Cow-bonded calf rearing in dairy farming

A practical guide

Bioland

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Christian-Albrechts-Universität zu Kiel

Agrar- und Ernährungswissenschaftliche Fakultät

In recent years, calf rearing has been recognised more and more as the key to successful dairy farming. The positive effects of early and enough colostrum intake, of ad libitum milk feeding, and of group housing have been demonstrated multiple times. Furthermore, the practice of early separation of the calves from their dams has been questioned. A growing number of farms nowadays enables contact between calves and cows for a longer period. This is being done in various ways, and in many cases the approaches are ongoingly refined and adapted to farm-specific conditions.

With this guide we would like to give beginners, experienced farmers, and all those interested in the topic an overview of possible ways to implement cow-bonded calf rearing in dairy farming. Moreover, we wrote this guide to point out aspects that must be considered by those getting started, to provide solutions to possible challenges, and – last but not least – to address questions that remain unanswered.

The guide is the result of intensive collaboration between farmers, advisors, and researchers within a project of the European Innovation Partnership (EIP) initiative. In creating the design and content, we focused on considering current needs in practice while including experience-based knowledge and scientific insights from research experiments. The database for practical implementation comes from a small sample of organic farms in Schleswig-Holstein and thus does not claim general validity.

We are aware that we certainly cannot answer all questions, that we may have overlooked an error or two, and that the statements made in this brochure will have to be reassessed in time. Therefore, we are always grateful for comments and suggestions. On the website **www.kuhgebundene-kaelberaufzucht.de** you will find further information (in German) as well as a contact form to send us a message.

We wish you pleasant reading and hope you will benefit from this guide!

On the website **www.kuhgebundene-kaelberaufzucht.de** you can download information, calculations, checklists regarding calf health, etc.

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Content

How to use this guide

The guide is based on questions that farmers often ask themselves when they think about trying out cow-bonded calf rearing on their farm. According to the diverse aspects of this topic, these questions do not necessarily build on one another. References to other chapters shall help the readers find their way through the web of information without overlooking anything important. The appendix provides checklists, assessment forms, and examples of calculation along with formulas. These tools are meant to facilitate the practical application of the information presented in the text. You can also download these tools along with various Excel forms on the website www.kuhgebundene-kaelberaufzucht.de.

Glossary

24-hour contact: The continuous contact between cow and calf or calves, only interrupted for necessary work routines, such as milking or providing fresh bedding

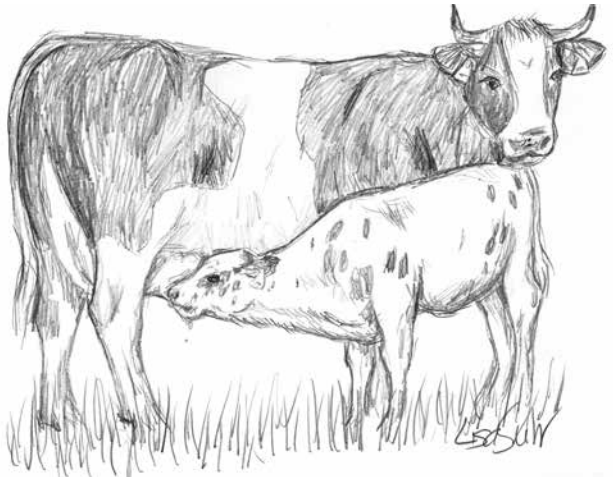
Weaning: Weaning from the milk

Gradual weaning: Contact time between cow and calf is reduced in several steps until the animals are separated

Two-step weaning: Either first spatial separation from the dam (transfer to foster cow or bucket feeder) and then weaning from the milk; or first weaning from the milk (e.g. nose flap) and then separation from the dam or foster cow

Separation: Spatial separation

Calf creep: Separate area for the calves



1 The central question – Why do I want to switch to cow-bonded calf rearing?

The answer to this question leads to decisions that can directly affect many areas of the farm management and may influence the economic success of the farm. In the following, several motives are listed, along with an attempt to infer possible consequences. Often there is not just one reason to choose this rearing method. It thus makes sense to create a list of priorities so that conflicting interests can be recognised early and are likely to be solved.

The animals can express social behaviour in the herd.

'I want to gain a higher level of professional satisfaction, want to be happier again when I work with the animals.'

'To see my animals in a natural herd makes me happy.'

For many farmers who practise cow-bonded calf rearing, this is an important point. Often, the farmers would also like to redirect their focus to the animals.

To date, the effect of professional satisfaction on the economic success of a farm has received little attention although it certainly should not be underestimated. More fun at work often directly affects the way in which the work is being done and thus the work efficiency. Nonetheless, one should be aware of the potential financial consequences for the farm.

➟ 4 What are the incurred expenses?

Calves that grow up in close contact with cows do not necessarily view a human as an important social partner, which is otherwise the case when a human raises the calves (e.g. bucket feeding). However, a good animal–human relationship is required for an easy handling of the calves later in their life, when they will have become cows or fattening bulls. Therefore, farmers who practise cow-bonded calf rearing must actively establish close contact to the animals.

➟ 2.9 How do I prevent the animals from turning wild?

‘It is my desire that my animals can express their natural behaviour even if I use them for milk and meat production.’

The use of animals implies the restriction of their natural behaviours to varying degrees, and cow-bonded calf rearing is no exception. For instance, if you keep a calf with its dam until the natural time of weaning, this period may last for more than 12 months.

➟ 1.1 How does that actually happen in nature?

The amount of saleable milk would be reduced greatly in this approach. Farmers whose income depends on milk production simply cannot afford to do that. Thus, while aspiring to establish an ideal natural husbandry system, a farmer will always have to compromise for various reasons. The need to compromise particularly applies to the processes of weaning the calves from the milk and separating them from the cow.

‘I would like the calves to be healthier.’

An improvement of calf health is often on top of the list of expectations associated with this type of rearing, and, as always, there is no simple approach to a solution. As a general rule, adverse husbandry conditions such as poor hygiene, bad air, or draught in the barn cannot simply be compensated by the calves now having contact to cows.

Practitioners often report improved calf health.

Nonetheless, positive effects may arise because abnormal behaviour and thus stress are prevented, the milk temperature is always optimal, and the calves experience immediate and species-typical care – for example through licking – which humans cannot replace. Therefore, care must be taken to not cancel out the health benefits that cow-bonded calf rearing can offer to the calves by neglecting other areas – especially because the monitoring of calf health in this system requires a much closer observation of each animal, which in other systems can be done during bucket feeding.

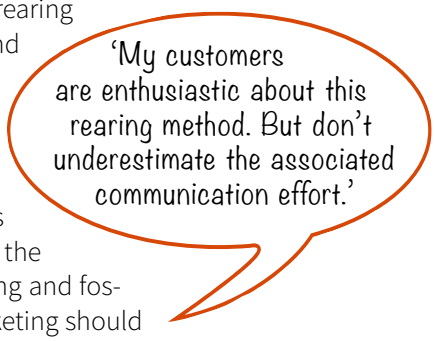
A note of caution: In this rearing system, just as in others, good management is crucial for calf health.

➟ 2.2 How can calf health and milk intake be monitored?

‘It is important to me that the calves not used for breeding can remain on our farm. That’s also what our customers want.’

Many international studies have shown that consumers of milk and milk products often do not know that most calves are separated from their dam shortly after birth and then raised with bucket feeders. When survey respondents were told about this practice, they mostly disapproved of it. Further information about the reasons for this early separation barely influenced their attitude.

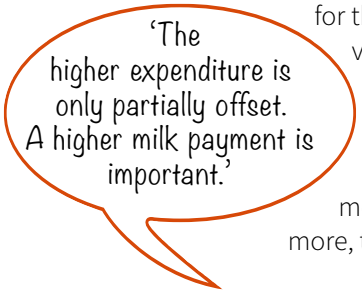
For farmers who have direct contact to their customers and can describe their rearing approach along with the consequences for the farm (such as added costs and increased working time), cow-bonded calf rearing can be an opportunity to increase sales and income. This gain is even more likely if the unusual rearing method can be displayed (for example when cows and calves graze together on pasture) and communicated (for example in the farm shop, during farm festivals, or via flyers). However, please be aware that perhaps not all trade-offs that were necessary to realise this rearing method may be communicable to the customers. It remains to be seen if consumers distinguish between dam rearing and fostered rearing and if they prefer certain forms. Especially farms with direct marketing should consider this point in the realisation of the method.



‘I would like to improve the farm income.’

The income from operations depends on two factors: expenses and proceeds. Cow-bonded calf rearing can affect both – and the expected outcomes are specific to each farm. Whereas farms with direct marketing can directly explain a price increase due to introduction of the new method to their customers, to date almost no dairy honours this special rearing method with better prices.

➟ 1.2 Which systems are available?



If this situation will change remains to be seen. Special milk types usually cause extra effort for the dairies because of the required registration and separate processing. Thus, a very high market demand is necessary for these special products. .

With respect to the incurred expenses, advantages might arise from improved animal health, reduced working time, or use of already present resources, such as the use of old buildings for fostering. On the other hand, additional investments and increased personal time input could cause disadvantages. Furthermore, the reduced amounts of saleable milk should not be underestimated.

➟ 2.4 What happens at milking?

'… but I also have other reasons.'

This small selection certainly does not cover all reasons why farmers may opt for cow-bonded calf rearing or even decide against it. It shall simply help in becoming aware of one's own underlying motivation.

1.1 How does that actually happen in nature?

Cattle that are kept in natural or semi-natural conditions show specific behaviours:

Before giving birth, cows usually withdraw from the herd and seek a slightly secluded, sometimes also vegetated place. This retreat serves to protect them not only from natural enemies, such as predators, but also from curious herd members. If retreat options are not available, the animals may stay with the herd. The cows are restless, getting up often and lying down again. Dairy cows have been observed to reduce their feed intake and rumination time shortly before calving; furthermore, they paw the ground, and they lift the tail and lick themselves more often than usual. Directly after calving, the cow begins licking her calf thoroughly. Time measurements have shown that dairy cows lick their calf on average for up to 90 minutes within the first 12 hours after calving. The licking is often accompanied by repeated deep mooing sounds. This interaction, along with picking up the calf's scent, plays an important role in the bonding between dam and calf. During this phase, an alien calf is quickly accepted by the cow.

From the natural behaviour of the animals, one can infer important aspects for designing cow-bonded calf rearing systems.

The calf usually begins seeking the teats after one to two hours, but several hours may pass until its first intake of colostrum. Studies under housing conditions have shown that up to one third of the calves do not take in colostrum within the first six hours after birth if they are left to themselves. During the first days after birth, the calf is left alone when the cow goes to feed. The cow repeatedly returns to her calf to nurse it. After only three days, the calf may join the 'kindergarten' formed by the calves of a herd.

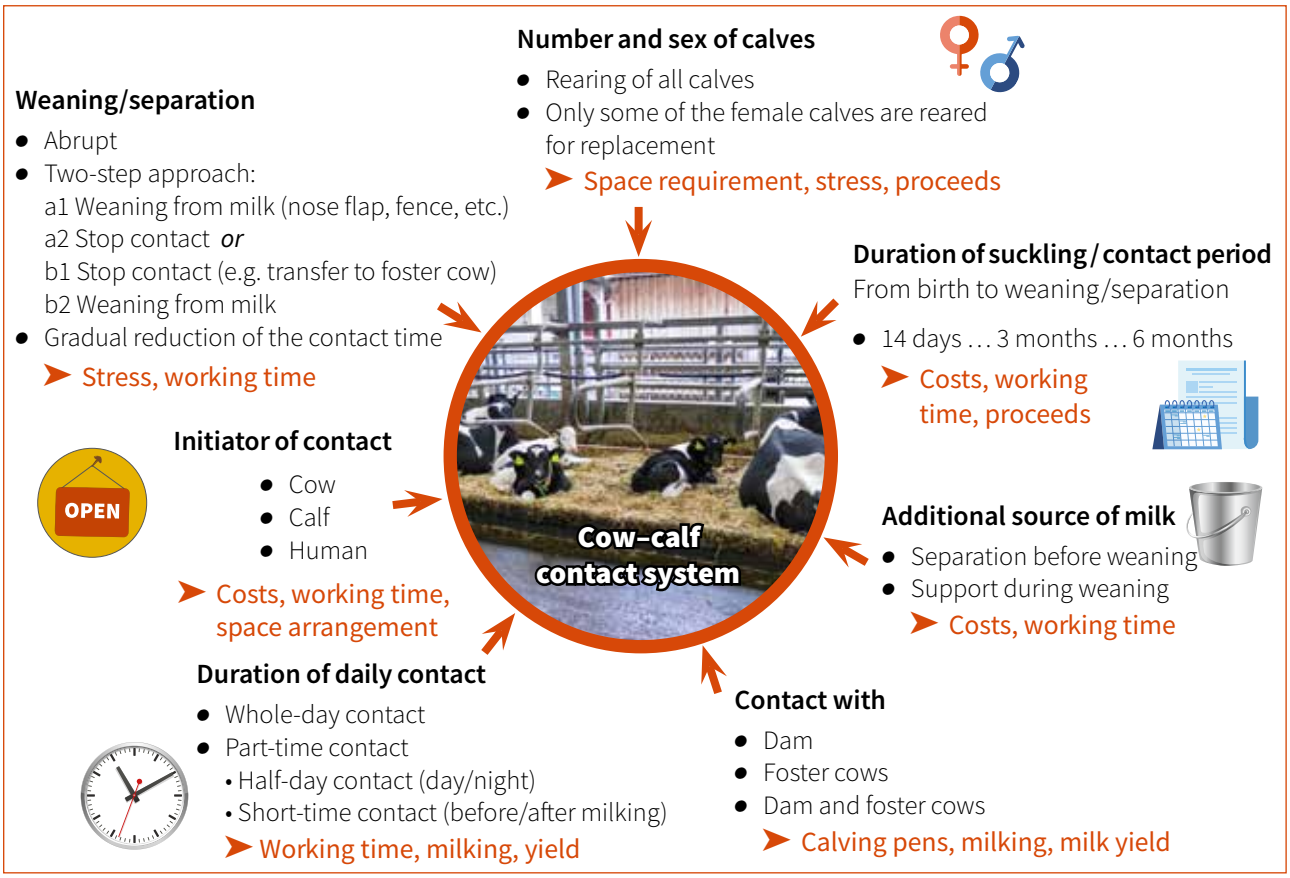
At first the calf does not visually recognise its dam, so she frequently calls it to suckle. At daytime, calves generally suckle six to eight times. During the first weeks of life, the cow identifies the calf by sniffing. Hence, calves mostly approach the cows from the front and then move alongside the body of the cow until they reach the udder. This inverse-parallel position is typical of calves suckling their dam. However, suckling from the back can also be observed. The latter position allows the calf to avoid the scent check by the cow. Thus, it can often be seen in calves that suckle another cow and not their own dam. The natural nursing period may last more than one year but usually ends with the birth of the next calf. The decline in the amount of milk with progressing lactation period corresponds to a slow weaning, which is further supported by the cow's rejections.

Farmers who would like their farming routines to closely match natural conditions should give the cows the opportunity to withdraw into a protected area for calving und facilitate close contact between cow and calf during the first days. The best option would be a single calving pen, but a structured group calving area is also conceivable. The latter also helps in supporting the

acceptance of alien calves. Especially in fostered or mixed rearing, the calves meet other cows early, which can ease the later management. To enable natural suckling behaviour during rearing, the calves must continuously, or at least more than twice during daytime, have the opportunity to suckle the cows.

