PRODUCTION



THE UNIVERSITY of EDINBURGH The Royal (Dick) School of Veterinary Studies

The Jeanne Marchig International Centre for Animal Welfare Education

What you will learn: How different production systems impact on welfare of dairy cattle

The differences in the life cycle of feral cattle in nature and dairy cattle in commercial farms How most farms for dairy cattle are structured and managed

Main welfare issues related to production approaches and opportunities to promote positive animal welfare

Life cycle of dairy

cattle and common

production systems

This brief introduction to the production cycle of dairy cows aims to help you understand the broader welfare issues as they relate to the different age/developmental stages of dairy cattle.



Life cycle of 'feral' cattle

Despite the absence of an existing wild ancestor of cattle, there are a few populations of feral cattle available and cattle that have had minimal human interference. These cattle are different from modern breeds of cattle, usually being smaller and producing far less milk. Adult and immature females and males tend to live together in relatively small herds. Bulls generally live separately from the cows.

In Bos indicus herds in semi-natural conditions, the cow separates from the herd prior to parturition and gives birth in a hidden place. The cow remains on the periphery of the herd for up to 2 weeks, near her offspring, and often threatening other cows that approach too closely.



Between 1 and 3 weeks after calving, the cow and her calf join the rest of the herd; the cow grazing with others, while the calf tends to associate with other calves. Calves suck for approximately 10 bouts per day, each lasting about 10 minutes, at 1 month of age, decreasing to 5-6 bouts per day by 6 months of age. Calves, both male and female, are naturally weaned from 5-6 months of age in Bos indicus cows. In free-living Bos taurus herds, calves can wean at around 10 months of age. However, cows continue to associate with their offspring long after weaning and choose them as grooming or grazing partners for many years. When not with their mothers, calves usually associate with each other. Social interactions and play involving mock fighting are quite common between older calves, as well as mock sexual interactions between male and female calves.

Calves reared with their dam start grazing and ruminating at approximately 3 weeks of age and regularly graze with adult cattle at 4 to 6 months of age. Young ruminants learn to recognize suitable feed sources through mimicking the feeding behaviours of social companions. The cow influences the establishment and persistence of the calf's diet and habitat selection. As the calf matures and it depends less on its dam for milk, the mother's influence decreases, and peers in the social group have a greater influence on diet.

Within female herds, relatively stable, near-linear dominance hierarchies occur, with social rank strongly related to the age of the animals. The incidence of aggression appears quite low with little evidence of aggressive defence of feeding or grazing areas.



Life cycle of dairy cattle in typical commercial production

The duration of the life cycle stages of dairy cattle presented here represents the average of reported for commercial farms. The duration of each segment of the cycle may differ depending on the genetics and management system adopted.

Heifers and cows

For cows to produce milk they need to give birth to a calf. The start of an animal's productive period is therefore when the young heifers first calve. Heifers normally come from the calf herd on the farm (replacements). Heifers may reach sexual maturity at around 12 to 13 months old, depending on genetics and nutritional management. For example, in Ethiopia, traditionally cows are classed as "young" between 1-3 years. Indian cows' heifers attain puberty at around 20 months and crossbred (cross of Indian and European cows) attain puberty around 13-14 months of age. The oestrous cycle lasts for 21 days (range of 18 to 24 days).

After puberty, a female then exhibits continued oestrous cycles at even intervals, normally every 18 to 24 days. Heifers that have cycled 2 or 3 times prior to mating are far more likely to get pregnant than those that are cycling for the first time. Therefore, heifers may be artificially inseminated or mated with a bull at when the reach puberty anywhere from 15 months old (or when they weigh about 360 kg), or at ~60% mature body weight, depending on the production context. The gestation period lasts 283 days (9 months), so they will be calving at around 24 months of age (at youngest). Normal cycling resumes within 40 days of calving.

Pregnant heifers/cows will be separated from the lactating herd about 6-8 weeks before they are due to give birth (classed as 'dry cows'). When a heifer/ cow is ready to give birth, she will try to find a clean and dry area away from other cows. If the calf is in the correct position for birth, the labour should not need any human assistance. The cow will often eat the afterbirth (placenta) as this would attract predators in the wild.

Cows begin to produce milk only after calving. The lactation period lasts for 10 to 12 months or longer, before milking is terminated (dry-off period). Lactation periods may be shorter if nutrition is suboptimal. Following the 60 days of dry period, the cow calves again and lactation cycle begins again (as shown below).



Heifers and dry cows are usually moved to a 'closeup' dry cow group for observation beginning at 3 weeks prior to calving. The period from 3 weeks before calving until 3 weeks after calving is called the transition period; cows make a transition to producing milk and consuming a higher energy ration. Once calving appears imminent, cows may be moved to individual maternity pens or an open calving area. Cows raised on pasture are sometimes moved to pens for calving to allow close observation in case the delivery needs to be assisted, to keep the calf out of cold air flows, and to allow careful attention to the calf immediately after birth. Calving pens are usually bedded with lots of clean wheat or oat straw, although sand and sawdust can sometimes be used too. These changes aid comfort of the cow and calf at parturition, and help monitor calving progress.

