

# **Influence of Facilities on Cow's Time Budget**

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## **Introduction**

The daily activities of a dairy cow typically consist of feeding, resting, drinking, socializing and milking. Research indicates that, except for milking, a cow budgets, or sets aside, a certain amount of time for each of these daily tasks. Some milking procedures and parlor characteristics influence how much time a cow spends away from the housing area, though. These factors include the amount of time spent in the parlor, travel distance to and from the parlor, group size, milking routine and visits from the veterinarian. Each of these variables affect the amount of time left for a cow's other important daily activities.

Facilities are another critical factor in a cow's daily use of time. In many cases, freestall dairy facilities are often overstocked to reduce the facility investment cost per cow or to allow gradual expansion of the dairy herd. Unfortunately, overstocking freestalls and feed spaces reduces the time available for cows to meet their individual time budgets. This publication investigates the degree to which the facilities and the actual time spent at the milking center impact a cow's use of time on a daily basis.

## **Past Research and Results**

Research from different experts reveals a direct relationship between a cow's daily amount of resting time and the amount of milk produced. Albright (1993) evaluated the time budget of a cow producing over 18,000 kg (40,000 lbs) of milk. He found she spent 13.9 hours per day resting and 6.3 hours per day eating. Matze's study (2003) discovered that cows in the top 10 % of milk production rested 14.1 hours per day, while average milk producers rested 11.8 hours per day. Both groups spent 5.5 hours per day eating, but the top 10 % spent less time perching, standing in alleys and drinking than the other group. Grant (1999) suggested daily time

budgets for dairy cows should include 5 to 5.5 hours for eating, 12 to 14 hours for resting and 30 minutes for drinking. An additional study he conducted in 2006 indicated that each additional hour of rest results in a 1 kg (2.2) lb milk response.

Research also shows that the stocked capacity of a facility directly affects a cow's resting time and, therefore, milk production. Metz (1985) reported that when time is limited for normal cow behavior, cows prefer to rest rather than eat or drink. Batchelder (2000) found similar results when pens were overstocked at 130 %. He observed cows preferred to rest rather than eat immediately after milking because they had spent more time standing in alleys waiting for a stall. Grant (2006) reviewed available research and tentatively concluded that, though eating time is not greatly affected by stocking density, resting time is reduced 12 to 27 % when pens are stocked at 120 % or greater. He also concluded that standing time increases 15 to 25 % when stocking density exceeds 120 %. His final analysis was that, in general, there is a negative impact when stocking density exceeds 120 %.

Overton et al. (2003) compared commonly used methods such as the cow comfort index, stall use index and proportion lying index to evaluate dairy cattle resting behavior. The cow comfort index is the number of cows lying in a stall divided by the total number of cows lying and standing in a stall. The stall use index is defined as the number of cows lying divided by the total number of cows lying or standing but not eating. Proportion lying index is determined by the number of cows lying divided by the total number of cows in the pen. Overton concluded maximum stall usage occurred one hour after the cows returned from the early morning milking.

### **Facility Occupancy Index**

The facility occupancy index is used to determine the impact of facilities on cow behavior. Before using a simple equation to calculate the occupancy index, though, the feedline occupancy rate and the freestall occupancy rate must also be known.

The feedline occupancy rate represents the average percentage of feeding spaces that are occupied while the cows are in the pen. The pen time ( $P_t$ ) in the following equation excludes the time cows are traveling to and from the milk parlor or at the milk center. The feedline occupancy rate equals:

$$\text{FEED}_{\text{OR}} = \{(C \times F_t) / (F_s \times P_t)\} \times 100 \quad (1)$$

FEED<sub>OR</sub> is the average feedline occupancy per day (%)

C is the number of cows in the pen

F<sub>t</sub> is the desired daily feeding time per cow (hrs)

F<sub>s</sub> is the number of 24 inch feed spaces available

P<sub>t</sub> is the time per day the cows are in the pen (hrs)

The freestall occupancy rate represents the percentage of freestalls that are occupied while the cows are in a pen. Since proper usage of a freestall involves resting, this index is based strictly on cows resting or lying in stalls without considering cows perching or standing in stalls. The freestall occupancy index, or cow comfort index, is considered a reliable tool for evaluating stall usage. The following equation calculates the freestall occupancy rate:

$$\text{STALL}_{\text{OR}} = \{(C \times R_t) / (S_t \times P_t)\} \times 100 \quad (2)$$