1.2 Which systems are available?

To date, there is no standardised method for cow-bonded calf rearing. Most of the farms have adapted their system to the given conditions, resulting in a variety of approaches. Nonetheless, all the approaches have several principal aspects in common. These do not necessarily form a logical linear sequence but rather have a weblike structure. Thus, we recommend assessing each aspect with respect to the own farm and going through various combinations of approaches before deciding on a certain system.



Modules of cow-bonded rearing – almost all module variants can be combined (red: the decision has an influence on, among other factors, …). Source: Dr. Kerstin Barth

Number and sex of the calves

The number of calves determines the required inputs (space, feed, working time) and has effects on the amount of saleable milk. If the male calves are not to be continually reared in the system, it is important to consider that separation from the cow after two to three weeks implies a high level of stress and that the calves during fattening may have problems learning to drink from a bucket feeder[1]. Immediate separation after calving would then require additional space and equipment, for example calf hutches. Farmers who would like to rear the bull calves in the system until weaning but not keep them for fattening should clarify the transfer of the animals in advance.

1 The term 'bucket feeder' refers to all milk feeding methods; thus, it includes automatic milk feeders.

Duration of the suckling period

To date, there are no general provisions stipulating how long a calf must suckle its dam or a foster cow to be considered as 'reared with cow bonding'. However, individual producer cooperatives have established their own standards, and we can expect more of those in the future. Because the pioneers of cow-bonded calf rearing were mostly organic farms and the organic farming guidelines require that calves drink whole milk for 90 days, this period is generally established. However, longer or shorter periods are also possible. If the suckling period is less than 90 days, organic farms must habituate the calves to drinking milk from buckets or automatic feeders, which requires additional effort and implies additional stress for the animals.

Additional source of milk

Experiments have shown that if calves are offered an additional source of milk besides suckling at the udder, they continue using this source upon weaning from the udder. In this way, the level of weaning stress can be reduced.[1] However, the additional supply involves additional effort.

Contact with dam and/or foster cows

Cow-bonded calf rearing includes dam rearing and fostered rearing equally. Considerable differences exist between the systems and have consequences for the entire management as well as for effort inputs and proceed outputs. Dam rearing means that the cows that are allowed to keep their calf will nurse it until weaning. In fostered rearing, the situation is not as straightforward, and additional questions arise:

- Shall the foster cow keep her own calf as well, or shall she only nurse alien calves?
- When shall the transfer from dam to foster cow happen?
- How many calves can the foster cow nurse?
- Shall the foster cow also be milked?

'Selecting the foster cow is a bit like trial and error each time. Older cows have worked well for me, but one of my colleagues favours heifers. It's best to stay flexible.'

The answers determine many other aspects in the system, such as the number and design of the calving pens, the selection of foster cows for the system, the herd management, etc.

Foster cows accept foreign calves more readily when they have just given birth to their own calf. Previous studies on beef cattle have indicated ways to promote acceptance: The alien calf is covered with a cloth jacket that the cow's own calf had worn shortly after birth.[2] Also, very early contact, for example during joint calving of several cows, can ease the acceptance of alien calves.

Duration of daily contact

The housing requirements will differ depending on the duration and timing of the contact between calves and cows.

If cows and calves are to have continuous contact, that is, for 24 hours (except for times of milking, etc.), they must be able to jointly use barn areas. This joint usage may not be possible because of unsuitable barn equipment or the location of the barn buildings; in such cases, part-time contact must suffice. Part-time contact may also be chosen if stricter control of the timing and duration of suckling is desired. Half-day contact, for instance, allows for a true milking interval during which the udder is not emptied, which in turn can ease the milking. However, half-day contact just as well requires that cows and calves can jointly use barn areas. This is not the case for short-time contact. In this practice, the calves are allowed to suckle for a limited duration after which they are reseparated from the cows. Short-time contact can be organised during times that best fit into the farming routine, for example before or after milking; suckling in the middle of the milking interval is also possible. What short-time contact cannot provide

1 Cf. Johnsen et al. (2015)

2 Cf. Dunn et al. (1986)

is repeated suckling throughout the day. Two contact times are most common, corresponding to two suckling events per day. As long as the milk supply from the cows is large enough, the calves gain as much weight as in other systems and do not show abnormal behaviours such as cross sucking other calves – nonetheless, especially in Simmental calves, cross sucking has been observed after weaning from the milk, and the underlying causes remain to be explained.

Dam and calf on pasture

Foster cow with calves in the contact area

Initiator of contact

The following options are possible:

- **Calf as initiator:** The calf can decide when it moves from the calf area to the cow in the barn.
- **Cow as initiator:** The calf can access a contact area from the calf area, but the cow decides whether she also enters this contact area.
- **Human as initiator**: Cow and calf are brought together by a human. This is the common approach in short-time and half-day contact. Of course, the latter can be combined with the first two variants during the actual contact time.

If the animals are free to initiate the contact, the situation more closely matches their natural behaviour. However, the active uniting has the advantage that the caretaker regularly handles the animals, the calves learn very early to be moved, and the animal health check can be done at the same time.

Weaning and separation

For the calf, the weaning from the milk and the separation from the cow are changes that are associated with stress. If weaning and separation happen abruptly – that is, the calf has at once no more access to the udder and no more contact with the cow – the associated stress is especially high. This situation should be avoided. For a stepwise (or gradual) approach, either the two events can be separated, or the contact duration can be reduced bit by bit. The chosen approach certainly influences the required working time.

1.3 So, which system suits my farm?

Before you choose the system, we recommend that you identify the underlying motivation for implementing cow-bonded calf rearing because from that realisation a preference for one or another system may already arise. Thereafter, a matching with the farm-specific conditions is advisable. To support the decision making, the flow chart below shows various key points for the assessment of the own system. The mental starting point in this flow chart is the wish for a continuous-contact dam rearing system. The table on Page 13 shows necessary prerequisites and the effects of the systems on important aspects of the farm management. The decision tree on Pages 14/15 reveals the advantages and disadvantages of the different contact times between calves and cows.

Important questions during decision making

[1] *To ease for example the milking, see the chapter references on the flow chart illustrating the duration and timing of contact with the associated advantages and disadvantages on Pages 14/15.*

[2] *For example waiting area, outdoor run.*

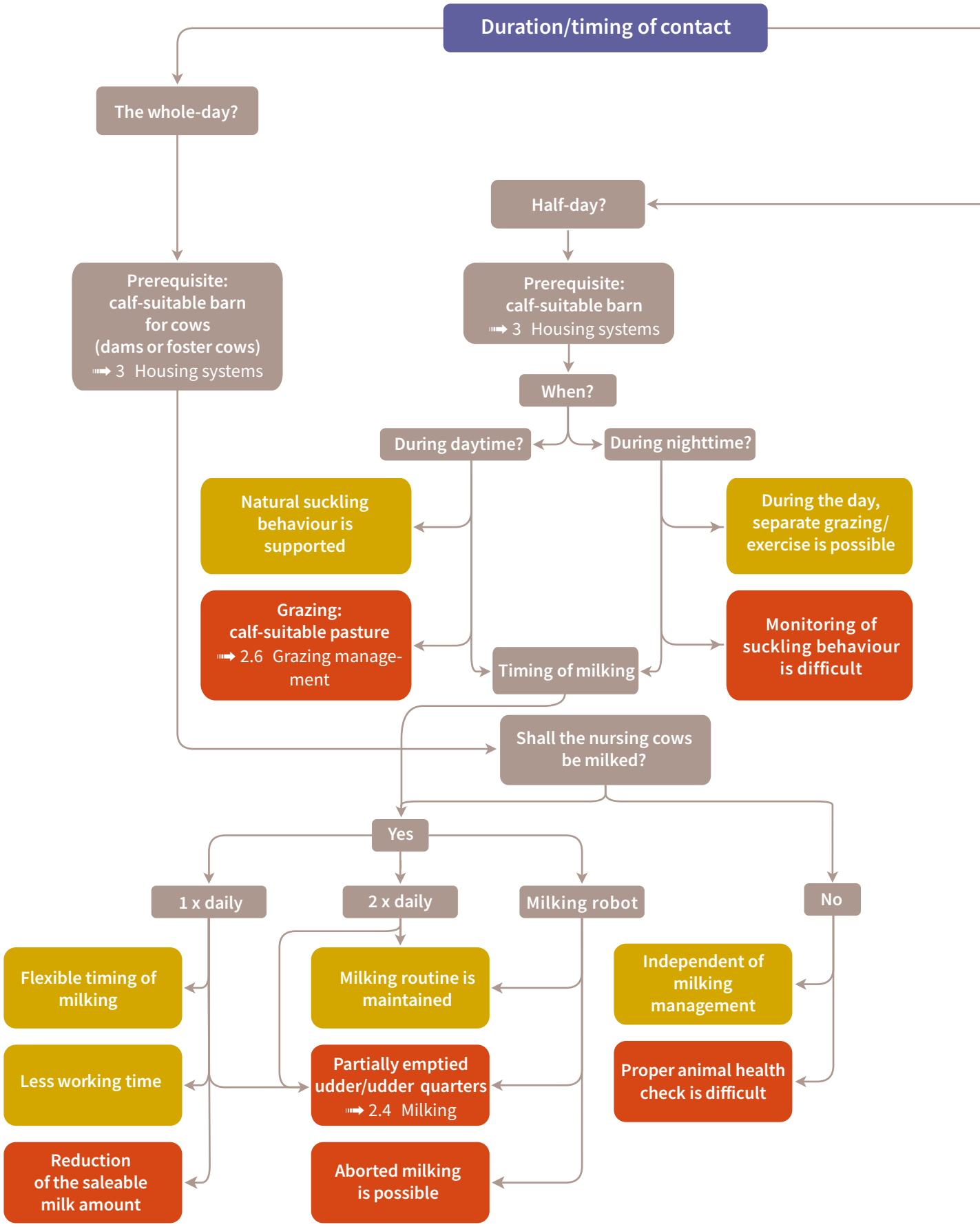
[3] *Installation of a calf area/calf creep is preferable.*

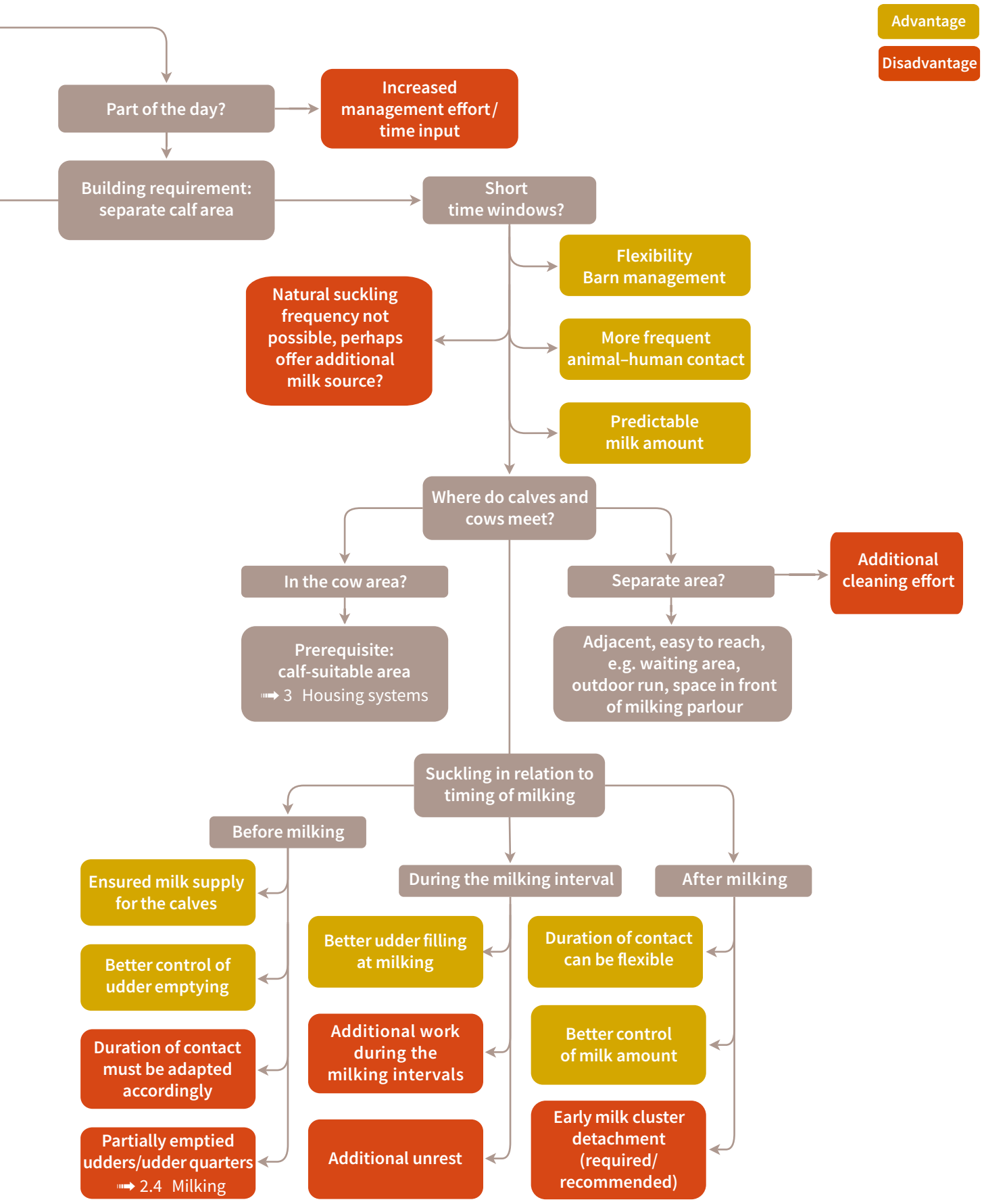
Requirements and effects of the different rearing systems with respect to housing and management

<table>
<tr><th>Rearing system / Effect on ...</th><th>Whole-day contact, dam (with milking)</th><th>Whole-day contact, foster cow (with milking)</th><th colspan="2">Part-time contact, dam/foster cow (with milking)</th></tr>
<tr><td></td><td></td><td></td><td>Half-day contact[1]</td><td>Short-time contact</td></tr>
<tr><td rowspan="3">… the housing</td><td>Milking parlour near the jointly used cow–calf area</td><td></td><td>Milking parlour near the cow area or the jointly used cow–calf area</td><td>Existence of a contact area (contact time before or after milking) near the milking parlour/calf area</td></tr>
<tr><td colspan="2">Separate calf area (freely accessible)
Available lying space in cow area > number of cows</td><td colspan="2">Separate calf area (controlled access)</td></tr>
<tr><td colspan="4">Eliminate safety hazards for calves
Jointly used barn areas must comply in Germany with TierSchNutztV Section 2 Article 6</td></tr>
<tr><td rowspan="2">… the grazing</td><td colspan="3">Joint grazing</td><td>Perhaps separate calf pasture (Consider vicinity to contact area!)
Reduce parasite pressure on calves by pasture rotation</td></tr>
<tr><td colspan="4">Fencing must be suitable for calves</td></tr>
<tr><td>… the workload</td><td colspan="2">Time input relatively low
• More elaborate animal health check owing to lack of fixed contact times
• Human–calf contact must be actively established</td><td colspan="2">• Workload higher owing to daily uniting/separating of cow and calf
• Fixed times for animal health check
• Frequent human–calf contact</td></tr>
<tr><td rowspan="3">… the milking</td><td>Milk ejection problems</td><td></td><td colspan="2">Milk ejection problems</td></tr>
<tr><td rowspan="2">Partially or completely emptied quarters before milking</td><td rowspan="2">After weaning</td><td>Contact before milking: Partially or completely emptied quarters during one milking sessiont</td><td>Contact before milking: Partially or completely emptied quarters before milking</td></tr>
<tr><td>Contact after milking (separation phase before milking): Udder full</td><td>Contact after milking: Udder full</td></tr>
<tr><td rowspan="3">… the calves</td><td colspan="2">Natural suckling frequency possible</td><td colspan="2">Controlled suckling frequency</td></tr>
<tr><td>Amount of available milk not limited</td><td>Amount of available milk limited by number of calves per foster cow</td><td colspan="2">Amount of available milk limited</td></tr>
<tr><td colspan="4">Contact with other adult animals
No cross sucking if milk supply is optimal</td></tr>
<tr><td>… the cows</td><td>Stress on udder tissue and teats due to milking and suckling is possible</td><td>• Perhaps increased risk of udder injuries when cow–calf ratio is too wide or milk yield is too low
• Foster cows should accept multiple calves</td><td colspan="2">Stress on udder tissue and teats due to milking and suckling is possible</td></tr>
<tr><td>… the marketing</td><td>• High acceptance by customers
• Amount of saleable milk is markedly reduced
• Reduced milk fat content is possible</td><td>Milk of foster cows is not marketed</td><td colspan="2">• Milked/suckled milk amount is more or less controllable
• Reduced milk fat content is possible</td></tr>
</table>

1 Includes contact time either during daytime or during nighttime

How much time per day should the cow (dam or foster cow) and calf spend together?




