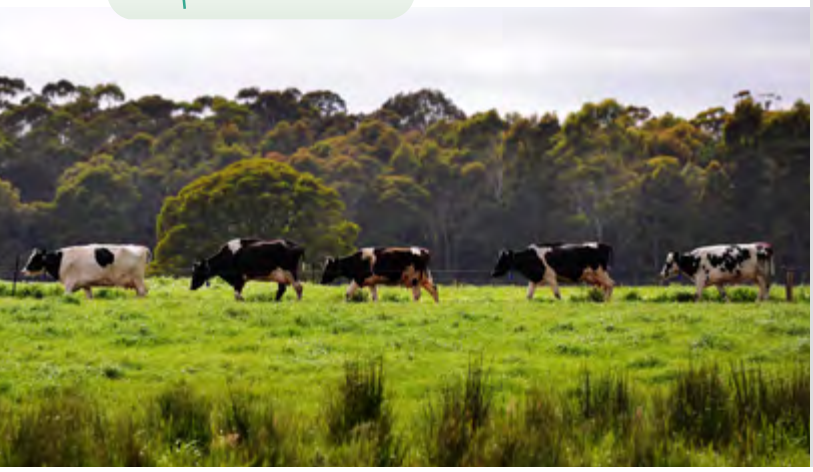
FUTUREDAIRY

InfoSheet

AUTOMATIC MILKING SYSTEMS



Key Points:

- Feed is the primary motivator used to encourage voluntary cow movement.
- Accurate pasture allocation is critical to achieving reliable and consistent voluntary cow movement.
- Cow traffic is a good indicator of whether feed allocations are too large or small.

Voluntary cow movement in automatic milking systems

by Cameron Clark and Kendra Kerrisk

A SUCCESSFUL automatic milking system (AMS) relies on achieving milkings that are relatively evenly distributed across the 24 hours in a day (distributed milking).

Most Australian AMS operate with voluntary cow movement ie cows move by themselves to milking and around the farm. And encouraging good voluntary cow movement is the key to achieving distributed milking. This is quite a different concept to a conventional milking system where the whole herd is milked in two or three concentrated periods of the day.

There are three types of trafficking systems with voluntary cow movement: free, controlled and forced.

With systems based on free cow movement cows can visit the feeding area as frequently as they want. This is commonly used with indoor AMS.

Both controlled and forced cow movement rely on the farmer setting criteria in the AMS herd management software that determine whether or not a cow has milking permission. For example, milking permission may be based on a minimum time period since the previous milking, or expected milk yield.

Most Australian AMS operate with controlled feeding, where an automatic drafting gate is programmed to direct cow traffic.

Cows that have milking permission when they arrive at the automatic drafting gate will be directed to the dairy to be milked before being given access to fresh feed or pasture. Cows that do not have milking permission upon arrival at the gate will be sent direct to the fresh feed or paddock. This avoids unnecessary cow traffic through the dairy.

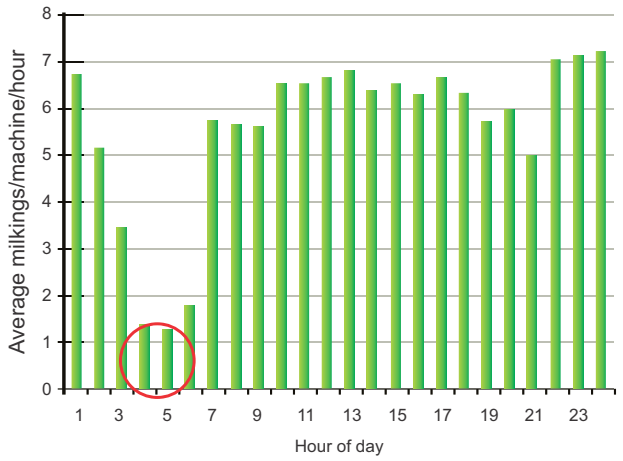
An AMS operating with forced cow movement is set up so that cows must pass through the milking unit to get access to the feeding area or fresh pasture allocation. Their milking permission determines what happens when they go through milking unit. If they have milking permission they will be milked on the way through; if not, they will be sent directly to the next feed, without being milked.

