interpret it.



Consider two cows producing the same amount of energy-corrected milk per kilogram of dry matter consumed. One leaves the herd on her third lactation. The other remains healthy and productive through eight lactations. On today's feed-efficiency report, they may look identical. From the perspective of the dairy system, they clearly are not.

The second cow has spread the biological and economic cost of her development across many more kilograms of milk. The first cow consumed feed throughout the rearing period, entered the milking herd, and then left after little time producing milk. Her departure also creates demand for another replacement heifer, which must again consume feed during growth before producing any milk.

This distinction matters because the average productive life of U.S. dairy cows remains short. A recent University of Maryland Extension review places it at approximately 2.8 lactations, and a 2026 survey of 60 large Wisconsin dairies found an average of 2.93 lactations per cow. These averages conceal enormous biological variation. Some cows leave during or shortly after their first lactation, while others remain productive for many lactations. The broiler's production cycle is predetermined. The dairy cow's productive cycle is not.

The Feed We Do Not See

If dairy efficiency is evaluated over the animal's lifetime, the equation changes. Researchers have defined lifetime efficiency as the energy contained in milk relative to total energy intake over the cow's lifespan. Under that definition, reproductive success becomes part of feed efficiency because reproduction affects whether the cow remains productive long enough to generate additional lactations. This is an important conceptual shift. Feed consumed by a replacement heifer is not visible in the feed-efficiency calculation of the lactating cow, but it is not free. Neither is the feed consumed during dry periods or the maintenance energy required throughout the animal's life. When a cow leaves prematurely, another animal must eventually replace her, bringing another

period of growth and maintenance before milk production begins. Longevity therefore changes the denominator of dairy efficiency in ways that a daily milk-to-feed ratio cannot capture.

Recent research strengthens this argument. Researchers at the Research Institute of Organic Agriculture (FiBL) in Switzerland evaluated short, medium, and long productive lifespans in representative Swiss dairy systems. Longer productive lifespans reduced greenhouse gas emissions and land use across all systems, largely because fewer replacement animals were required. Greenhouse gas emissions per ton of milk declined even when longer-lived cows produced less milk. Interestingly, the longest productive lifespan did not always generate the highest gross margin under current economic conditions, demonstrating that biological, environmental, and economic efficiency are related but not identical. Research from New Zealand published in 2026 reached a similar conclusion from another direction. Increasing herd replacement rate from 13% to 19.5% reduced expected cow lifespan by approximately 400 days and increased methane emissions per unit of milk fat plus protein. As cows remained productive longer, the methane burden associated with raising replacements was distributed across a greater amount of lactational production.

This does not mean that keeping every cow longer automatically improves efficiency. An older cow with poor production, chronic disease, reproductive failure, or excessive maintenance costs does not become efficient simply because she survives another lactation. The objective is not longevity for its own sake, but productive longevity, and that distinction is critical. A cow that remains healthy, fertile, and productive for eight lactations has accomplished something fundamentally different from a cow that produces very efficiently but must be replaced after three lactations. Daily feed efficiency measures one part of that performance, while lifetime productive efficiency measures another.

Fertility also separates the dairy cow from the broiler comparison. A broiler does not need to reproduce to complete its commercial purpose. The dairy cow must become pregnant repeatedly to initiate subsequent lactations. Reproductive success therefore influences how long the animal can remain productive and how effectively her rearing costs are distributed across lifetime milk production. Modeling work has specifically identified reproduction as a key component of lifetime dairy efficiency for this reason.

Modern reproductive technology adds another dimension. Sexed semen allows producers to generate replacement females preferentially from selected animals, while beef semen can be used on cows not needed to produce replacements. This means that replacement production itself can increasingly be managed rather than accepted as a fixed biological consequence of maintaining the dairy herd. In an article published in *Dellait* we described this interaction among sexed semen, targeted beef-on-dairy breeding, and selection technology as a management opportunity in which reproductive decisions affect both replacement supply and farm economics.

From Feed Conversion to Lifetime Productive Efficiency

None of this makes daily feed efficiency obsolete, but quite the opposite. Knowing how much milk a cow produces from each kilogram of dry matter remains essential for ration formulation and economic management. Recent technologies capable of estimating individual feed intake may

make these measurements increasingly useful on commercial farms. We have previously discussed this opportunity in the context of precision dairy technologies and the potential to measure individual cow feed intake throughout lactation rather than relying primarily on research-farm measurements. The problem arises when short-term feed efficiency is treated as if it describes the efficiency of the entire animal.

Dairy production needs two complementary measures. Lactational feed efficiency tells us how effectively the cow converts feed into milk while she is producing. Lifetime productive efficiency asks how much useful output was obtained from all the resources invested in that animal throughout her life. The latter is necessarily more complicated. It includes feed consumed during rearing, lactation, and dry periods; lifetime milk and milk-component production; reproductive performance; productive lifespan; and the replacement consequences of early removal. A complete system analysis can go further by considering calves and eventual beef production. Research evaluating individual cows across different system boundaries has shown that both profitability and greenhouse gas intensity improve with longer productive life, while cows failing to complete even their first lactation perform particularly poorly because their rearing investment has barely begun to be recovered.

Here is where comparing broilers with dairy cows becomes useful, not because one species should be declared more efficient than the other, but because the comparison exposes a weakness in the way efficiency is currently discussed.

For the broiler, the production cycle and lifetime are the same economic window. Feed enters, growth occurs, the bird is marketed, and feed conversion can be calculated across the entire productive life.

For the dairy cow, the efficiency clock is much longer as she must first grow, then produce milk, reproduce, recover, calve again, and remain healthy enough to repeat the process. A cow producing more milk per kilogram of feed today is more feed efficient today, but a cow that is somewhat less efficient on a daily basis yet remains healthy, becomes pregnant, completes multiple lactations, and spreads the feed required for her development across a much greater lifetime output may ultimately be the more efficient animal for the farm.

Feed efficiency should therefore be considered within a broader measure of biological efficiency that accounts not only for how effectively a cow converts feed into milk, but also for how efficiently the dairy system converts the resources invested throughout her life into valuable lifetime production. For broilers, the end of the production cycle answers that question. For dairy cows, longevity helps define it.

Further reading

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