Advantage
Disadvantage
Part of the day?
Increased management effort / time input
Building requirement: separate calf area
Short time windows?
Flexibility Barn management
Natural suckling frequency not possible, perhaps offer additional milk source?
More frequent animal–human contact
Predictable milk amount
Where do calves and cows meet?
In the cow area?
Separate area?
Additional cleaning effort
Prerequisite: calf-suitable area
➠ 3 Housing systems
Adjacent, easy to reach, e.g. waiting area, outdoor run, space in front of milking parlour
Suckling in relation to timing of milking
Before milking
During the milking interval
After milking
Ensured milk supply for the calves
Better control of udder emptying
Duration of contact must be adapted accordingly
Partially emptied udders/udder quarters
➠ 2.4 Milking
Better udder filling at milking
Additional work during the milking intervals
Additional unrest
Duration of contact can be flexible
Better control of milk amount
Early milk cluster detachment (required/ recommended)

2 Management and good agricultural practice – What should be considered?

Although the individual systems differ markedly from one another, there are a few principles that should always be considered..

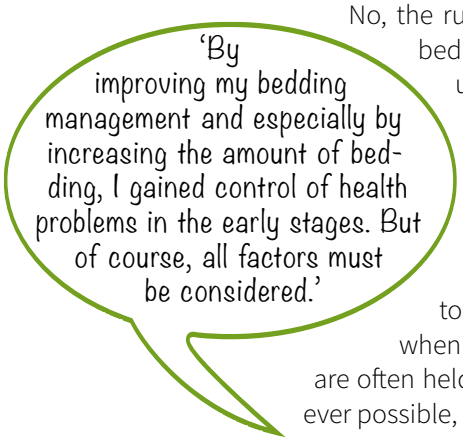
General legal framework

Like all farming operations, farms that practise cow-bonded calf rearing are subject to legal regulations. You will find a selection of relevant laws and regulations in the appendix. Please note that this guide mainly addresses farmers in Germany. Regulations specific to individual federal states or other countries are not included. Before conversion of the calf rearing system, farmers are well advised to clarify the current legal situation. The same applies to private-law contracts, for example milk delivery contracts, which might exclude this form of rearing.

In line with the **Animal Welfare Act** (German designation: **Tierschutzgesetz**, TierSchG), animals must be housed, fed, and cared for according to their needs and species-specific requirements. They must not be forced to perform in ways that go beyond their abilities or exceed their powers (**TierSchG Article 2, Article 3**). Regarding calf husbandry, the **Directive on the Protection of Animals and the Keeping of Production Animals** (German designation: **Tierschutz-Nutztierhaltungsverordnung**, TierSchNutztV) must be observed. The standards for organic farming go well beyond these regulations because there, individual housing of calves is only allowed until their seventh day of life (**Regulation [EU] 2018/848 Annex II Part II, 1.9.1.2 c**). Furthermore, the same regulation stipulates the feeding of maternal milk for at least 90 days (**Regulation [EU] 2018/848 Article 14[3] and Annex II Part II, 1.4.1 g** and **Commission Implementing Regulation [EU] 2020/464 of 26 March 2020**). Furthermore, access to pasture must be possible whenever weather and soil conditions allow it (**Regulation [EU] 2018/848 Annex II Part II, 1.9.1.1 e**).

2.1 Are there any specific requirements for barn hygiene?

No, the rules of good agricultural practice apply. However, the cleaning effort and bedding requirements can be increased in systems in which cows and calves use the same barn areas. If, for example, the lunging space in the freestalls shall also serve as lying area for the calves, this space must be cleaned regularly.



To be able to break chains of infection, farmers should follow the 'all in–all out' protocol with appropriate timing of cleaning and disinfection. This protocol should be considered in the design of the housing system, for example when planning the number of calving pens. If calving is not seasonal, the calves are often held in mixed-age groups, and thus the hygiene requirements are high. Wherever possible, one should schedule periods for thorough cleaning and disinfection.

2.2 How can calf health and milk intake be monitored?

2.2.1 Feeding

In general, the feeding requirements in cow-bonded rearing are the same as in bucket feeding.

Colostrum intake

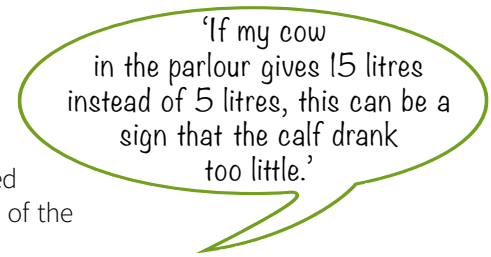
In the first days after birth, the calf receives colostrum from its dam. This first milk is essential because a newborn comes into the world without functional immune responses to infections. Colostrum contains many antibodies (immunoglobulins), which protect against various infectious diseases and stimulate the development of the gut flora. Therefore, a sufficient initial supply during the first four hours after birth is crucial (TierSchNutztV Article 11 Clause 2). At least two to four litres of colostrum are recommended.[1] It takes several weeks for the calf's own, actively acquired immunity to set in.

There is evidence that this passive immunisation of the calf despite contact with the dam is not always guaranteed.[2] Some calves fail to drink milk directly from the dam's udder during the critical period. Simply leaving the calf alone with its dam after calving thus increases the risk of failure of passive immune transfer. Therefore, the intake of colostrum must be monitored. Calves, especially those of primiparous cows, that do not suckle enough colostrum should be fed supplementary colostrum. We recommend keeping a stock of colostrum – which of course should be checked for its quality, for example with a refractometer.

Whenever calf health problems arise, the supply of colostrum should be checked thoroughly. It can be checked directly in blood samples of the calves (total protein content). To do so, blood samples of several (preferably six to twelve) 2- to 10-day-old calves are taken and analysed. If fewer than 75% of the calves have at least 55 g/L total protein, the management must be improved accordingly.[3]

Additional milk supply

In a recent study, calves that had access to an automatic milk feeder during the suckling phase used the feeder rarely but showed less stress during weaning because they could switch to the automatic feeder.[4] Likewise, calves can be offered additional milk in a teat bucket. Especially in fostered rearing, this could be an option to reduce the competition for the teats of the cows.



Roughage intake

The calves must be offered roughage from their eighth day of life onward (TierSchNutztV Article 11 Clause 6). To encourage roughage intake early on, it is helpful when the cows can serve the calves as a model. Joint grazing on pasture and joint feeding in the barn can support this process. However, options for joint feeding in the barn are not always easy to establish. For hygienic reasons, calves should be prevented from walking on the feed table and thus on the feed of the cows; feed fences for cows are not always calf appropriate (for example: inadequate height, locking clamps pose a risk). In a separate calf area, roughage provision is easier to realise because competition by the cows is omitted and soiling is easier to avoid. Adjacent feeding areas for cows and calves are the best solution.

➟ 3.2.4 Feeding area

Controlling the extent of milk intake

In contrast to bucket feeding, the milk intake in cow-bonded rearing is not as easy to control. Here, it is important to look at each calf individually: Does it seem vital and active? Does it play with its dam or with other calves?

If the calves have only short-time contact with the cows, the suckling of the calves is particularly easy to control. If necessary, for example if a calf is repeatedly displaced from the udder,

1 Cf. Kunz/Steinhöfel (2012)

2 Cf. Beam et al. (2009)

3 Cf. De Kruif et al. (2014)

4 Cf. Johnsen et al. (2015)

'Since we reduced the cow-calf ratio, we have seen a marked improvement in the vitality of the calves.'

the farmer can intervene. In mixed or pure fostering systems, younger calves should be able to suckle before the older ones so that they can drink enough milk.

In dam rearing, the calves usually receive enough milk – unless the dam produces too little milk or refuses her own calf. In cow-bonded rearing, in which one cow will nurse several calves, it is necessary to ensure that the milk amount is enough for all caves. Based on the production level of the cows and the minimum amount of milk that each calf shall receive, one can estimate how many calves a cow can maximally nurse.

Calculation of the number of calves that can be nursed by one cow (cow–calf ratio)

Parameter	Example with milking	Example without milking	Own calculations	
Milk yield (Litres per cow and day)	28	28		
	–	–	–	–
Milkable milk (Litres per day)	10	0		
	=	=	=	=
Milk for suckling (Litres per day)	18	28		
	÷	÷	÷	÷
Minimum milk supply (Litres per cow and calf)	10	12		
	=	=	=	=
Cow–calf ratio	**1,8 (≙ 1 bis 2)**	**2,3 (≙ 2)**		

However, this simple calculation does not suffice. The following points must also be considered:

Is the cow–calf ratio appropriate?

- The lactation curve: The milk production declines over time so that cows in late lactation can nurse fewer calves.
- The number of functional teats per cow.
- The number of calves in one suckling group and the age structure: Older, stronger calves displace younger ones and switch more quickly from one cow to another.
- Acceptance of the calves by the cows: If not all cows accept all calves equally, the calf-friendly cows are suckled excessively, which can lead to udder skin lesions.

➟ 2.3.1 Udder health management

To find out exactly how much the calves drink, one could use the 'weighing-suckling-weighing' method[1], which is applied as fol-

1 Cf. Boggs et al. (1980)

lows: The calf is weighed, then allowed to suckle, and finally weighed again. The difference between the two weights (minus possible release of urine and faeces) gives the amount of drunk milk. This method is very elaborate and thus not suited for practical on-farm use.

On the farm, only direct observation of the calf helps: Do you see the calf suckle, is its belly filled, what are the daily weight gains? However, the checking of the body weight alone cannot reveal if the weight gain resulted from milk or other feedstuffs. If the calves are offered a feeding bottle and respond to it, their responsiveness can indicate insufficient milk supply. Empty udder quarters at milking indicate suckling by the calves, but you will not know if it was the cow's own calf that drank the milk. You can only find out by direct observation. For that, the regular calf health check is helpful.

➟ 2.2.4. Health monitoring of calves

Supply of concentrate feed and minerals

Calf-appropriate concentrate feed is best provided in a separate calf area. Even though suckling calves do not eat much concentrate feed, the early provision may ease the transition after weaning from the milk.

An adequate supply of minerals, trace elements, and vitamins for the calves must be guaranteed. Hence in the beginning, adequate feeding of the dam is essential, and later, with increasing intake of solid food, the calves must be given adequate mineral feed.

Selenium supply must be checked regularly in dry cows and late-gestation heifers. In case of calf health problems, also the iron supply should always be checked and improved as necessary.

Supporting the roughage intake through additional supply in the calf area

Water supply

From the second week of life onward, all caves must have access to enough water (TierSchNutztV Article 11 Clause 4). Water troughs for calves should be installed in places where the animals stay most frequently. Especially on pasture the calves need access to water. An adequate height of the water trough is important so that the calves can easily drink from it (recommendation from practical experience: height of approximately 50 cm). You can find information on water supply for cattle in DLG Fact Sheet 399[1].

1 Herrmann (2014)

2.2.2 Monitoring of the weight development

Periodic weighing or estimation of the body weight with an animal weight measuring tape will indicate the weight gain of the calves. At least the weight at birth and the weights before and after weaning should be recorded to obtain relevant information for the management of the system. As experience teaches, two persons are needed for this task (duration per calf: five to seven minutes). The positive side effect: These persons have direct contact with the calves and can positively influence the animal–human relationship with minimal time input.

With an animal weight measuring tape, the weight development of the calf can be checked.

2.2.3 Calf diseases

In cow-bonded calf rearing, animals can also get sick. In the following, we address several important calf diseases that can be relevant for this rearing type. Please see them as general information – for all specific questions about animal health, the farm veterinarians should be consulted.

The basic prerequisite for good immune defence of the calf is the early intake of enough high-quality colostrum. The additional adequate supply of milk and water and supplementary feed must be ensured. ➟ 2.2.1 Feeding

‘Since we established dam rearing on our farm, we have had a significant reduction in veterinary expenses.’

Nutritional deficiencies in the first weeks and months of life render the calves more susceptible to infections and lead to long-term performance loss. Good hygiene management (such as frequent bedding exchange, intermediate cleaning and disinfection) and health-promoting housing conditions (dry, insulated, draught-protected lying areas and good air quality) play a significant role.

During the milk feeding phase, the most frequent problems are diarrhoea and bovine respiratory disease. Especially in the first three weeks of life, cases of infectious diar-

rhoea can occur frequently, followed by respiratory diseases, which can occur increasingly from the fifth to seventh week of life onward.[1]

For all infectious calf diseases, the transmission from older to younger calves plays an important role. When problems with diarrhoea and/or bovine respiratory disease arise, this aspect must be considered, and if necessary, measures to change the calf management must be taken. Specific control measures, such as vaccinations, and treatment plans that contribute to reducing the infection risk must be coordinated with the farm veterinarian.

Other infectious diseases, some of which can be transmitted directly between cow and calf or can lead to lifelong infections, should by all means be noticed and controlled.

Thus, if paratuberculosis and mycoplasma infections, Mortellaro's disease, or udder health problems occur, farmers should consult the farm veterinarian to decide whether and, if so, how cow-bonded calf rearing can be implemented.

2.2.4 Calf health monitoring

In the first weeks after birth, the calf is exposed to new environmental influences. Because its immune system still needs to develop, the risk of getting sick is increased. The wellbeing of the calves must be checked at least twice per day (TierSchNutztV Article 11 Clause 1). With bucket feeding, these regular checks are easily done, whereas cow-bonded rearing often requires a different approach, especially if cows and calves have continuous contact and typical 'suckling times' do not exist. The best solution is to implement a daily routine for a brief calf health check, during which observable indicators are assessed in a predetermined way. The health check offers an opportunity to be in contact with the calves and establish a positive animal–human relationship in order to prevent the calves from 'turning wild'.

At the beginning, one should become familiar with each of the health check criteria by studying the following illustration and reviewing it periodically. We recommend scheduling the health check in the work routine and documenting the observations. These records can then be used for the self-monitoring and during veterinary visits.