Cows will be bred again at about 90 to 120 days after calving to maintain a yearly calving schedule while they are producing milk. Cows average about 2.5 lactations in a dairy herd, although many remain productive considerably longer. Lifespan varies with housing and management systems, and usually cows kept in more confined systems are replaced sooner compared to cows managed in more extensive systems. The leading reasons cows leave the dairy herd include low production, infertility, mastitis, and lameness. In settings with limited veterinary services, disease is a key issues too.

Calves

New-born calves are normally separated from the cow within the first 24 hours after calving, depending on the management system. The cow has a strong maternal instinct and is normally distressed by the removal of her calf. Both the calf and mother make loud calls trying to locate each other after they are separated. In cases where the calf is immediately separated from the cow, the mother is milked for colostrum and this is fed to the calf from a bottle, nipple feeder or bucket, otherwise the calf is left to suckle colostrum from the dam before separating.

In commercial settings, calves are raised in a separate environment from lactating cows, and can be housed in individual pens, paired or group housed or in some systems may be individually tethered indoors or outdoors. Female calves are kept in the herd for replacements as the next generation of heifers. Male calves are not economically valuable for dairy producers, but they can be raised as beef calves (more common in small subsidence farms), sold to veal or 'dairy-to-beef' farms, or culled. In less intensive systems, calves may still mix with adult animals, but are kept in small pens, yards, or tied on tethers, while the adult herd grazes. This can create risks for disease transfer, as well as limit access to feed and water, unless supplemented.

Aside from the very first days when calves are fed colostrum, they are often fed discarded milk or milk replacer. In some cases, feeding discarded milk can be a risk for increased antibiotic resistance so may not be practiced in some farms. Male calves raised in commercial dairy farms may have less milk allowance than female calves. Calves may also be offered water and calf starter feed, but access to these supplementary feeds, and the type of feed provided, is variable across production systems. Hay or fresh forage may also be offered to calves prior to weaning. In systems with cow-calf contact, calves are fed milk from the cow directly. Suckling needs to be balanced with retention of milk for sale purposes, so calves in these settings also need supplementation if they are to grow well.

In commercial contexts, calves are often weaned from milk at around 8 weeks of age. At weaning, calves are normally moved to group housing. Forms of group housing include hutches, free stall barns, and open housing on bedded pack. Some calves are weaned directly onto pasture. Normally, heifers are kept in these housing systems until they reach breeding age at 12 to 15 months. In commercial dairy production, feeds offered at this stage tend to include some calf starter, perhaps some other grain or corn silage and excellent quality hay is offered. Following breeding, heifers are maintained as a separate group until moving to the dairy farm for calving. Facilities are often less extensive. Often heifers are raised in feedlots, or on pasture, although some heifers are also raised in free stall barns. In smallholder contexts, weaning may not happen until ~6 months of age, as calves are kept with the cow.



Stock bulls

Bulls may be used for natural mating with heifers/ cows. They are normally kept in a separate pen/ paddock. A mature bull can serve 3 cows every 2 days or approximately 30 cows in 3 weeks. On larger scale commercial farms, most females are artificially inseminated. Vasectomised bulls can also be used in farms for heat detection.

Inbreeding

If keeping bulls for natural mating, it is important to avoid inbreeding, which is breeding of closely related animals. Increased inbreeding in a herd causes reduction in fertility and general viability, and leads to higher incidence of genetic abnormalities. Inbreeding can also cause loss of genetic variation and may also affect growth and productivity of animals.



Health and safety

A mature stock bull brings a distinct safety risk, with even docile bulls having the potential to be unpredictable. This means facilities should be adequate to house, manage and handle the bull without putting human health and safety at risk. Bulls may often be housed in small pens, although they may be grazed when conditions allow. Bulls should also be provided adequate housing space like cows in farm.

Dairy production

systems

Dairy production systems vary widely among geographic regions and can be divided into four categories, based mainly on housing type and husbandry management. Most dairy cattle in North America and Europe are in confinement free stall, tie-stall, dry lot or bedded pack systems with a smaller percentage on pasture. This can be seasonally variable, with winter housing and summer grazing very common in Europe. Cows in their first third of lactation, when milk yield is highest, may be more likely to be kept inside to facilitate access to highly nutritious feed.

In other areas of the world such as South America, New Zealand, and Australia, for example, pasturebased, pasture-intensive or semi-confinement systems are more common than confinement systems. In many parts of the world, however, dairy cows may be kept in small numbers for household milk consumption or contributing to dairy supply chains.



These smaller scale systems can be extensive, grazed systems or 'cut and carry' systems where fresh fodder is brought to the cows who may be tethered, at least for part of the day, or penned. These systems are more common in African and Asian dairy production. In these settings, systems may be more intensive (zero-graze or mixed farming), or more extensive (pastoral, agropastoral), and cows can be hand milked between 1-3 times a day, with most milk sold, and some kept for household use.