STALL<sub>OR</sub> is the average freestall occupancy per day (%)

C is the number of cows in the pen

R<sub>t</sub> is the desired daily resting time per cow (hrs)

S<sub>t</sub> is the number of freestalls in the pen

P<sub>t</sub> is the time per day the cows are in the pen (hrs)

The facility occupancy index is calculated by adding the feedline and freestall occupancy rates, as shown below.

$$F_{\text{OR}} = \text{STALL}_{\text{OR}} + \text{FEED}_{\text{OR}} \quad (3)$$

F<sub>OR</sub> is the facility occupancy rate (%).

Ideally, facilities should not hinder cows from having adequate time for feeding or resting. The facility occupancy index must be less than 100 % if cows are to exhibit natural behavior (other than eating or resting). An assumption in this model is that certain cows will use freestalls or feeding spaces even when most of the cows are involved in activities outside the

housing area. Other key assumptions include: cows are healthy, stalls are bedded properly, and feed is readily available. The acceptable facility occupancy index must be less than 100 % when lame cows are standing in stalls, adequate fresh feed is not available, or minimum bedding is used.

If at least one stall and one feed space is available per cow and time away from the pen does not exceed 3 hours per day, then the facility occupancy index will be equal to or less than a beneficial 85 %. If the facility occupancy index is between 85 % and 100 %, the facilities may not hinder the cow’s normal behavior, but the pen is overstocked. When the facility occupancy rate index exceeds 100 %, some cows may be limited from exhibiting normal behavior.

### **Dangers of Overcrowding**

If 100 lactating cows are housed in a 67-stall pen, making the stocking density 150 %, then the facility occupancy index equals 132 %. When the cows are not at the milking center, 93% of the freestalls must be occupied to ensure adequate resting time for each cow in the pen. In addition, 39 % of the feeding spaces must be occupied. Once the facility occupancy index exceeds 100 %, cows must choose between feeding and resting, therefore preventing them from exhibiting normal behavior.

Table 1 illustrates the impact of overcrowding of dairy facilities at 0%, 25%, and 50%. Assuming the herd size is 100 cows, the results are related to the number of cows per stall and the amount of time spent per milking. Overcrowding by 25 % results in a facility occupancy index of 110 %, with 120 minutes per milking. If the time at the milking center is reduced to 60 minutes, then the facility occupancy index decreases to 100 %, since 2 additional hours are available each day in the housing area. Facilities that are overcrowded by 50% are still inadequate, even if time at the milking center is reduced.

Table 1: Facility occupancy rate based on a milking frequency of 2 times per day

Time at Milking Center (min/milking)	Overcrowding of Facilities (%)	Freestall Occupancy Rate (%)	Feed Line Occupancy Rate (%)	Facility Occupancy Rate (%)
120	0	62	26	88
120	25	78	32	110

120	50	93	39	132
60	25	70	30	100
60	50	84	36	120

### Impact of Milking Time

Research suggests 20.5 hours in the housing area is the minimum time required for a cow to socialize, rest, drink and feed. Cows which are in the milking parlor more than 3.5 hours per day may not have adequate time for normal activities.

Table 2 uses data from a 100-cow dairy to illustrate the impact of milking times on facility occupancy rate, assuming there is no overstocking of the feedline or freestalls. Data was gathered from 2 times of milking per day with times at the milking center of 60, 120 or 180 minutes per milking.

Table 2: Facility occupancy rate based on time at milking center per milking

Time at Milking Center per Milking (min)	Travel Time to and from the parlor (min)	Freestall Occupancy Rate (%)	Feedline Occupancy Rate (%)	Facility Occupancy Rate (%)
60	10	56	23	79
120	10	62	26	88
180	10	69	29	98

Table 2 suggests these particular facilities are not a limiting factor to a cow's time budget because the facility occupancy rate is less than 100 %. If facilities are not overstocked, the freestalls will only be occupied 60 to 70 % of the time, even with longer milking times. It is important to remember that, on average, 56 % of the freestalls need to be occupied if the desired resting time is 12 hours per day, assuming time in the parlor is limited to 1 hour or less per milking.