1 Cf. Svensson et al. (2003)

Assessment of calf health[1]

Important: If the calf shows noticeable problems in one of the criteria, the body temperature should be measured to check for

Criterium	Score 0	Score 1
General condition	Normal (active)  	Slightly limited activity  
Respiratory tract	No coughing	Occasional coughing
Nose and nasal discharge	No discharge, no obvious secretion  	Watery discharge or dry nose  
Eyes	Normal  	Both eyes slightly watery  
Ears	Upright  	Droopy  

1 Cf. Roth et al. (2006)

fever (morning: >39.1 °C; evening: >39.5 °C). Causes and the best treatment method should be clarified with veterinary help.

<table>
<tr><th>Score 2</th><th>Remarks</th></tr>
<tr><td>Severely limited activity
 
  </td><td rowspan="3">Bovine respiratory disease (BRD): First signs of BRD are often lack of appetite and limited activity. A suspected diagnosis may be confirmed by additional symptoms such as heavy breathing, repeated coughing, and mucopurulent nasal discharge. The causes can be various viruses and bacteria. Non-infectious factors such as late or insufficient colostrum supply, draught, cold, poor barn hygiene, or supply deficiencies should also be considered.

Caution: Pasteurella species, which belong to the pathogens causing BRD, can be transmitted from calf to cow and cause udder inflammation.</td></tr>
<tr><td>Repeated coughing</td></tr>
<tr><td>Mucopurulent discharge, yellow-greenish discolouration
   </td></tr>
<tr><td>Purulent eye discharge
   </td><td>If the calf increasingly produces tear fluid, the eyes are irritated. Causes can be a beginning disease or external irritants (for example wind, UV radiation, fly infestation, harmful gases, increased dust exposure). The causes should be identified in further examinations and remedied accordingly. Purulent eyes should be treated by a veterinarian.</td></tr>
<tr><td colspan="2">Healthy calves carry the head high, and their ears are upright forming a V. Drooped ears can be a sign of general discomfort. An infection of the middle ear, which can be one symptom of BRD, can also cause ear droop, as well as head tilt. Calves that increasingly scratch or rub their ear often have an infection of the outer ear, which may be due to a mite infestation or injury.</td></tr>
</table>

Criterium	Score 0	Score 1
Anal region	Clean  	Soiled with dried faeces  
Navel	Normal  	Swollen, without discharge  
Other	 *Calf with clinical facial eczema (trichophytia) on the head*	 *Poor appearance – could indicate parasite infestation!*

Score 2	Remarks
Soiled with wet/humid faeces  	**Calf diarrhoea:** The most important infectious pathogens that can lead to diarrhoea in calves under four weeks of age are cryptosporidia and rotaviruses, as well as occasionally coronaviruses and gut-harming E. coli. Non-infectious factors such as stress (due for example to regrouping), hygiene shortcomings, or deficient immune defence promote the incidence of disease. It is important to recognise and treat (electrolyte solutions, etc.) affected animals early and to eliminate the causes. Problems can be reduced especially by improving colostrum intake and barn hygiene. In older calves, severe diarrhoea caused by coccidia can lead to high losses. If calves drink too much and possibly too fatty milk, which can happen when they suckle after milking, they may get non-infectious diarrhoea. In that case, the faeces are very light coloured and watery, but the calf is vital.
Swollen, with purulent discharge  	Unfavourable environmental conditions (poor barn hygiene, neglected calving and navel hygiene) can cause a **navel infection**. A purulent, swollen navel always requires veterinary inspection. As a preventative measure, the hygiene conditions in the calving and calf areas as well as during the postnatal navel care should be checked and, if necessary, improved.

In addition to the listed indicators for the assessment of calf health, further abnormalities should be documented.

The condition of the **coat** or **skin** also reflects the health of the calf. A rough coat indicates that the calf is not well. Skin and coat changes can have various causes. Often, fungal (for example clinical facial eczema – **caution: zoonosis!**) or parasitic infections are present, which are promoted by supply deficiencies, a weakened immune system, and high infection pressure..

➟ 2.6.3 Parasite management

Furthermore, claw and joint health of the animals should be checked regularly because injuries of these body parts might indicate hazards originating from barn equipment.

➟ 3.5 Safety hazards

You will find a form for the assessment of calf health in the appendix on Page 98.

Advice on hygiene management

The control of cryptosporidia and coccidia is only effective with special disinfectants. A generally dry and clean environment and the 'all in–all out' protocol with thorough cleaning and intermediate vacancy are effective and important containment measures and should be considered in the design of calving pens and calf areas.

Information for organic farms – cleaning and disinfection:

For the cleaning and disinfection of barn buildings, facilities, and equipment, only those products can be used that are approved in Regulation (EU) 2018/848 Article 24 and Annex II Part II, 1.5.1.6. According to Article 12 of Commission Implementing Regulation (EU) 2021/1165 of 15 July 2021 authorising certain products and substances for use in organic production and establishing their lists, a transitional provision states that the previous authorisation in Annex VII to Regulation (EC) No 889/2008 remains legally valid until 31 December 2023.

Information on farming products that are approved for organic agriculture is available from sources such as the input list of the Research Institute of Organic Agriculture (German designation: Forschungsinstitut für biologischen Landbau, FiBL; www.input-list.com).

Organic farmers' associations additionally restrict the use of certain agents.

2.3 And what about the health of the cow?

Because cow and calf have direct contact in this rearing system, the health of the cows also plays a significant role. Several rules should absolutely be followed:

Comply with the hygiene regulations

For cow-bonded rearing, the same hygiene regulations apply as in milk feeder rearing. Instead of assuring the cleanliness of buckets or artificial teats, practitioners of this systems must attend to the cleanliness of the udder (maintenance of lying areas and outdoor runs!).

Use only healthy and productive cows for calf rearing

This rule should be followed for several reasons:

- Only healthy cows produce milk in the quantity and quality required for the nutrition and healthy development of the calves. Milk of cows with clinical (milk is flaky) or subclinical mastitis (high somatic cell count, without visible changes in foremilk) is changed in its overall composition (altered protein composition, less milk sugar, higher salt content, etc.).
- Visibly sick cows or infected but symptom-free cows can transmit pathogens to the calves. If the calves suckle from multiple cows, pathogens might even be transmitted from one cow to another.
- Sick cows could be overtaxed by the calves (especially in fostered rearing). This would be the case, for example, if lame cows are unable to reject overly pushy calves.
- Milk that contains antibiotics can harm the gut flora of the calves and promote the development of resistant bacteria strains. In accordance with good agricultural practice, the milk of cows under antibiotic treatment should not be fed to calves during the legally prescribed latency period.[1]
- The udder of old cows often has a small distance to the ground, and not all calves may be able to reach the teats.

1 Cf. Aust et al. (2013) and Maynou et al. (2017)

Have a 'Plan B' in place

Diseases can never be fully excluded and require quick action. Cows in early lactation can suffer from milk fever, clinical ketosis, acute mastitis, etc. and thus may not be available for nursing the calves. For these situations, farmers should have developed a plan, which includes having the necessary equipment (such as feeding bottles) on hand and being prepared to separate the calf from the sick cow. This precaution also applies to special circumstances, such as herd sanitation or an epidemic, that make cow-bonded rearing impossible.

It is always advisable to review the rearing system with the farm veterinarian and point out distinct features. During this review, potential treatment strategies that best fit the system can also be discussed.

2.3.1 Udder health management

Here, we address only those aspects of udder health that are directly related to the rearing method. For other disease aspects, please consult other sources.

Condition of the teats and teat skin

In cow-bonded calf rearing, the udder of the cows is under high stress. Either the cows are milked in addition to nursing the calves, or several calves suckle one cow. In both cases, the demands on the teats are higher than in conventional milking. The teat skin, in addition to the teat canal, is an important barrier to infections and should always be soft, smooth, and intact to fulfil this function. If the nursing cows either are milked with a milking robot or are not milked at all, their udder and teat condition should nonetheless be checked regularly. In conventional machine milking, the checking is possible during each milking. According to the current EU hygiene regulations , cows whose milk is used for human consumption must be free of udder skin lesions that could negatively influence the milk quality.

With the following checklist (see Page 28), udders and teats of cows of the own herd can be evaluated. In case of increased occurrences of lesions or the like, one should check if the cows are preferentially suckled, for example because they

- especially tolerate alien calves or
- are the first to join a group of calves

and are thus subject to increased mechanical stress.

In the second case, one should make sure that the calves join the cows only after all cows are in the nursing area or arrange a stepwise access per age group of the calves.

Teat dipping

The use of teat dipping products on nursing cows must be avoided so that the calves do not ingest product residues. Owing to the calves' saliva and repeated suckling, fewer pathogens are found on the udder skin of suckled cows even without dipping products.[1]

If dipping products are nonetheless being used, the time lag between administration of the dipping agent (usually immediately after milking) and readmission of the calves should be long enough, such as in half-day contact. In this case, dipping could be done following the milking after which the calves are not admitted to the cows.

1 Cf. Rasmussen und Larsen (1998)

Assessment of the teat condition

Teat condition	Description	What does that look like?	Recommendation
Smooth skin			
Dry skin	Teat with skin that feels dry and chapped		Use udder care products.
Hyperkeratosis	The outer layer of the teat canal opening shows cornification or a thickened horny layer on the surface. If it is chapped, pathogens can easily colonise it.		Check milking machine settings; if necessary, reduce the number of milkings or of suckling calves per cow.
Chaps	Mechanical stress on the teat skin can cause open wounds and bleeding.		Reduce the number of suckling calves per cow. Leave more milk in the udder and thereby increase the milk supply for the individual calf to prevent suckling on an emptied udder. Allow suckling before milking.
Scab formation	On open chap injuries, sloughing has begun.		Support healing with care products.

You will find a template for assessing the teat condition in the appendix on Page 100.

Udder infections and mastitis

As already mentioned, only healthy cows should be used for nursing the calves. Trying to solve udder health problems in the dairy herd by allowing calves to suckle is the wrong approach and adversely affects the calves (and consequently the health of the herd in the long term). If a problem with mastitis pathogens exists in the herd, sanitation should always be of primary concern before starting cow-bonded calf rearing.

Despite all precaution, udder diseases can occur even in udder-healthy herds and can assume the following forms:

- **Subclinical:** No externally visible signs, the foremilk sample looks normal, but the somatic cell count is increased
- **Clinical:** Foremilk is altered, may contain flakes or blood or appear watery, udder may feel warm and show swellings, udder skin may be reddened

If calves have a choice, they avoid suckling on clinically diseased teats.

If antibiotic treatment is necessary, the cows should no longer be used for nursing the calves. If the general condition of the cow is not strongly affected so that she does not need to be separated, an udder net can be used to prevent suckling, and additional stress through separation from the calf can be avoided. Of course, an alternative supply of enough milk must be ensured. Either the calf is already used to suckling from other cows, or it must be fed by bottle or teat bucket.

We recommend periodic bacteriological milk analyses for the early detection of major pathogens. These include cow-associated bacteria, such as *Staphylococcus aureus*.

Dry-off

The use of antibiotic dry-off formulations (so-called dry cow therapy) must be kept at a minimum so that the milk after calving can be offered to the calf without restriction. However, if the treatment is nonetheless necessary because of a diagnosed udder infection (bacteriological milk analysis), the milk should be milked and discarded after calving, the udder covered with an udder net to prevent the calf from suckling, and the calf provided with antibiotic-free milk. In this way, contact with the cow can be maintained, and the normal suckling can begin after a few days. In fostered rearing, cows that were dried off under protective antibiotic treatment should not be used for nursing after calving.

Although internal teat sealants do not pose a health risk to the calves, they should nonetheless be completely removed by manual foremilk stripping before suckling is allowed.

2.4 What happens at milking?

In most forms of cow-bonded rearing, the nursing cows are additionally milked. This approach involves several challenges, which are explained in the following sections.

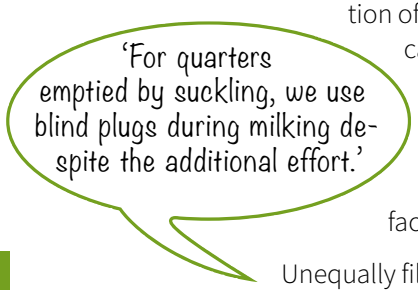
2.4.1 The timing of milking and suckling

If the cows are milked in addition to being suckled, the milking should begin as soon as possible after calving so that the cows get used to it. If milking begins after weaning of the calves, a period of habituation is likely required. Cows that previously nursed calves often do not accept the milking machine right away.

Usually, the nursing cows are milked during the same milking session as the other cows of the herd. Even though the milking in automatic milking systems is cow-individualised, the timing of when to allow the calves to suckle is still a critical aspect.

With whole-day contact, there is no option to control when the calves suckle. Thus, it is possible that the cows were suckled just before milking and that individual udder quarters or the whole

udder is empty when the cow arrives at the milking parlour. This situation requires special attention of the milking personnel to avoid overmilking-induced stress on the udder. The same can happen with short-time contact before milking because calves do not equally suckle from all teats of a well-filled udder. In these cases, milking systems are advantageous in which the teat cups are individually detached per quarter based on the milk flow. This happens in automatic milking systems. However, some milking robots register the cup detachment as aborted milking. One could ask the manufacturer if such abort records can be bypassed.



Unequally filled udders or overmilking of individual teats can be avoided if

- under short-time contact, the cows are admitted to the calves after milking;
- the time lag between suckling and milking is long enough so that the udder cistern has been filled, which takes at least four hours;
- under half-day contact, a milking interval is scheduled during which the calves cannot reach the udder. In half-day contact systems, one can choose to allow daytime contact or nighttime contact, but daytime contact more closely meets the natural suckling behaviour of the calves.

Independently of the chosen timing of suckling, it is possible that the cows do not release all the milk.

➟ 2.4.3 Milk ejection problems

2.4.2 Milking hygiene

Regarding milking hygiene and milk quality, the respective legal requirements and all agreed private-law contracts, such as milk delivery contracts, apply. The careful adherence to hygiene standards is not only required for food quality assurance but also benefits the acceptance of cow-bonded rearing, especially in terms of food safety. Particular attention should be directed to udder injuries.

➟ 6.2 Legal requirements
➟ 2.3.1 Udder health management

Even though it can help prevent milk ejection problems, simultaneous milking and suckling should be forgone because the milk might get contaminated, for example through calf saliva.

2.4.3 Milk ejection problems or: 'The cows don't let down the milk!'

For the extraction of most of the milk stored in the udder, the hormone oxytocin must be released. Then, the milk is pushed out of the little tissue vesicles, the alveoli, and moves through the small and medium-sized into the large milk ducts and the cistern. Only then can the milk be milked by a machine or by hand. The oxytocin release is induced by tactile stimuli (for example the foremilk stripping, the udder cleaning, or the movements of the liner). The calf stimulates the cow during suckling by massaging the teats and butting the udder. Furthermore, the presence of the calf adds olfactory and visual stimuli. Oxytocin release is higher during calf suckling than during machine milking.[1]

Cows that also nurse calves respond in various ways to machine milking, but mostly with a so-called 'milk ejection problem' – they do not completely let down the milk. This problem is not always obvious, but there are indications:

- **Bimodal milk flow curves:** The milk contained in the cistern can be milked easily, but then the flow is interrupted because the milk stored in the alveoli has not yet reached the cistern. If, in addition, the teat cup climbs (something that can usually be seen towards the end of milking when individual quarters are already empty), the liner will close the junction between udder and teat, and the milk can no longer flow.