Extensive/subsistence systems

- These systems endeavour to match cow numbers with forage production on-farm/in communal grazing areas and graze livestock outdoors most or all of the year (≥9 months), or carry cut forage to the animals.
- Grass is less intensively managed and used more continuously without rotation among paddocks.
- No specific strategy of supplementation is practiced, and facilities may limit the volume of milk production.
- Cows may be milked once or twice a day, often by hand.
- The extensive/subsistence group represents the lowest production per unit of input.
- Herds may have a dual purpose, with animals kept for milk and meat or the females for milk and the males for draft.
- Hybrid grazing approaches are diverse. For instance, in some systems cows can be taken to pasture on uncultivated areas for 3-4 months a year, returning to more restricted conditions for calving.



Pasture-based systems

- Cows are kept outdoors. These systems may include hybrid approaches that use a combination of housing and enough land to support a few months (3–8) of grazing with forage preservation for non-growing periods.
- Pasture is closely managed, and cows are offered new areas to graze often. This may include changing paddocks every 12 or 24 h, which can result in greater milk production per cow and per acre than lowmanagement pasture systems.
- Concentrated feeds, which are high in energy and minerals that the cows need, as well as other forms of roughage (feed that is high in fibre, such as silage, straw and lucerne), may be used to keep the cows well fed where necessary.
- Many farms choose to calve seasonally and do not produce milk during the winter months when pasture availability is limited.
- If well managed, the farmrelies on minimal external inputs (supplementary feed, concentrated feed and fertiliser).



Semi-confinement system

- Cows are on pasture for part of the day.
- Pasture is not the main source of feed; cows are housed indoors for a large proportion of the day, receiving silage and concentrate supplementation; feed is usually offered in a bunk alley with concrete flooring.



Confinement systems

- Confined systems house animals with most or all feed harvested and brought to the animals with minimal use of grazing (≤2 months).
- Cows are usually milked two or three times a day and the method of milking depends on the housing type (e.g. by robot, machine milking, hand).
- Lactating cows may be kept in various housing systems, such as tie-stalls, freestall with cubicles, or bedded pack or dry lot systems.
- Cows may be fed a mixed ration that includes forages and concentrates, or component feeding can be used where cows are fed forages (such as hay and silage) and concentrates separately.



Housing systems for lactating

cows in confinement:

Tie-stall systems: Lactating cows are tethered in an individual stall. They are fed and usually milked while tethered and have no or limited outdoor access. Water is offered in individual water bowls or drinkers, placed in front of each stall. The type of water infrastructure often limits the amount available. Tie-stall housing limits animal social interaction and movement, including walking, grooming, and grazing. Some farms provide an exercise area where cows can spend part of a day untethered and socializing. In colder climates, this opportunity for movement can be seasonally restricted.



Free stall systems: Cows can move from stall to stall and along the passageways freely and are not tethered. Cubicles with bars to separate adjacent cows are provided in the lying areas and can be bedded or provided with rubber mattresses. Cows are taken to the milking parlour two or three times a day. Milking parlours can be of various types such as low-cost step-up, herringbone, parallel or rotary. In front of the milking parlour there is a waiting area where cows gather until they can enter the parlour to be milked. All cows within each pen or group are usually brought to the parlour holding areas together. In farms with very progressive infrastructure, cows with freedom of movement can be milked voluntarily in a robotic milking system, where the cow may choose when she wants to be milked. Cows are fed a total mixed ration (TMR) that includes forages and concentrates inside the freestall barn using a feed bunk. Clean water is always available using water troughs normally positioned in the alleys.



Zero-grazing smallholder systems: these are often akin to free-stall systems, but areas available may be very small, and opportunities for ad libitum water hard to provide. Bedding is often limited or hard to keep clean and dry. Milking is done by hand in the pen or nearby, 1-3 times a day.

Bedded pack systems: Composed of a large covered resting area bedded with straw or corn stalks (conventional bedded pack) or with sawdust and stirred twice a day (compost bedded pack or 'compost barn'). Bedded pack systems offer freedom of movement to the cows as there are no restrictions to positions assumed while lying down and the surface is soft. If well managed, bedded packs can result in excellent cow comfort and udder health. However, if the bedding gets too wet or soiled, it can result in greater mastitis incidence. It can be extremely difficult to maintain bedding cleanliness and thermal comfort for cows. In these systems, cows are also milked in a parlour and fed in a feed bunk as described previously. Clean water is always available using water troughs normally positioned along the covered area.

Dry lot systems: More commonly used in the United Stated or other countries with arid climates. Cows are housed on large resting areas of dirt or sand, and come to a feed bunk to eat, which may or not be covered. There can also be shaded areas within the dirt lot and these can include cooling systems, such as fans and foggers. Heat stress can be a problem if appropriate heat mitigation practices are not implemented. Muddy conditions can also cause stress during certain times of the year. Cows come to a parlour to be milked as described above.



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