Regardless of the type of trafficking system, not all cow movement will be voluntary as there is always a proportion of cows that require fetching or encouragement.

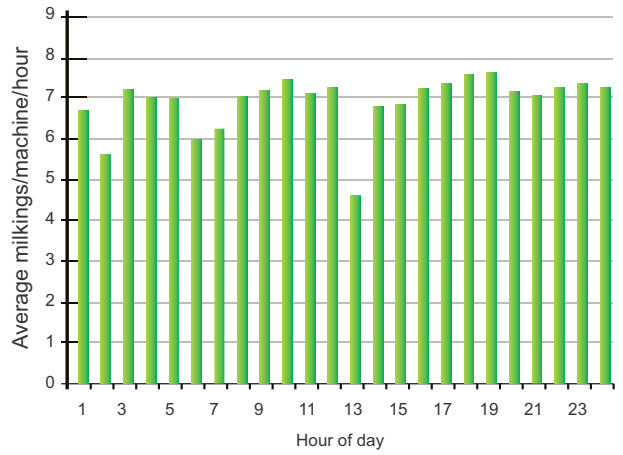
A well-managed system should aim for a low number of cows that require fetching at any point in time so that the fetched cows queue at the dairy for no longer than an hour before being milked. For example, if there is only one single-box robot at the dairy, aim to fetch no more than eight cows at a time; or 16 for two single-box robots etc.

Influencing voluntary cow movement

It is more challenging to achieve evenly distributed milkings with a grazing-based AMS than it is with an indoor system. Pasture-fed cows typically rest from about 2am to about 5am following a grazing session around midnight (see diagram below).



*Above: **Pasture based AMS** - it is common to see a significant reduction in milkings/hour during the early hours of the morning - 'sleep time'.*



*Above: **Dutch TMR AMS farm** - cows fed a TMR ration are more inclined to have a very even distribution of milkings throughout the day and night.*

Successful AMS farms follow similar principles to encourage voluntary movement and high levels of milking unit utilisation across 24 hours. The highest level of efficiency is gained by optimising both production per cow and per machine. Maximising one is likely to result in a dramatic reduction in the other. In a grazing-based AMS, voluntary cow movement is affected by feed, farm layout, herd mates, routine and climatic conditions.

Feed

Feed is the primary motivator used to encourage voluntary cow movement in an AMS. Cows with stronger appetites typically attempt to seek out new sources of feed and move around the farm more regularly.

Higher producing cows tend to have stronger appetites. As cows in early lactation produce more milk they have a stronger appetite and move around the farm more.

FutureDairy work has found that the two most useful management practices for encouraging voluntary cow movement in a grazing-based AMS are accurate pasture allocation and the number of feeds offered a day (3-way grazing).

During periods of supplementary feeding, the timing, location and availability of supplementary feed can be used to manipulate cow traffic. Results from a preliminary study suggest that flavour-enhanced pellets may encourage voluntary cow movement by less motivated cows.

Pasture allocation

Accurate pasture allocation is critical to achieving reliable and consistent voluntary cow movement. The effects of pasture allocation errors will be quickly seen in an AMS. For example, if feed is consistently over allocated, cows will stay in the paddock for longer, resulting in reduced milking frequency and a drop in milk production.

Under-allocation will increase milking frequency but reduce feed intake, milk harvesting efficiency (litres harvested per minute at the AMS) and overall milk production. When feed is under-allocated cows tend to loiter at the dairy waiting for the next pasture allocation to become available, resulting in reduced system efficiency.

The well-established pre- and post-grazing cover pasture management principles used on conventional dairy farms work very well on AMS farms. In fact, the cow traffic is a very good indicator of whether feed allocations are too large or small.

3-way grazing

FutureDairy work has shown that offering cows two allocations of pasture per day is workable but 3-way grazing creates more frequent cow movement, resulting in higher levels of AMS utilisation. It also allows the operator to be more selective about when cows are drafted for milking – thereby allowing them to eliminate (or at least minimise) very short and very long milking intervals.

In FutureDairy studies, cows offered feed in three allocations every 24 hours produced an average of 18% more milk, with a 40% increase in milking frequency and a 10% improvement in AMS unit utilisation.