1 Cf. Bruckmaier (2009)

- **Lowered fat content in the milk:** The fat content of the milk usually increases during milking – on the one hand because the larger fat globules pass through the milk ducts later than the smaller ones, on the other hand because part of the fat is only released from the milk-secretory cells when oxytocin is present.
- **More rest milk remains in the udder:** This effect can only be demonstrated by administration of exogenous oxytocin, which induces another milk ejection. However, if calves are allowed to suckle the udder after an allegedly complete milking, one can often see them ingest quite a bit of milk.

Possible solutions

The presence of the calf during milking has a stimulating effect on the cow. However, simultaneous suckling during milking should be prevented because a contamination of the milk through the calf's saliva cannot be ruled out. A solution can be milking parlours that allow calf contact in the head space of the cow, where the calves cannot reach the udder.

Studies on stimulation by means of calf odour (calf hair or cloths with which the calves had been rubbed down), playing recorded calf calls, or a stronger manual stimulation by the milker have so far not been successful.[1]

We advise against countering impaired complete milk ejection by administrating exogenous oxytocin because the cows will respond physiologically with a reduced own oxytocin release.[2]

Staying calm and handling the situation consciously is what often helps the most – especially if the cows show ejection problems at milking as a response to additional stressful events, such as the final, permanent separation from the calves. In most cases, the problem will vanish after a few days.

2.4.4 Milk composition

The composition of the milk can change over the period during which the calves suckle the cows. Owing to possible milk ejection problems, the fat content may be reduced. Depending on how many cows of the lactating herd are nursing calves, the fat content of the bulk tank milk may vary. Such variations can have economic consequences for the farm because they can affect the milk price. After weaning and separation of the calves, the fat content of the milk will increase again.

Owing to the higher stress on the teats, sightly increased somatic cell counts may occur, but these should not affect the milk quality under conditions of good udder health.

1 Cf. Zipp. (2018)

2 Cf. Bruckmaier/Wellnitz (2008)

2.5 Breeding

2.5.1 Milk recording

The common milk recording is not intended for cow-bonded calf rearing. Nursing cows can be recorded as foster cows, but their productivity is not considered.

An authorised milk recording is currently only possible for cow-bonded rearing with half-day contact, by choosing a recording method based on a predefined milking session. For daytime contact, one would select the morning milking for the recording because the milking interval (from evening milking to morning milking) does not include suckling. For nighttime contact, the evening milking would be appropriate. Nonetheless, one should always consider that the cows may show milk ejection problems. However, implausible milkings (very small milk amount and very little fat content) are always excluded from the calculations.

As long as no specific regulations exist for milk recording in cow-bonded calf rearing, we recommend contacting the responsible organisation and coordinating the approach. This recommendation applies especially to farms selling animals for breeding.

However, the estimated breeding value from the milk recording is only one aspect to be considered. The laboratory results of the milk recording have increasingly been used as indicators of animal health and animal welfare. Regarding cow-bonded rearing, it is necessary to consider that the suckling by the calves has effects on the amount and composition of the milk. Especially the decreased fat content can lead to false interpretation of the fat-to-protein ratio, which is used as indicator of metabolic disorders. Significant variations in the milk amount can occur, and if the milk samples are collected after suckling, increased somatic cell counts may be recorded despite absence of infection. This is because the number of somatic cells naturally increases during milking (thus also after suckling). Thus, for interpreting the values, the type of cow-bonded rearing system must always be considered.

2.5.2 Selection of the cows

Depending on the method – dam rearing or fostered rearing –, the demands on the cows may vary. In fostered rearing, a preferable cow would be one that readily allows several calves to suckle and, in the best case, cares for them as if they were her own. In dam rearing, the cow should particularly attend to her own calf. In each case, a good animal–human relationship is important. Cows that are aggressive toward humans pose a danger and are not suited for this form of rearing.

Because it is still unknown if milk ejection problems can also be based on a genetic component, the milking behaviour of the cows should be watched closely. It may be possible to select cows that do not show severe problems in response to machine milking.

For the calves to easily reach the teats, the udder-to-ground distance should not be too small. If old cows with very low-hanging udders are used for rearing, a close monitoring is necessary to assure that the calves can suckle easily and sufficiently.

2.6 Grazing management

Grazing offers all cattle the possibility to express their species-typical behaviour. In particular, the calves are given the opportunity for locomotor play, that is, to run and jump. In most calf barns, this activity is almost impossible owing to the spatial dimensions and shape (for example square-shaped floor plans). Furthermore, the animals learn early how grazing 'works'.

Information for organic farms – grazing:

In organic agriculture, grazing must be offered whenever the circumstances, such as weather conditions or ground-surface condition, allow it (Regulation [EU] 2018/848 Article 6 l and Annex II Part II, 1.4.2.1., 1.7.3, and 1.9.1.1 b). Most likely, organic farms will face much stricter mandatory grazing regulations in the future, an obligation to be kept in mind.

2.6.1 Grazing together or separately?

In natural conditions, calves follow their cows within a few days after birth. Thus, there is no reason why the calves should not join the cows during pasture grazing early on. However, not every rearing system is suited for joint grazing. Depending on the chosen system, cows and calves can access the pasture together (whole-day contact, half-day contact) or separately (short-time contact, but also half-day contact). Potential benefits of joint grazing are:

- A potential reduction of the parasite pressure for the calves

➟ 2.6.3 Parasite management

- An early encouragement of roughage intake because the calves imitate the feeding behaviour of the cows. This roughage intake potentially supports the development of the forestomachs in the calves.

In separate grazing, the calves could use barn-adjacent areas, which could be smaller (because of the smaller space allowance required for calves than for cows) and thus easy to oversee. Here, pasture hygiene is particularly important (**parasite pressure!**).

2.6.2 Pasture equipment

Fence design

If the existing fencing is designed for cows, we recommend adding a wire in the lower third.

The use of a knot fence is not advisable because the calves might get caught in it and injure themselves. Putting up electrified barbed wire is forbidden according to DIN EN 60335-2-76 Annex E and VDE 0131.[1]

'It has worked well for me to place the bottom wire 40 cm above the ground. But be careful: Always keep an eye on it so that it does not get overgrown.'

Putting in an additional wire prevents calves from escaping.

1 see: AID Infodienst (2016)

Before their first pasture visit, calves are not familiar with a pasture fence. Therefore, they should slowly be habituated to an electrified pasture fence. Young animals are curious and will learn from the first touch and the following electrical shock to perceive the fence as a boundary.

Water supply for the calves

Cattle have a high need for water. Depending on the growth stage of the vegetation, its water content varies, but the vegetation alone cannot cover the water requirement of cattle. Therefore, additional water sources must be available year-round on pasture. The following points must be considered:

- Appropriate water quality is mandatory (Regulation [EC] Nt. 183/2005).
- A non-slippery area around the water trough protects against trampling damage and muddying and aids in parasite management.
- The height of the trough must be adjusted for the calves (recommendation from practical experience: 50 cm trough height).
- The trough or drinker should be easy to use for the calves.

Shade provision

High temperatures can cause stress in cattle. On sunny days, trees, hedges, shelters, or free access to the barn can offer shade. If it is very hot, grazing should be postponed to the night.

2.6.3 Parasite management

First-season grazing cattle have not yet developed an immunity against parasites and thus are especially susceptible to infections. Under conditions of high parasite pressure and poor immune defence, possible consequences can be severe weight loss, diarrhoea, or (in case of a lungworm infection) coughing and pneumonia, and occasionally even death.

A targeted parasite management can often prevent problems. Especially infestations with gastrointestinal nematodes (GIN) can often be controlled effectively with a systematic grazing management coupled with proper animal observation and periodic diagnostics (see table on Page 36).

In this context, the joint grazing of calves and cows can be beneficial. On the one hand, it provides a ‘vacuum cleaner’ effect because the immune adults ingest lots of grass – and thus parasites – but excrete very few parasite eggs. On the other hand, the suckling calf (when on pasture) can slowly develop immunity because at first, it ingests only small amounts of grass (and thus very few parasites). A robust immunity against GIN is acquired after four to five months of contact. Hence, springtime calves are usually immune after their first grazing season. In contrast, for calves born in a later season, a reliable immunity in the second year cannot be expected (see diagram on Page 37).

Possible measures to reduce parasite pressure can be:

- Mowing and removal of the first growth: Overwintered parasites are removed to a large extent.
- Periodic pasture rotation
- Mixed grazing with other animal species (for example horses).

Throughout the season, the parasite load on pasture increases depending on the weather conditions (see diagram on Page 37). Besides a regular monitoring of the calves for signs of a parasite infection, such as lack of weight gain, a rough coat, or the like, we recommend collecting bulk faeces samples for analyses no later than early summer. In case of known problems, the individual animals should be sampled regularly during the second half of the grazing season. Nec-

essary treatments and the adequate strategies must be coordinated with the farm veterinarian.

A needs-based supplementation with minerals, trace elements, and vitamins to support the immune defence must be ensured. In addition, a large enough food supply helps prevent the animals from feeding too close to the dung patches.

Lungworms and liver fluke are rather difficult to control with pasture hygiene measures. Regarding the latter, the most effective measure is to generously fence off or drain wet areas because they can harbour the dwarf pond snail (Galba truncatula), the intermediate host of liver fluke. Considering lungworm infestations, older animals can be heavy excreters and thus can start or increase the pasture contamination. We recommend driving first-season grazing cattle onto safe and preferably minimally contaminated pastures. Diagnostic analyses of a blood sample or a bulk tank milk sample can reveal a lungworm infestation.

As a tool for parasite management, a cost-free interactive decision tree is available (in German): www.weide-parasiten.de/jungrinder/entscheidungsbaum.

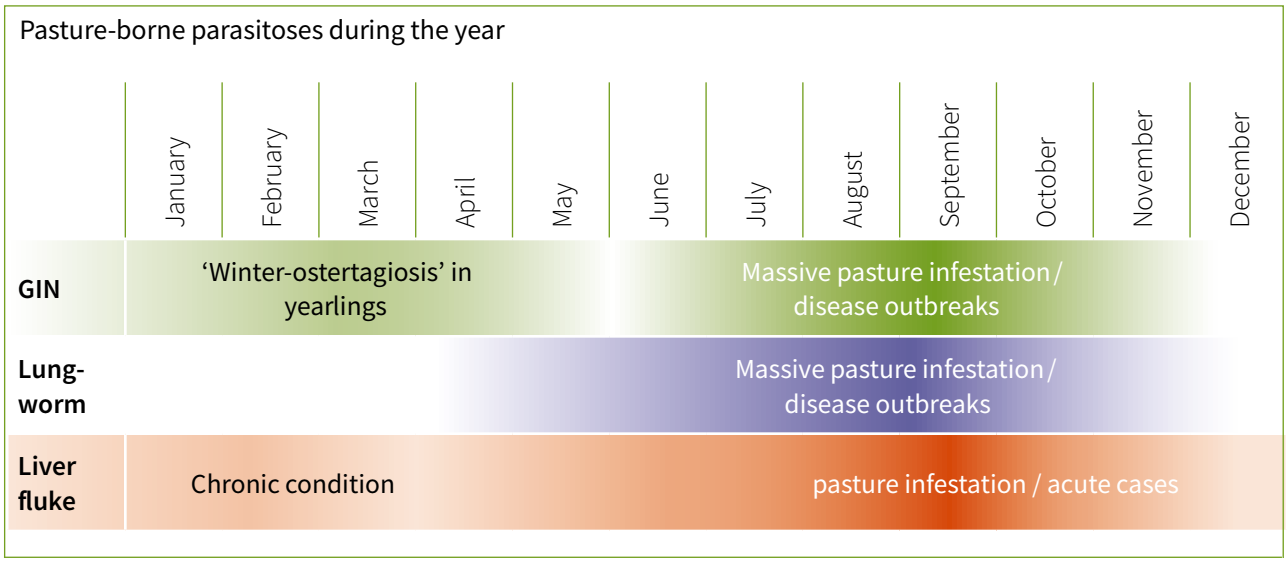
Information for organic farms – parasite treatment:

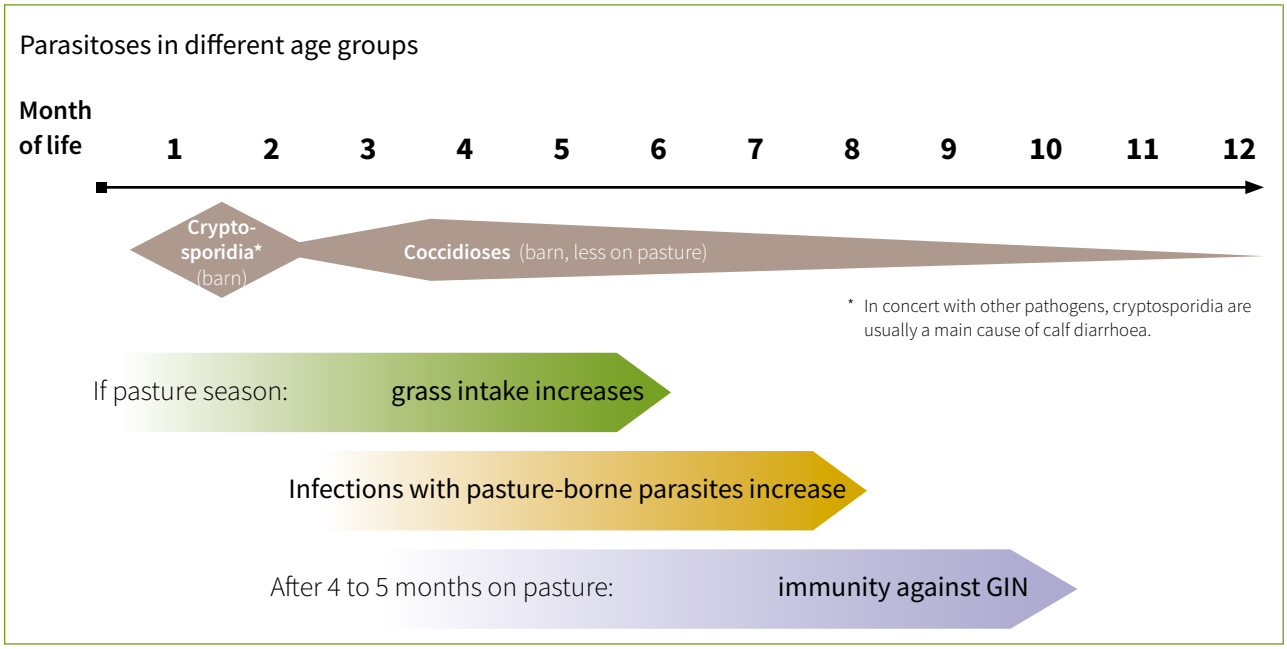
For organic farms, the EU organic regulation stipulates: All treatments with chemically synthetised medicinal products – including antiparasitics – are only permitted after diagnosis and instruction by a veterinarian. Thus, the common practice of routine deworming is not permissible in organic agriculture. Before administration of an antiparasitic, member farms of organic associations should consult their farmers' association about its permissibility. The treatment(s) must be documented. The two-fold legal withdrawal period (at least 48 hours) shall be applied (Regulation [EU] 2018/848 Annex II Part II, 1.5).

Joint grazing makes use of the so-called 'vacuum cleaner' effect.

