

# Long-day lighting: Now a profit tool for all dairy operations

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Most dairy farmers are facing an unfavorable milk-to-feed cost index, and some are looking for an alternative to using rBST. What tools remain available to improve the productivity of the many types and sizes of U.S. dairy farms? Long-day lighting (LDL) is a simple and well-proven technique to increase milk production and profitability.

Farmers who previously concluded they were unable to practice LDL because they milk 3X or almost 24/7 should give LDL a second look. New developments now allow these herds to successfully use LDL. Well-researched and highly profitable, LDL should be considered a best management practice in dairy farming. Don't overlook this valuable tool when considering your options to modernize and develop your dairy enterprise.

## Long-day lighting basics

Numerous research studies in North America have clearly demonstrated that when dairy cows are provided summerlike, long days in the winter, they respond with increased milk production.

The increase in yield noted in nine such studies average 5 pounds per cow per day. No negative effects on fertility or health have been reported.

The recommendations for LDL are:

- A light level of 15 or more foot-candles for lactating cows
- 16 to 18 hours of light per day
- A daily dark period of 6 to 8 hours
- Dry cows managed with natural, short-day length

Herds milking 3X usually are able to meet all but one of these basic requirements. They are unable to provide six hours of uninterrupted darkness at night. Inventive farmers and advisers have tried different ways to get around this stumbling block.

## Is it cost-effective?

When preparing an investment budget for farmers considering LDL, the typical result is an estimated payback of one year or

Description	Estimates
Herd size	Expansion from 450 to 650 lactating cows. Analysis based on 550 cows.
Estimated increase in milk production (4.5 lbs./cow/day)	903,400 lbs./year
Cost of fixtures (list price)	\$43,500
Cost of installation	\$19,200 (low) - \$38,400 (high)
Net profitability	\$169/cow/year. Total of \$93,200/year
Payback time	0.7 to 0.9 years (low vs. high installation cost)
Accumulated net profits (10-year economic life)	\$850,300 - \$869,500 (low vs. high installation cost)
Return on investment	114% to 149% (low vs. high installation cost)
<i>Milk price assumed \$15.00 cwt, feed cost \$0.08/lb. DM, energy cost \$0.08/kWh, estimated annual maintenance costs of \$530 considered.</i>	

less, a net profit of \$100 or more per cow per year and a return on investment of at least 100 percent. This translates to \$10,000 added net income per year for a 100-cow dairy, or \$100,000 per year for a 1,000-cow dairy.

Table 1 summarizes the results from an economic analysis of a plan to invest in LDL on a Midwest dairy farm using a six-row freestall barn.

For new construction, light fixtures for basic lighting are

required. The cost-effectiveness of LDL would be even higher if only the cost for additional light fixtures was considered. Although the milk price as well as the cost of energy and feed varies between regions and individual farms, LDL remains profitable.

## New solutions for 3X or 24/7 milking dairies

Using low-level red light instead of complete darkness has been tried because dairy cattle perceive low levels of red light as "dark." However, many farms abandoned the red lights because it proved not suitable for workers' needs when moving cows and cleaning barns. Installing higher intensity red light for better work lighting would jeopardize the effectiveness of LDL because cattle perceive higher intensities of red light as "light."

Another attempt to achieve the required length of darkness was to offset the timing for fixtures in different sections or barns by one to two hours, thus making better use of the naturally dark hours. This compromise does not provide six hours of darkness for all groups of cows. In addition, the movement of cows between pens or barns with different LDL schedules creates



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## A profit tool for all dairy operations, cont'd from front

an inconsistent lighting schedule and the production response to this arrangement is uncertain (not studied). Depending on how many cows remain on a consistent LDL schedule, using staggered light schedules may achieve about half of the normally expected production increase of 4 to 5 pounds per cow per day.

Thus, neither red light nor staggered lighting schedules seem to be viable solutions for 3X herds interested in achieving the full benefits of LDL.