An AMS farm in Tasmania has more evenly distributed milkings throughout the day and night than most grazing-based AMS. This farm achieves consistently high levels of robot utilisation throughout 24 hours. Rather than offering three equal pasture allocations over 24 hours, this herd receives a smaller allocation leading up to midnight and two larger allocations in the morning and afternoon.

The FutureDairy team plans to evaluate this feeding approach under research conditions to better understand ways to improve voluntary cow movement on AMS.

Breed differences

Observations from farmers suggest that there are breeds of cows that have greater voluntary cow movement and that there are certain bloodlines that generally have greater voluntary cow movement. Preliminary work on this topic supports these observations but a large scale study is yet to be conducted.

Supplementary feed location

FutureDairy compared the effects of offering supplementary feed on a feedpad at the dairy before or after being milked. Cows with access to supplementary feed before milking took 1½ hours less to return to the dairy but spent more time at the waiting and feeding areas. Overall these cows increased their milking interval compared with the cows offered supplementary feed after milking.

Feeding cows before milking could be a useful tool for encouraging cows to spend more time on the feedpad, particularly during periods of high supplementary feeding or at times when paddocks are waterlogged.

Feeding after milking is the preferred option when the herd's intake is predominantly pasture, and the supplement fed at the feedpad is a 'top up.' This option enhances cow movement through the dairy and maximises time spent on pasture.

These findings suggest an ideal design for an AMS with a feedpad would position the feedpad with the flexibility to divert cows to supplementary feed either before or after milking, depending on the need, which may change throughout the season. This would also allow some priority drafting; for example a cow that came to the dairy and was overdue for milking could be offered feed after milking; while a cow that has only recently been granted milking permission (i.e. a relatively short interval since its previous milking) could be offered feed prior to milking. This type of strategy is likely to enhance milk harvesting efficiency by further reducing extremely short and long milking intervals.

Flavour-enhanced pellets

The FutureDairy team also investigated the use of flavour-enhanced pellets offered immediately after milking time through automatic feed stations. The aim was to encourage voluntary cow movement. The time spent in the feeding area increased by 95 minutes with flavour enhanced pellets while the time to return to the dairy decreased by 110 minutes and waiting time at the dairy fell by 20 minutes. Overall, cows spent 30 minutes more grazing. The greatest impact on cow movement was on heifers and low to moderate yielding cows. These findings suggest there is potential to use flavour enhanced pellets to encourage voluntary cow movement, especially animals with less motivation to move around the dairy such as lower yielding cows, later lactation cows and heifers.

Different forages

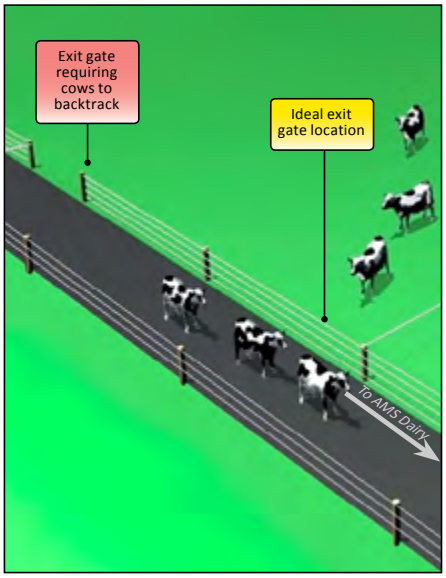
FutureDairy evaluated the use of soybean – a highly palatable forage to cows – to determine its potential to encourage voluntary cow movement in an AMS. Replacing pasture with soybean provided no additional incentive to increase voluntary cow movement within an AMS. As soybean is a forage of high preference by cows, it is unlikely that alternative forages (to pasture) will increase voluntary cow movement.

However, this doesn't mean that forage crops can't be incorporated into the grazing system. They can provide an opportunity to grow more grazable feed in paddocks close to the dairy, thereby reducing the average walking distance between the paddocks and the dairy.