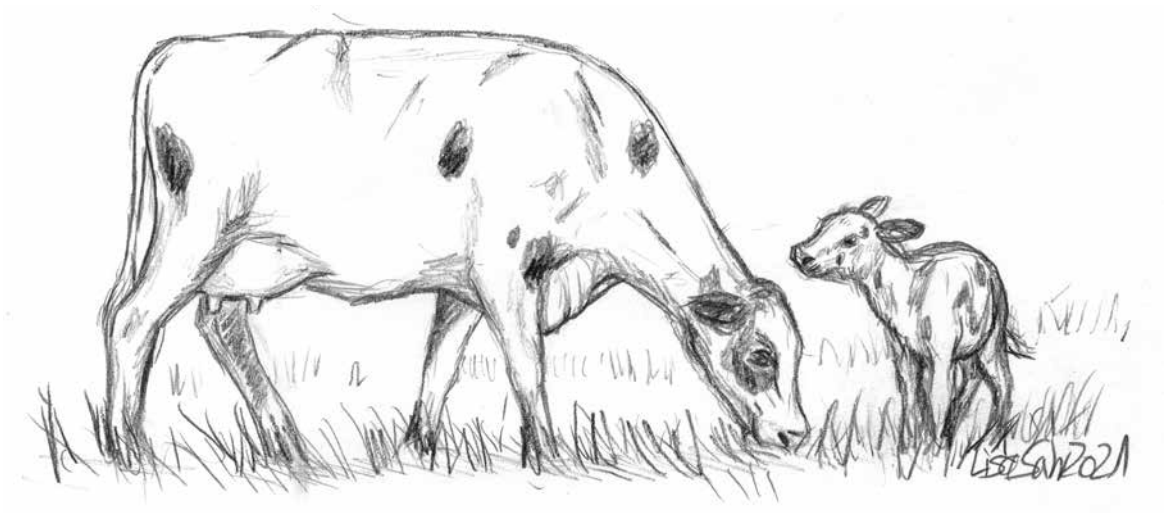
Overview of the most common pasture-borne parasites

Parasite	Transmission	Recommendation
Gastro-intestinal Strongyloides	• GIN overwinter on pasture and in infected animals. Weather-dependent development into infectious larvae → ingestion of grass → development into worm and egg excretion in non-immune animals → increasing infection pressure on pasture → reduced performance, sickness in non-immune animals • **Relatively robust immunity after 4 to 5 months of contact** • Especially problematic: humid meadows, high stocking rates, continuously grazed pastures	• Reduction of the infection pressure by frequent pasture rotation every 2 to 4 weeks, driving onto safe pastures, joint grazing with immune adults • Monitoring, e.g. by animal observation and faeces analyses, if necessary relocation to another pasture or treatment of infected animals • **Please note:** Under heavy infestation, sickness during the housing period (late winter) possible; heavy pasture contamination to be expected in spring
Lungworm	• Similar to GIN – but shorter life cycles; high levels of pasture contamination and sickness already possible 6 to 8 weeks after the grazing started • Humid and warm weather promotes the development • Adults can also get sick • Quick but not robust immunity, must be 'refreshed' by periodic minimal parasite contact	• If possible, frequent rotation (after 4 to 10 days, in between at least 30 to 40 days ungrazed), put young animals on safe pasture • Daily animal health check and quick treatment of all animals upon outbreak • In case of problems: treatment before the housing period starts reduces worm load in spring
Liver fluke	• Development at water temperatures >10 °C via intermediate host (dwarf pond snail) → ingestion of infectious larvae during grazing → larvae migrate through the gut wall and into the liver • Acute infections are rare: mostly in late summer/autumn • Frequently: chronic disease with performance loss! • Only partial immunity – new infections are always possible	• Fence off water bodies and humid areas: at least 2 metres • Drainage and slip-proofing of the ground surface around water troughs • Only well-composted manure on humid pasture, slurry is problematic • Make silage but not hay from infested areas (larvae can survive up to 6 months in hay) • Systematic pasture rotation after diagnostics, strategy development in cooperation with the farm veterinarian
Pasture coccidia	• Very resilient eggs, survive many months and overwinter • Humidity and warmth promote development into infectious stage • Non-immune (young) animals are vulnerable, especially on humid pastures grazed in the previous year by infected animals	• Put young animals only on clean pastures • If possible, no grazing on contaminated pasture areas for 1 year, or annual alternation between grazing species (cattle, sheep, horses) • Avoid humid areas! • Good animal monitoring: swift action needed upon outbreak





Risk of infection with selected pasture-borne parasites during the year and life (Table and diagrams: Ulrike Peschel)



2.7 Stress-free weaning and separation – Is it possible?

The natural weaning (from the milk) takes place after 8 to 10 months, but it may be delayed until the birth of the next calf. In natural herd structures, the young animals still have contact to their dams until they leave the herd (bulls). In dairy farming, the weaning from the milk usually occurs much earlier. Moreover, the separation from the cow often occurs at the same time. Both events are stressors for both the calf and the cow. The induced stress is visible and audible through behavioural changes, such as loud vocalisation, unrest, and other behaviours. In addition, the daily weight gains can decline. The stronger the bonding between cow and calf, the stronger do the animals react. After calving, the bonding intensifies almost by the hour, so that a very early separation leads to less obvious stress.

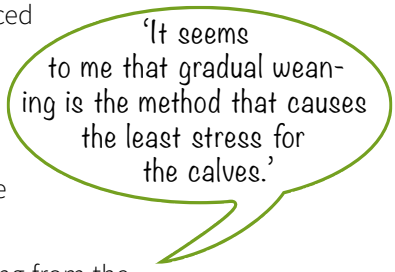
Because natural weaning is usually not possible in cow-bonded rearing, it is essential to keep this stress as minimal as possible. Preventing it entirely may not be possible. An abrupt separation of the calf from the cow along with simultaneous weaning from the milk is especially stressful and should be avoided. The two events can be decoupled (two-step weaning), either by first preventing the calf from suckling before separating it from the cow or by first separating the calf from the dam before weaning it from milk. Suckling can be prevented in various ways.

After the calf has learnt that it no longer gets milk from the udder, its interest in the cow will diminish so that the next step, the separation from the cow, can happen. This step is also associated with stress for the calf, and in this case induced stress is also obvious in the behaviour of

Ways to prevent the suckling by the calves on the cows

Method	Example	Advantages	Disadvantages	Tips
Udder net		Direct contact to the cow remains	• Additional workload at milking • Net can get dirty → **mastitis risk!**	Udder net is best replaced with a cleaned net after each milking
Anti-suckling device (nose flap)		Direct contact to the cow remains	• Can cause pressure marks and injuries in the calves' nose • Self-grooming of the calf is hindered	Use only for a short time and check daily. Feedstuffs and drinkers must be accessible without restriction despite nose flap.
Fence-line contact		No additional animal equipment necessary	Barn modification required so that the cows can have intensive contact with the calves, but the calves cannot suckle	

the cow. With gradual weaning, the contact time between calf and cow is reduced in several steps before the animals are separated. An example would be the switch from whole-day to half-day contact before the calves are separated. However, studies on a gradual weaning over three weeks during which the contact time was reduced bit by bit (whole-day contact → half-day contact → morning contact → fence-line contact) showed that even with this method, the animals may still vocalise.[1]



A two-step weaning in which separation from the dam happens before weaning from the milk can be done, for example, by introducing bucket feeding or by transferring the calves from the dam to a foster cow. If transitioning to a foster system, it is furthermore possible to admit older calves to the foster cow only after younger calves have already suckled. This approach reduces the milk supply for the older calves and promotes the intake of solid feed.

If applying this sequence of the two-step weaning, one should consider that the abrupt removal of the calf is also stressful for the cow. Thus, ideally, the separation should be arranged in a way that is as gentle as possible for the cow as well. For example, in the first phase the dams could have restricted contact with the calves through a fence, without the calves being able to suckle.

➟ 5.1 Farm profile Domäne Fredeburg

All conceivable mixed approaches are possible. For instance, the use of a nose flap may be followed by a period of fence-line contact in an adjacent barn compartment, with the calves no longer having to wear the nose flap. However, suckling must be prevented reliably. Studies on calves weaned with a nose flap showed that the motivation of the calves to visit the dams decreases significantly during the first week with nose flap and that no further changes occur during the second week.[2]

On the other hand, the use of a nose flap can lead to considerable behavioural impairment such as significantly reduced play behaviour and lying durations and can cause pressure marks and injuries on the nasal septum.[3] Thus, we strongly recommend using the nose flap only for a short period of maximally one week and checking the noses of the calves for injuries. In many cases, a reasonable mixed approach could thus be a combination of nose flap with subsequent fence-line contact.

In cow-bonded rearing, the roughage and concentrate feed for the calves should be of best quality to prevent weight gain problems and weight losses especially during the weaning phase.

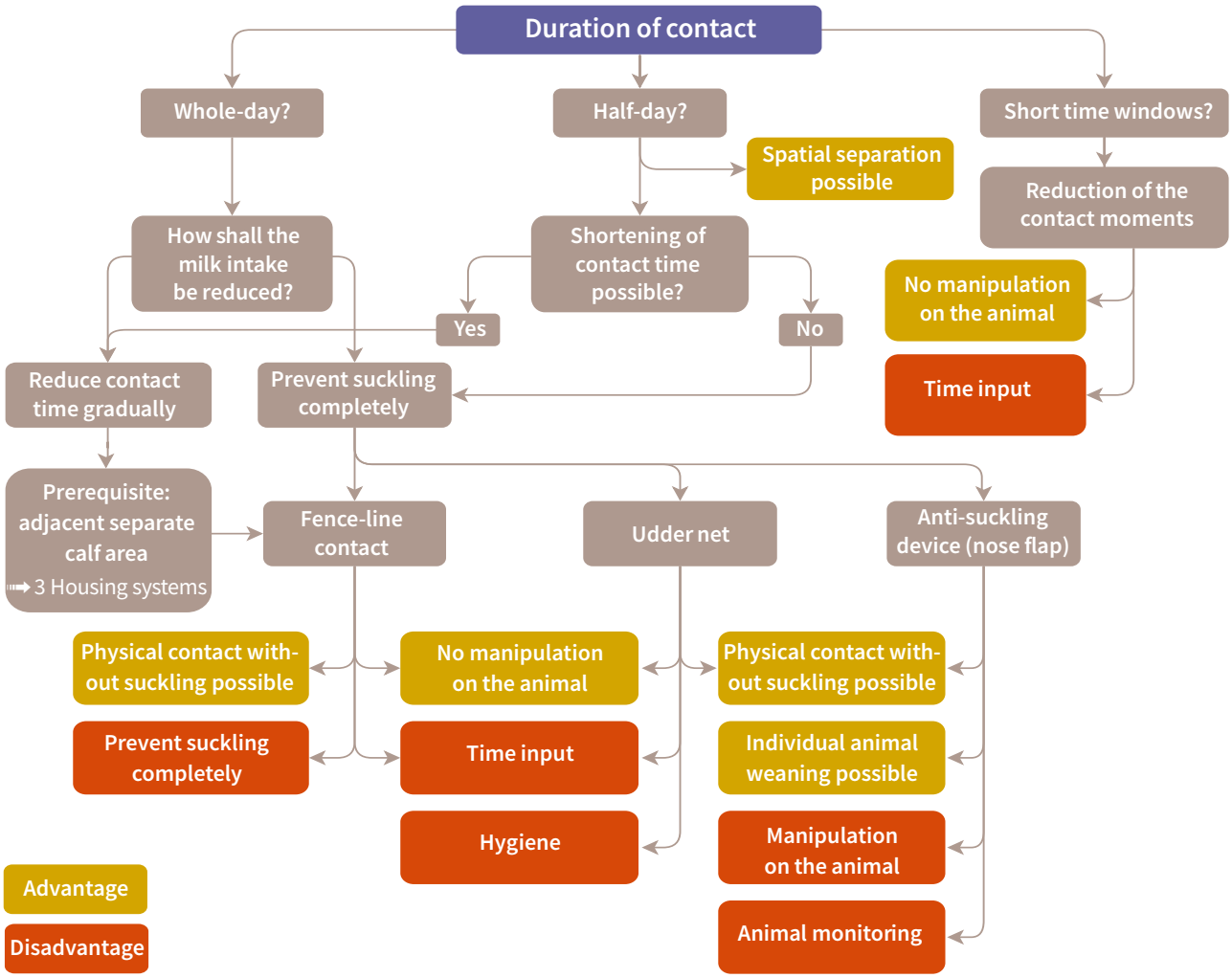
In general, the weaning and separation of the calves can be managed in numerous ways. Depending on the given farm conditions and the expressed wishes of the farm manager, a suitable approach must be found. As experience teaches, the approach is often continuously refined. You will find suggestions for the development of a systems that suits your own farm in the decision tree for 'contact duration and consequences for the weaning method' on the next page and in the tabular overview of the weaning methods applied on the project farms on Page 41. The latter is a snapshot in time because the farms continually refine their weaning methods.

1 Cf. Vogt et al. 2020

2 Cf. Vogt et al. 2021

3 Cf. ibid.

The weaning from the dam/foster cow – contact duration and consequences for the weaning method



Overview of the weaning methods used on the project farms

Weaning method	Rearing system	Timing of weaning and separation	
Hof Dwinger		**From 14th week of life (WL)**	
Abrupt	24-hour contact with the dam	Immediate spatial separation from the dam with homeopathic support, separation onto own pasture	
Hof Möller		**From 14th WL**	**14th–15th WL**
Two-step Nose Flap	24-hour contact with the dam	Use of a nose flap Calves remain a few more days in the herd	Separation onto own pasture with audible and visual contact to the cows
Hof Bock		**From 14th WL**	
Two-step Nose Flap	24-hour contact with the dam	Weaning starts on the 91st day of life. Use of a nose flap for some time. Calves stay with their dams for a certain time. They are separated after a few weeks and rehoused to the young cattle.	
Hof Tams-Detlefsen		**From 14th WL**	**From 15th WL**
Two-step Fence line	24-hour contact with the dam / foster cow	4 to 5 calves are weaned simultaneously 3 to 4 days in calf creep with visual contact to the dam / foster cow	Separation from the dam / foster cow, rehousing to the young-cattle area
Domäne Fredeburg GbR		**13th–15th WL**	**14th–16th WL**
Gradual	2 × 1 hour contact with the dam/ foster cow after milking	2 to 3 calves are weaned simultaneously. Reduction of the contact to 1× per day	Separation from the dam / foster cow
Hof Elisabethheim Havetoft e. V.		**13th WL**	**14th WL**
Gradual/two-step Nose Flap	24-hour contact with the dam, seasonal calving	2 days before separation, 4 to 8 calves are fitted with a nose flap. During daytime they are separated from the dams, at night they are reunited.	Separation from the dam, rehousing to the young-cattle area
Hof Berg GbR		**8th WL**	**From 14th WL**
Gradual	2 × 0.5 hours contact with the dam / foster cow after milking	From the 60th day of life onward, only in the evening or morning 0.5 hours contact with the cow. A few days before separation, reduction of the contact duration (<0.25 hours) and frequency (1× per day)	Separation from the dam / foster cow, rehousing to the young-cattle area
Hof Jensen			**14th WL**
Gradual	24-hour contact with the foster cow		Separation from the foster cow, rehousing to the young-cattle area

2.8 What do I do with bull calves or with female calves for fattening?

A special question is how to handle the calves that are not intended to stay on the farm. In the best case, all calves born on the farm are raised with cow-bonded rearing. However, this may not always be possible for economic or resource-related (available space, working time, etc.) reasons. Various approaches are possible::

Method	Advantages	Disadvantages
Immediate separation after calving, milk feeder rearing	Calves are used to a milk feeder before sale. Selling to fattening farms is unproblematic.	Two methods on the farm. Additional need for separate rearing-places. Additional workload.
The animals stay with the dam or foster cow until being sold	No additional method on the farm. Possibly higher weight gains and higher proceeds upon sale.	Calves have no experience with milk feeding methods. High level of separation stress. Possible difficulties in selling to fattening farms
From the 8th day of life, familiarisation with milk feeder rearing	Calves are used to a milk feeder before sale. Selling to fattening farms is unproblematic.	Two methods on the farm. High level of separation stress. Additional effort for training on the milk feeding method.