To evaluate the impact of time at the milking center, cow time budgets for the first and last cows through the parlor were also examined. The model inputs include: time at the milking

center, travel time to and from the milking center, time in the wash pen, and daily time allowance for veterinary activities. Time for the veterinarian is assumed to occur only once per day, while the other time allocations occur at each milking.

Using the 100-cow dairy example, Table 3 compares the time at the milking center to the resting time available for the first and last cows through the parlor. The facilities enable the first cows through the parlor to potentially rest for 15 hours per day, as compared to the intended 12 hours per day. The last cows through the parlor can obtain the targeted 12 hours of rest if the time at the milking center is limited to one hour or less. They do not receive adequate rest if they are at the milking center two or more hours per milking. Cows moving through the parlor during the first half of the milking shift have plenty of time for their normal daily activities.

Table 3: Time at the milking center compared to the resting time of cows milked first and last in the parlor

Time at Milking Center (min)	Travel Time (min)	First Cows Through Parlor (hrs)	Last Cows Through Parlor (hrs)
60 (2X Milking)	10	15	12.8
120 (2X Milking)	10	15	10.8
180 (2X Milking)	10	15	8.8

Table 4 illustrates the difference between 2 times and 3 times of milking per day. The first cows through the milking center are not necessarily impacted by milking frequency. However, the resting time of the last cows through the parlor is influenced by milking frequency, time at the milking center and overcrowding. When milking 3 times per day, the time at the milking center must be reduced to less than one hour each time. The last cows through the parlor will only have 8.5 hours of resting time with 2 hours of milking 3 times each day.

Table 4: Influence of milking frequency on facility occupancy rate and resting time

Time at Milking Center (min per milking)	Milking Frequency	Number of Stalls	Over crowding of Facilities (%)	Facility Occupancy Rate (%)	Available Resting Time (hrs)	
					First Cows Through Parlor	Last Cows Through Parlor

120	3X	100	0	100	13.1	8.5
120	3X	80	25	125	13.1	8.5
120	2X	100	0	80	13.9	10.8
120	2X	80	25	110	13.9	10.8
60	3X	100	0	85	14.1	11.5
60	3X	80	25	106	14.1	11.5
60	3X	100	0	85	14.6	12.8
60	2X	80	25	100	14.6	12.8

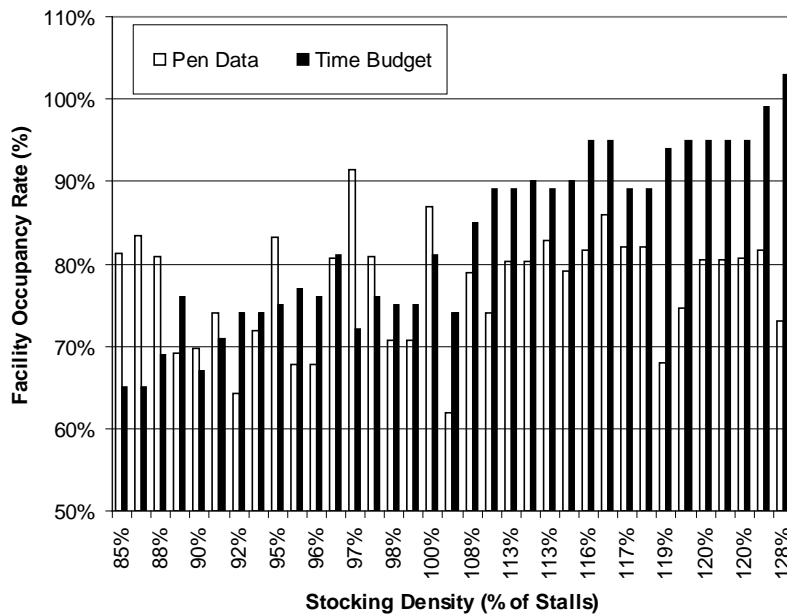
### **Kansas Dairy Research**

A research study was conducted at Kansas State University in the fall of 2007 to evaluate the potential impact of facilities on dairy cows' feeding and resting time allocations. The impact of time away from the feeding and resting area was also evaluated.