Farm layout

Farm layout can encourage voluntary cow movement by making it easy for cows to access what they want. If possible, have three laneways leading out from the dairy to enable 3-way grazing. Position gates to minimise back tracking and associated confusion. Aim to have most of the milking paddocks within 800 meters of the dairy as FutureDairy research has shown that milking frequency gradually declines with longer walking distances. This reduction is related to the additional time it takes the cows to walk between the paddock and the dairy and back again. Longer walking distances also affect milk yield because extra energy is expended in walking that could have been used for milk production.

Right: This gate location means cows have to backtrack to exit the paddock.



Long walking distances become an issue with larger herds.

For more information refer to the FutureDairy Info Sheet Managing incentives in large automatic milking herds.

Feedpads can act as a feed allocation (thereby replacing one of the pasture allocations) or they can be used to supplement pasture allocations. But cows will leave a concrete floor to access a comfortable loafing area for rumination. If a feedpad is used to as a feed allocation it will need an adjacent comfortable and clean loafing area otherwise cows will be reluctant to stay at the feedpad for extended periods.

Avoid using the location of water as an incentive for voluntary cow movement. The incentive is lost if there is any surface water in the paddocks after rain or irrigation. And the incentive is not as great during cool wet weather. Using water as an incentive carries a high risk of reducing water intake and therefore a fall in milk production.

Ideally make water available in all locations. Water can be located in the laneways rather than in the paddock to alleviate challenges associated with having a trough at every pasture allocation (particularly when temporary fencing is used to get accurate pasture allocation). If the water is in the laneway it may encourage some cows to continue walking to the dairy but if pasture is not depleted cows will be inclined to walk back to the pasture allocation after going to the trough.

Cows per milking unit

In a grazing-based AMS, the most appropriate number of cows per milking unit will depend upon the desired milking frequency, peak demand (particularly in seasonal calving herds), production level of the cows, economic considerations and the skill and experience of operators (particularly their ability to achieve distributed and frequent cow movement).

AMS farms with excellent voluntary cow movement typical operate at 70 cows per milking unit and have milking frequencies of 2.2-2.3 milkings/cow/day. Increasing cow numbers past these levels carries the risk of increased cow waiting time before milking which can result in reduced milk production.

However, a higher number of cows per milking unit may be very desirable to optimise milk production per robot if cows are lower yielding and target milking frequencies are lower.

For the first 12 months after commissioning, consider operating with less cows per milking unit (say 50-60). This reduced pressure creates some buffer while the staff are developing their management and operational skills with the AMS.

Herd mates

Some cows move as individuals but many are influenced by the behaviour of others in the herd. As a result, many cows on AMS farms move in small social groups. However, the complexities of the herd dynamics make it difficult to use social factors to encourage voluntary cow movement. At least realising that cows may be waiting for a herd mate may help to understand why one cow will loiter at a given area of the system and another may not.

Routine

When establishing an AMS routine, aim for cows to have no surprises, no negative experiences, and sufficient rewards for the effort of an action.

An inexperienced animal (particularly heifers) may have difficulty finding its way round the system and may struggle to compete with herd mates. The best time to educate or train animals in AMS is before they calve. This way they have the experience and confidence to move around the farm and hold their place in queues.

If possible, avoid negative experiences at milking, at least during the training period. It is also important to minimise queues at the dairy otherwise cows may be more reluctant to return next time. If a feed reward that is normally available at the AMS unit is removed, expect cow movement to slow down dramatically.

Although cows might be familiar with a certain structure (e.g. a one-way gate) if the structure is moved and placed in a new location you can be sure that the cows will all baulk at it for the first day or two. This makes it challenging to envisage the successful incorporation of portable structures in the system.

Climatic conditions

We are not sure whether providing additional comfort at the dairy (e.g. sprinklers and fans in hot weather) affects voluntary cow movement. We would expect that extreme weather events will affect cow flow. Short-lived weather events (e.g. a heavy downpour) are likely to affect cow flow in the short term. Prolonged unfavourable weather may affect cow flow initially; but cows usually adjust and continue with their routines. For example we wouldn't expect cows to stop moving around the farm during persistent heavy rain.

Milking

A full udder, or the need to be milked, has some effect on a cow's desire to move to the dairy. However this is not a strong incentive. The cost (effort) associated with getting the reward (being milked) is generally too great. Feed is far more reliable and works for all cows.

FOR MORE INFORMATION

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