Before choosing an approach, one should always clarify the demand for the calves and the resulting proceeds situation.

2.9 How do I prevent the animals from developing wild behaviours?

'In our fostered calf rearing, we seek direct contact to our calves every day. This helps prevent the calves from turning wild.'

In cow-bonded rearing, the calf no longer perceives the caretakers as 'milk deliverers', and so a direct relationship with humans is not given. This is also true for rearing systems with automatic milk feeders, but at least humans can closely interact with the calf when training it to use the automat. Moreover, during bucket feeding, the calf can actively approach the farmers (suckling on finger or clothing). Stroking can also positively influence the relationship. To a limited extent, the human becomes a social partner of the calf.

To build a good animal–human relationship in cow-bonded calf rearing, the caretakers must actively establish contact with the calf. This contact can be initiated immediately after birth. Studies have shown that assisting the calf during suckling or bottle-feeding it with co-

lostrum helps the calf to establish a positive relationship with a human.[1] Regular positive contact with the calves, for example during the daily barn walkthroughs and feed provisioning or during the weekly health check, reinforces the relationship during the entire rearing period and eases potentially required procedures, such as the sampling of faeces for parasite monitoring. In addition, it prevents the development of wild behaviours. Especially helpful is the stroking of the calf in the neck–shoulder area to imitate social licking. Stroking is easy to integrate in work routines, for example during milking, feeding, dung removal, or the daily animal health check.

An increased suckling on fingers by the calves can indicate that the milk amount provided by the cow is too small, because obviously the need for suckling was not sufficiently satisfied. Recommendation for fostered rearing: Reduction of the cow–calf ratio.

So far, little is known about the role model function of cows for the calves. However, one may assume that calves will learn something if they witness humans interacting with the adult cows. The direct interactions with humans during separation of the calves before milking or after suckling periods certainly also help in this process. Right from the beginning, the calves have daily experience with being moved – a routine that takes place considerably less often in milk feeder rearing. Furthermore, early on the calves can grow familiar with farm-specific barn equipment, such as selection gates or manure scrapers.

➟ 3.5 Safety hazards

To get an idea about the quality of the animal–human relationship on the own farm, farmers can try out the avoidance distance test, which is often used in scientific experiments. This test works well for assessing the responsiveness of the animals to humans. In the appendix, you will find detailed explanations on how to conduct this test.

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➟ 6.5 Instructions for the avoidance distance testt

Practical experience has shown that applying the low-stress-stockmanship method during interaction with the animals can greatly improve the ease of handling. The central element of this method is to lead and move the animals in a way that is as stress-free as possible. This is achieved in a sequence of three steps: 'create attention', 'recognise readiness', and 'wait for responsiveness'. The cattle are encouraged to perform desired actions by setting impulses. The key is that the person who works with the animals understands 'cow signals' and uses the own body language to help the animals establish trust.

1 Cf. Waiblinger et al. (2020)

3 Design of housing systems

Recommendation from practical experience: In building the system, you are well advised to keep the pens variable in size (adjustable partitions), so while you refine the rearing system, you can make changes within the given farm conditions.

The barn generally serves the animals as shelter from weather conditions and allows for a year-round provision of food and water in the desired quantity and quality. For the caretaker, the barn eases the monitoring and handling of the animals and allows for short walking distances and proximity to storage areas and technical facilities such as the fodder silo, the slurry tank, the storage of solid manure, and the milking system. Thus, the barn must meet the needs of both the animals (such as being able to express species-specific behaviours) and the caretaker (such as controlled input and output, short walking distances, automated work routines).

This chapter will cover the following topics:

- Appropriate housing systems for cow-bonded calf rearing
- Design of functional areas and their spatial arrangement
- How to calculate the number of required animal-places

Four examples of housing systems and an overview of potential safety hazards for the animals shall serve as suggestions. The described design options are primarily meant as building bricks that may be considered in the own planning and can be combined as appropriate.

During the planning phase it is a good idea to visit as many farms as possible that have already established the envisaged system. These visits will provide ideas for an adequate, farm-specific implementation. Experienced practitioners, among other things, recommend designing individual areas or pens in a way that keeps them variable in size so they can be adapted to the farm conditions during the ongoing development of the rearing system. If you intend to utilise subsidy programmes, you must consider additional requirements that may concern, for example, the design of functional areas. Organic farms must comply with the space allowance requirements of the EU regulations for organic agriculture.[1]

1 Regulation (EU) 2018/848 Article 14(3) and Annex II Part II, 1.6.3, 1.6.4; Commission Implementing Regulation (EU) 2020/464 Annex I

3.1 Which housing systems are appropriate for cow-bonded calf rearing?

Type of rearing	Appropriate housing system	Remarks
Joint barn area for milked cows with calf	Loose housing system with cubicles (freestall barn) or with bedded lying area (e.g. designed as straw pack or bedded with composting material), with or without outdoor run or pasture access	One feeding and one lying place per cow; an additional 5–10% feeding and lying places should be included if the calves can access these areas. Additional separate lying and feeding area for calves (calf creep), inaccessible to the cows. Feed fences must be safe (no injury risk) for the calves; prevent passage of the calves onto the feed table, e.g. with adequate self-catch feed fences, or make feeding area only accessible to cows (selection gate). Feeding alleys and walkways in the cow and/or calf area: solid or slatted floor; adjust manure scraper system and slat width to calves if these areas are accessible to calves. Slatted floors: slat width ≤2.5 cm (concrete slats) or ≤3.0 cm (coated with elastic rubber or topped with elastic rubber mats; TierSchNutztV Article 6 Clause 2c); if necessary, plan for a manure robot. For manure scraping: calf-safe design of manure pit (no injury risk, no slipping of calves into the manure pit).
Special-needs areas (cow with calf)	Deep-bedded loose housing system (with or without separate walkways)	For (among other purposes): calving; cows in early lactation up to 14 days after calving; sick cows.
Separate calf area	Deep-bedded loose housing system (with or without separate walkways) with or without outdoor run or pasture access	Start with a generous first layer of bedding material, add enough during re-bedding, and check daily.* Recommended amount of bedding material: 3.0 kg per animal and day in the lying area.* Feeding alleys and walkways: solid or slatted floor with rubber mats; usually elevated across from the lying area.
	Calf hutch or group igloo with (partially) roofed outdoor run	Start with a generous first layer of bedding material, add enough during re-bedding, and check daily; daily manure removal in the outdoor run; keep water trough frost free in winter.* Recommended amount of bedding material: 1.5 kg per animal and day (lying area); 1.5 kg per animal and day (outdoor run).*

* The recommendations are based on the web application 'National framework for the assessment of animal husbandry practices': KTBL (2006).

3.2 Design of the functional areas

3.2.1 Lying area

The lying area can be designed as a bedded lying area (deep bedding, composting material, etc.) or as cubicles in a freestall barn. Because the cows – in contrast to suckler cows in beef cattle husbandry – are also milked, the lying area must ensure a very high level of udder cleanliness. This aspect and the additional activity of the calves in the lying area have consequences for the design and management of a loose housing system with bedded lying area: they require the lying area to be more spacious with more bedding material and more frequent re-bedding than required in suckler cow husbandry or in dairy barns without cow-bonded calf rearing.

In deep-bedded loose housing systems with separate walkways, the lying area should measure at least 8 to 10 m^2 per cow. If the calves have access to the lying area of the cows, 10 m^2 or more should be provided. For housing systems with composting bedding material (e.g. wood chips), the recommended space allowance is 10 to 15 m^2 per cow.

Jointly used lying areas in deep-bedded loose housing systems bedded with composting material or straw.

To ensure clean udders, the daily amount of fresh bedding material for deep-bedded loose housing systems with separate walkways also lies in the upper range of values recommended in the literature.[1] Thus, for cows with calf one should calculate at least 10 kg per cow and day, for cows without calf at least 8 kg per cow and day.

For manure removal from the deep-bedded areas, the housing system should include adequate access gates and/or alleys and swing gates. The latter allow separating the animals into, for example, the feeding area during manure removal.

In loose housing systems with cubicles (so-called freestall barns), the calves like to lie in the lunging space of the cubicle to be close to the resting dam. Alternatively, the calves can lie in adjacent cubicles, thus increasing the number of required cubicles. The design of the cubicles can ease the use of the lunging space as a place to lie down, for example by:

- A large enough dimension of the lunging space in the cubicle (length approximately 0.8 to 1.0 m), with easy access from both sides (calf can escape to the front, caretaker can put down bedding and clean the lunging space).
- Lateral control elements between the cubicles, preferably of flexible material and simple in design (rather no rigid loop-partitions).
- Control elements between lying area and lunging space only near the ground (brisket boards) or at a height that does not interfere with the typical rising behaviour of the cows and that allows the calves to walk through underneath (height ≥1 m); if necessary, flexible neck rail.

1 Cf. KTBL (2015); KTBL (2018)

If the lunging space of the cubicle, owing to its dimensions or accessibility, is not suited as a lying area for the calves, a much greater number of cubicles must be provided.

The daily amount of fresh bedding material should follow the recommendations of the KTBL[1], and if applicable, an additional amount of bedding material must be calculated for the lunging space of the cubicle.

Options for a calf area or an escape alley for the calves in the cubicle area.

3.2.2 Separate calf area

A separate calf area (calf creep) is also recommended in case of whole-day contact between cow and calf because it provides a retreat area with a calf-appropriate microclimate. Moreover, not only the lying area but also the feed and water supply can be adapted to the needs of the calves. Importantly, the calves should reside in a draught-free barn or at least have draught-free space available.

Separation of the feeding area in the calf barn.

Calf barn allowing contact with the cows.

1 Cf. KTBL (2015); KTBL (2018)

In general, deep-bedded areas (with or without separate walkways), bedded calf hutches, or a group igloo with (partially) roofed outdoor run are suited as calf creeps (be aware: compliance with the country-specific interpretation of the EU regulations for organic agriculture is mandatory). Access from the cow barn is possible via an entrance that only the calves can pass. If necessary, the access can be prevented by a transponder-controlled system. The dimensions of the entrance depend on the size of the calves (width at least 0.4 to 0.5 m; height 1.0 to 1.1 m).[1]

Calf creep with narrow entrance that cows cannot pass.

Calf selection gate between calf barn and outdoor run.

3.2.3 Areas for animal traffic or exercise

Walkways for animal traffic, feeding or exercise can be designed with solid or slatted floors. For slatted floors, the slat width must be adapted as mandatory for calves (slat width concrete slats ≤2.5 cm; coated with elastic material or topped with elastic mats ≤3.0 cm; TierSchNutztV Section 2 Article 6 Clause 2c) if calves have access to these areas. A rubber mat is recommendable.

Alleys alongside the cubicle rows must be at least 2.5 to 3.0 m wide[2], for horned animals at least 4.0 m are required[3]. The alley at the feed table ('feeding alley') must be wider to allow two cows to pass in opposing direction behind the feeding cows. The recommended minimum width of the feeding alley is 3.5 to 4.0 m.[2] If the feeding alley is additionally used for animal traffic, for example leading to the automatic milking system (see barn layout on Page 57), if water troughs are installed in the feeding alley, or if horned animals use it[3], the feeding alley must be at least 5.0 m wide.

Cross alleys between the cubicles should be included every 12 to 15 cubicles (every 5 to 15 cubicles for horned animals and near the waiting area for milking[3]) and at the barn end (avoid dead ends in alleys of less than 4.5 m width). The cross alleys should be at least 2.5 m wide[2] and much wider (3.5 to 5.0 m) if water troughs are installed there[3].

Manure removal from the walkways and feeding alleys can be achieved mobile (with a farm loader), with scrapers or via a slurry channel. In case of scraping, the manure pit must be calf safe (no injury risk, no slipping of calves into the manure pit).

1 Cf. Möntenich (2015)

2 KTBL (2018)

3 Johns et al. (2019), p. 29

3.2.4 Feeding area

The required width of the feeding place depends on characteristics of the animals (breed, age, etc.) and, if applicable, on the guidelines of the respective organic farmers' association. The Cattle Framing working group of the Lower Saxony Ministry of Food, Agriculture and Consumer Protection recommends for new buildings a feeding place width of 0.70 to 0.75 m.[1] For horned cows, depending on the breed, 0.80 to 0.95 m per animal must be calculated.[2] An animal-to-feeding-place ratio of 1:1 generally allows stress-free access to the feed; for horned animals or if calves have access to the feeding area, an additional 10 % feeding places must be provided (1 animal place:1.1 feeding places).

If calves have access to the feeding area of the cows, the design of the feed fence must neither allow the passage of the calves onto the feed table nor pose an injury risk to them. Commercially available safety and curved ('palisade', 'Sweden') self-catch feed fences should generally serve these purposes, but we recommend consulting the manufacturer in advance. Another option would be to control the access to the feeding area with, for example, selection gates that only cows can pass.

Controlled access to the feeding area with a selection gate.

Curved self-catch feed fence.

If cows and calves are fed separately, the feed table of the calves is best located next to the feed table of the cows because visual contact can stimulate the learning behaviour of the calves.

Stimulating the imitation effect during roughage intake; calf-appropriate feeding place design.

Calf-appropriate headlock feed fence with the option to install buckets as needed.

1 LAVES (2007), p. 37

2 Johns et al. (2019), p. 25

3.2.5 Waterers

Water supply for the lactating cows is provided in water troughs (height: 0.8 m, length: 1.5 m; flow rate: 20 L/min; 20 to max. 25 animals per trough; for horned animals max. 10 animals per waterer)[1], which are installed in the (cross) alleys and/or in the feeding area. If waterers are installed in the walkways or feeding alleys, the alleys must be widened accordingly. Additional waterers must be provided in the outdoor run. ➟ 3.2.3 Animal-traffic areas

In the calf area that is inaccessible to the cows, water troughs for the calves must be provided (height: 0.5 m; flow rate: 18 L/min; 5 to max. 15 animals per trough)[2].

3.2.6 Milking and waiting area

Principally all parlour types and automatic milking systems are suitable. If possible, the waiting area and the parlour should not be accessible to the calves.

In case of time-restricted contact between cow and calf, the meeting area (contact area) should be located near the parlour. Thus, after milking, the cows could be led through selection gates from the parlour to the contact area and afterwards back to the feeding area of the dairy barn.

In milking parlours with front exit, the exit or holding area can also be used for allowing contact between cow and calf during or after the milking. Milking parlours with parallel orientation of the cows (side-by-side parlours) have the advantage that the cows already face the calves during milking.

Automatic milking systems (AMS) allow an animal-specific, variable milking frequency especially in the early lactation stage. Thus, in rearing systems with time-restricted contact, an individualised contact frequency between cow and calf after milking is possible. The quarter-specific teat cup detachment in AMS prevents overmilking of individual quarters. This is of significant advantage in husbandry systems with cow-bonded calf rearing because the filling degree of individual quarters can vary greatly according to the timing of the last suckling. However, we recommend consulting the manufacturer of the AMS in advance to make sure that hardware and software of the AMS are suited for cow-bonded calf rearing. For instance, quarters that were (partially) emptied by the calves before milking must not lead to abortion of the milking. First and foremost, the AMS must allow for specific settings for cows that are nursing calves.