A Kansas dairy with 7 pens of lactating cows was used for evaluation..There were two pens with 60 stalls, one pen with 88 stalls and four pens with 100 stalls. Hourly data was collected between 9 a.m. and 4 p.m. on five different days. The dairy limited pen stocking density to 85 to 125 % based on the number of free stalls available. Data collected from each pen included the number of cows lying in free stalls and the number of cows eating at the feedline. Information was only collected when all the cows assigned to a pen were present and not at the milk center.

.Only once were more than 85 percent of the cows found to be resting or feeding at any given time during the study. As the stocking density increased beyond 100 %, the FOR index predicted 90 to 100 % of the cows must be resting or feeding in order to obtain 12 hours of rest and 5 hours of feeding. Therefore, once the FOR index exceeds 85 percent, the cows' normal time budgets for resting, feeding, drinking and socializing may be altered. When the cows are at the milk parlor 3 hours per day, the remaining time in a housing area equals 21 hours per day. In addition, 3 hours, or 15 percent of the day, are required for socializing within the housing area, which explains why the facility occupancy rate should not exceed 85 percent. Additional studies at different facilities and various seasons are required to determine if facility occupancy rates are observed at other dairies.

Figure 1: Illustrates the impact of stocking density and the facility occupancy rate (FOR) for all data collected



### Comparison to Other Research Study

Data was taken from Overton et al. (2003) to evaluate the concept of facility occupancy index and to use the data as model inputs in the Kansas study. The Overton study used 129 cows in a 144 stall pen with 144 feed spaces, and the cows spent 2 to 3 hours per day at the parlor. The feedline occupancy rate was 21 %, the freestall occupancy rate was 54 %, and the overall facility occupancy rate was 75 %. These results indicate the facility was not limiting cows from obtaining 12 to 13 hours of rest and 5 to 5.5 hours of feeding time.

Data gathered from the Overton study tracked the number of cows lying down during a 24 hour time period. Their results suggest the average number lying down was 50 to 54 %, with a range of 76 to 25 %, and the freestall occupancy rate was similar at 54 %. The research shows the facility occupancy index may provide a reasonable method to evaluate facilities without the use of videotaping or 24 hour visual observations.

### Conclusion/Summary

As research of facility occupancy index continues, care must be taken not to misuse the results in the dairy industry. Additional stress on employees to increase milk parlor capacity so cows have more time in an overstocked pen is not the purpose of this tool. Knowing a facility's occupancy index may be useful in identifying behavior inhibitors to the animals, though. The

FOR helps explain why it is sometimes difficult to move animals to the pens or why there is agitation among some cattle pens.

The facility occupancy index provides a management tool to evaluate the impact of facilities on cow time budgets. Research suggests when facilities are overcrowded by 25 % or more, they begin to limit cows from exhibiting normal behavior. The feed, freestall and facility occupancy indices are based on the percentage of cows that must be resting and feeding during a given time in a pen. Overcrowding results in inadequate time for typical resting and feeding activities. Using the FOR index provides a way to determine if the particular facilities will allow cows to exhibit normal behavior in a pen without practitioners having to analyze videotape or conduct 24 hour visual observations.

The model also may be used to evaluate the impact of time at the milking center and milking frequency on the cow's time budget. A study of different scenarios indicates the first cows through the parlor have adequate time for resting, feeding, socializing and watering. However, the last cows have inadequate time for other activities if they spend 2 or more hours per milking at the milking center. Reducing time at the milking center is critical when milking 3 times per day in order to ensure the last cows have adequate time for normal behavior activities when in the housing area.

### **Considerations for Optimum Milk Production and Happy Cows:**

- Resting time should be 12 or more hours per day.
- Eating time should be approximately 5 hours per day.
- Drinking time should be approximately 30 minutes per day.
- Time for socializing should be around 3 hours per day.
- Time in the milk parlor should be 75 minutes or less for each milking session if milking twice each day.
- Time in the milk parlor should be 45 minutes or less each time if milking three times each day.
- Stall usage should be 60-70%.
- Avoid overstocking the facility at greater than 15%.

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