Given these challenges, 3X herds need a radically different, but simple approach to LDL. Based on new studies about dim lighting for dairy cattle, a new LDL model was developed specifically to suit the needs of 3X herds. This approach includes:

- A single lighting schedule for all lactating cows (all sections of same barn, all barns, holding area, etc.)
- Full light level (15 foot-candles or more) for 16 to 18 hours
- Dim light at 1 to 1.5 foot-candles during the “dark” period each night, 6 to 8 hours per day

This model provides a consistent LDL schedule throughout the lactation period for all cows. Cows can be moved freely between pens and barns as needed – with no change in the LDL schedule for the cow. If and when the herd is expanded, or the parlor schedule changes for other reasons, these changes can take place with no negative impact on the LDL program because the LDL schedule is independent of the parlor schedule.

### Dim light for cattle and workers

Many dairy farmers interested in LDL have raised the question: How dark is “dark” for the cows? Until recently, we had very little guidance from scientific studies regarding the level of light that cattle can tolerate while still perceiving it as “dark.” Studies from Canada (University of Manitoba and University of Alberta) with professor Alma Kennedy as lead researcher now fill this information

gap. According to these studies, dairy cattle can tolerate at least 1 foot-candle of white light and still experience this as “dark.” This research also showed that exposure to 5 foot-candles at night reduced the normal level of the main nighttime hormone (melatonin) by 50 to 70 percent, a significant interference with the animals’ normal nighttime function. Thus, the maximum intensity of night light tolerated by cattle might be somewhere in the 2 to 4 foot-candle range. Based on the present research findings, we may design night light in dairy barns with an intensity of about 1 to 1.5 foot-candles.

How useful is a level of 1-1.5 foot-candles for nighttime work in a barn? Three things need to be considered:

#### *The quality of the light*

**1** Human vision works best with white light. Any colored light (e.g., red or orange) reduces the effectiveness of the eye.

#### *Even distribution of the light*

**2** An average of 1 to 1.5 foot-candles can be obtained using a single, powerful light source or by using many lower-powered light sources well distributed over the area. Large contrasts between the brighter areas and the darker areas reduce visibility.

#### *Barn work and the human eye*

**3** Working in the barn typically means moving about relatively quickly. With unevenly distributed lighting, workers are exposed to variable light intensities as they go between bright and dark areas. During this movement, there is not enough time for the workers’ eyes to adjust to the constantly changing light levels, so the workers’ eyes are not able to function optimally in the brighter or the darker areas.

This aspect underscores the previous point; if the light levels are uniform, little adaptation is needed and the available light can be effectively used, even when moving about.

Thus, to be of good use for working in the barn, it is essential that dim lighting at night be generated from many low-powered sources, evenly distributed throughout the barn and that the light is white. When this is the case, dim light at 1 to 1.5 foot-candles allows surprisingly precise observation. Literature reports that a person with normal eyesight can read newsprint with 1 foot-candle of light. More specifically, dairy farmers report that ear tags can be read and cows identified at a distance when using this level of dim light. Some farmers refer to this as “moonlight.”

The challenge is to create evenly distributed dim white light such that the entire barn area has levels close to the target average of 1 to 1.5 foot-candles. The area with substantially higher or substantially lower light levels should be minimal. In principle, this dim light can be created with separate fixtures or as a built-in function of dual-level fixtures. When designing LDL systems for 3X herds, dual-level fluorescent fixtures are commercially available, specially developed for this purpose.

### Recommendations

- Find out the expected costs and benefits for practicing LDL in your own facilities, new or existing.
- Do your homework. Basic research information is available online. (e.g., from University of Illinois at [www.livestocktrail.uiuc.edu/photoperiod/](http://www.livestocktrail.uiuc.edu/photoperiod/)). You may also contact me for additional, more applied information or reference to studies on LDL.

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• Include lighting as an issue to plan for at an early stage in your construction project. This saves money and can make for more effective LDL.

• Get information on lighting from commercial lighting distributors/manufacturers and other sources. Also, be sure to ask for assistance with planning the lighting system such that it allows efficient herd management while meeting the requirements of LDL.

• If you start now, doing your “homework” this summer, your new, effective and efficient barn lighting system may be up and running when the days are getting short and dark in the fall. **PD**

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