For example:

- Variations in the milk amounts of individual quarters or in the total milk amount from the expected milk amount shall not be recorded as erroneous milking (e.g. ‘incomplete milking) if calves had access to the cows before milking or during the entire day. Such variations must never lead to abortion of the milking.
- Adjustable settings for early teat cup detachment for those cows that will nurse their own or alien calves after the milking. Alternatively or additionally: optional, adjustable setting for non-milking of individual quarters.

Furthermore, we recommend considering if and how the contact area for cow and calf can be integrated in a selectively controlled cow traffic.

1 Cf. Johns et al (2019); KTBL (2006); KTBL (2018)

2 Cf. KTBL (2006); KTBL (2018)

3.2.7 Contact area cow and calf

In rearing methods with short-time contact between cow and calf, the calves can suckle the cows during fixed times, for example after milking. Cow and calf meet for a limited time in the contact area and are re-separated afterwards.

A suitable space would be a preferably roofed area with a non-slippery surface (solid floor, with minimal bedding layer, or slatted floor; with rubber mat as appropriate). Manure removal can be done by means of a slatted floor (consider the maximal slat width for calves!) and/or with a farm loader or manure robot. Furthermore, the chosen space should be wind protected.

Here, the contact area is between cow barn and calf barn.

Cow and calf should leave the area as soon as possible after suckling; thus, neither feed provision nor a lying area is necessary, and neither cow brushes nor any other attractive objects should be installed in the contact area.

Water supply must be provided if the animals are likely to stay in the area for more than one hour, for example because the calves are admitted to their dams after the whole herd has been milked. In this case, access to the feed table may also be advisable.

The space allowance depends on the number of cows and calves that simultaneously use the contact area. We recommend 15 m^2 for the first and 6 m^2 for each additional cow and 1.5 m^2 per calf. The length of the shortest side should be at least 4 m.

3.2.8 Calving and special-needs areas

Before giving birth, cows prefer to withdraw from the herd. Not only during the period before calving but also for the bonding process between the dam and her own calf immediately after birth, single pens are especially useful (advisable for the period from calving until at least the third day after birth). Afterwards, a group pen is possible. Ultimately, the length of stay in the areas for calving and for cows in early lactation (so-called fresh cows) determines the required number of animal-places. The size of these barn areas should also be adapted to the length of stay. Thus, for single pens at least 14 m^2 are advisable. The length of the shortest side should be at least 3 m (for horned animals: at least 4 × 4 m[1]).

If a cow shall serve as a foster cow and thus will nurse alien calves, calving in a group pen is advisable for several reasons: the bonding to potential foster cows can occur early, the suitability of cows as foster cows can be monitored, and the selection of a suitable foster cow is possible.

Deep-bedded pens are well-suited either with or without a separate feeding alley. The required amount of bedding material is approximately 15 kg long-stalk straw per animal and day.[2]

1 Pelzer (2014)

2 Cf. KTBL (2006)

3.3 Spatial layout and functional diagram

For the spatial layout, the numbers and sizes of the required barn and storage areas are calculated first. In general, the calculation of animal-places and required storage space (for feedstuff, bedding, manure, slurry, etc.) is not different from the calculation used for common dairy barns. However, because the length of stay in the individual barn areas can differ between individual farms, especially the calculation of animal-places must be adjusted accordingly. Furthermore, because calves are present in the barn area of the milked cows, this area has higher space and bedding requirements per cow.

➟ 3.2 Design of functional areas

In the following table, the required numbers of animal-places per barn area are calculated exemplarily for a calving interval of 385 days and a herd size of 100 cows. Spare places are required despite evenly distributed, year-round calving schedules to account for the natural variability in calving. The shorter the length of stay, the more spare places must be calculated. In the areas for calving and for fresh cows, the additional demand may amount to at least 50% of the calculated places (see table below). Examples of required numbers of animal-places in systems with seasonal calving are provided in KTBL (2018) and other publications.

You can find a template for calculating the required animal-places in the appendix on Pages 101 ff.

Exemplary length of stay in the individual barn areas and the resulting proportion of animals per barn area.
The listed required animal-places are based on a herd size of 100 cows and include spare places.

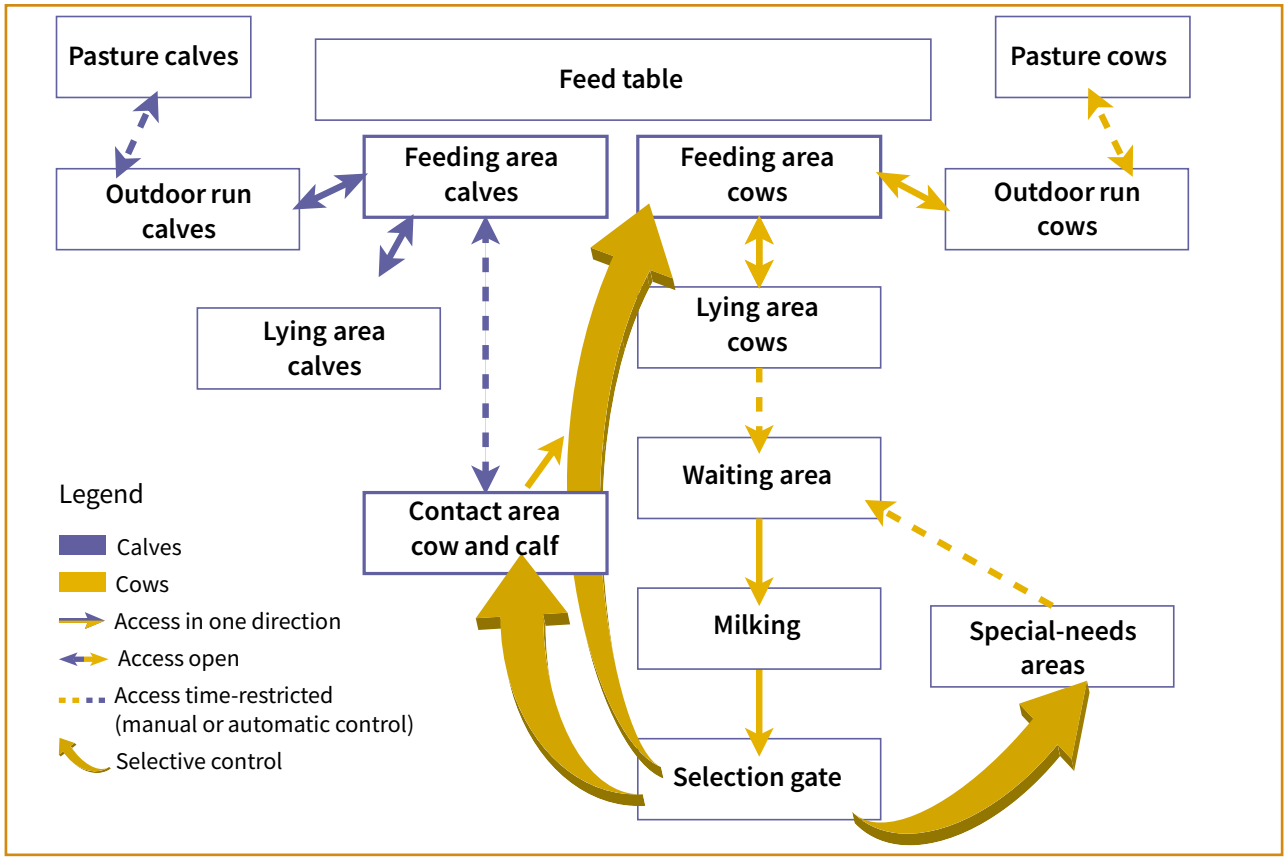
Barn area	Length of stay (days)	Proportion (%)	Spare places	Required animal-places (per 100 cows)
Calving Day 7 a. p. to day 3 p. p.	11	2.9	+ 50 %	5
Fresh cows Day 4 to 14 p. p.	10	2.6	+ 50 %	4
Lactating with calf Day 15 to 90 p. p.	76	19.7	+ 25 %	25
Lactating without calf From day 91 p. p.	230	59.7	+ 10 %	66
Dry cows; From day 65 a. p. (… of these, for in-calf heifers)	58	15.1	+ 30 % (2 – 3)[1]	20
Sick cows	–	–	3[1]	3
Selection area	–	–	7[1]	7
Total	385	100	30	130

a.p. antepartum (before birth), p.p. postpartum (after birth)

1 KTBL (2018)

The functional diagram generally illustrates the spatial arrangement of the functional areas relative to one another and to further facilities (feed storage, bedding storage, manure storage, slurry tank, etc.). Lines and arrows illustrate traffic alleys (for animal movement, vehicles, and personnel) or lines and thus show connections between areas. The two functional diagrams presented here show which functional areas are required in the barn, which of them should be close to each other, and which walkways and (if applicable) movement directions (mediated for example through one-way gates or selection gates) exist between the functional areas. On this page, you will find an exemplary functional diagram for a system with short-time contact, meaning that the calves are admitted for suckling only during the contact times (in this case: after milking). The functional diagram has the following characteristic features:

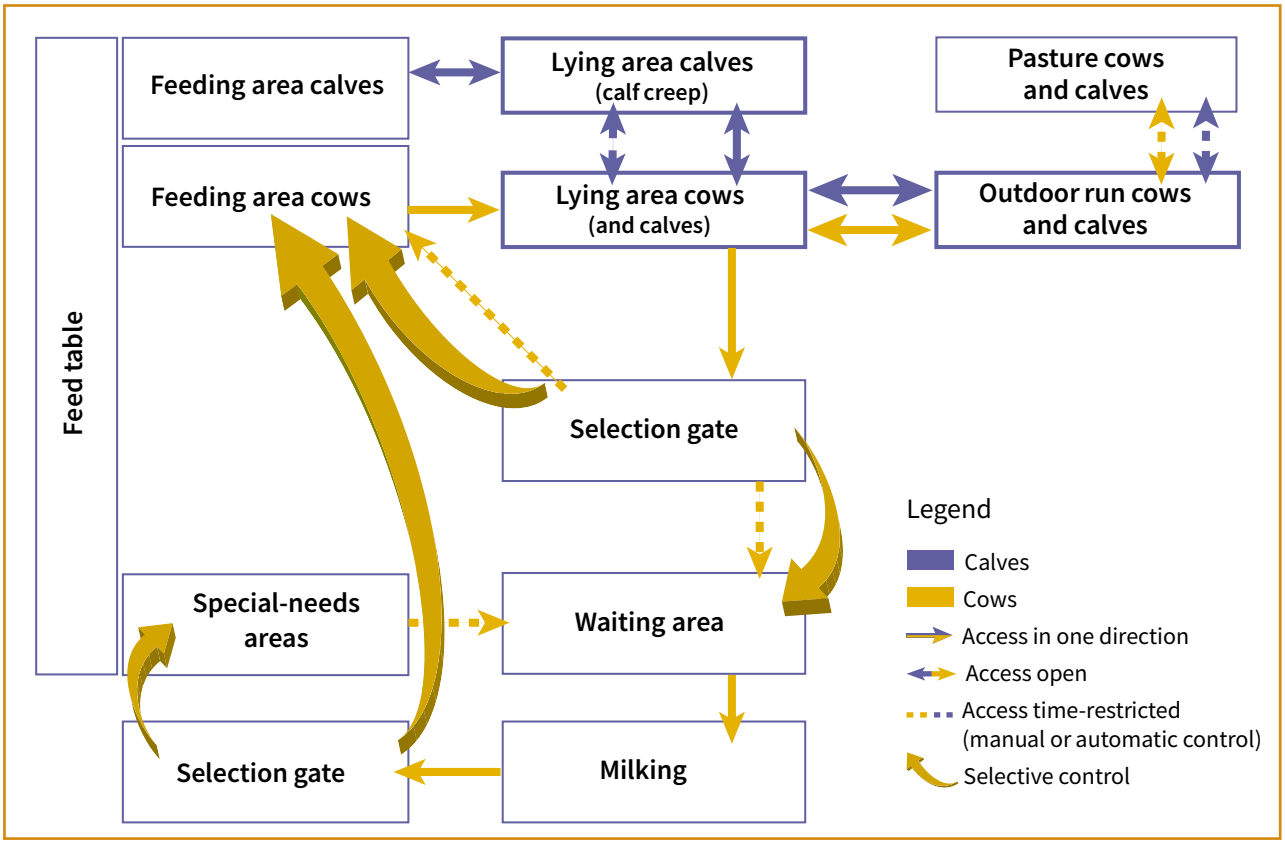
- Separate lying area, feeding area, outdoor run, and pasture for both the cows and the calves.
- Joint use of the contact area during the given contact times; here: after milking.
- Spatial proximity of the cow–calf contact area to the milking parlour, the calf area, and the return lane.
- Spatial proximity between the feeding areas for cows and calves. Thereby, visual contact can stimulate the roughage intake of the calves. For the caretakers, the structural connection will simplify the feed provision.
- After milking, the cows return to the feeding area so that they first feed and then lie down.
- Spatial proximity of the special-needs areas (calving, fresh cows, sick cows) to the milking area.
- Exit to the outdoor run (and the pasture) from the feeding area to prevent disturbance in the lying area.



Functional diagram for systems of cow-bonded calf rearing with short-time contact

The following chart shows a functional diagram for a system with half-day or whole-day contact. Cows and calves share the lying area, the outdoor run, and the pasture. The design includes an additional separate lying area and a separate feeding area for the calves. In addition, the functional diagram has the following characteristic features:

- Free (or time-restricted) access for the calves to the cows' lying area and joint use of outdoor run and pasture.
- Additional separate lying area for the calves as a retreat area (calf creep) to meet the calves' higher need for rest and offer them an adequate microclimate.
- Spatial proximity between the feeding areas for cows and calves. Thereby, visual contact can stimulate the roughage intake of the calves. For the caretakers, the structural connection will simplify the feed provision.
- The cows have access to the feeding area via a selection gate that also controls the access to the milking area in a time-restricted or selective way; the calves have no access to the cows' feeding area.
- After milking, the cows return to the feeding area so that they first feed and then lie down.
- Spatial proximity of the special-needs areas (calving, fresh cows, sick cows) to the milking area and the feed table.



Functional diagram for systems with half-day or whole-day contact, calf creep, and selective access to the feeding and milking areas

3.4 Examples of housing systems

In the next two sections, we introduce two examples of housing systems for a dairy farm with dam rearing. Both housing systems have an automatic milking system and consider the rearing of all (meaning female and male) calves, with the associated requirements for the spatial lay-out and functional diagram. In Example 1, the calves have half-day or whole-day access to the lying area of the cows. The barn was conceptualised as a loose housing system with bedded lying area, and the lying area can principally be designed with deep bedding, shallow bedding, or composting material. In Example 2, the contact between cows and calves is limited to the suckling times (short-time contact) and takes place after milking. The lying area of the cows is designed as a freestall barn with a feed table on both sides. The dimensions are based on horn-less cows.

3.4.1 Example 1: Dam rearing with whole or half-day contact and milking robot

In this example, a loose housing system was designed for a herd size of 130 cows (see the layout on Page 57). The cows are transferred to the calving area about one week before the calving date and stay in single pens until at least the third day after birth. From the 4th to 90th day in milk, cows and calves stay together in the group 'cow with calf'. The calves have whole-day or half-day access to the lying area of the cows. A separate calf creep with waterers and own feed table serves the calves as retreat, lying, and feeding area. Upon weaning of the calves, the cows are transferred to the group 'cow without calf'. The weaned calves stay for about two weeks in the 'weaner area' with visual (and tactile) contact to the calf group and the cows without calf.

The two groups of cows are milked with an automatic milking system. Milking robot 1 for the early postpartum cows and the 'cows with calf' only milks a small group for several reasons: The low operational load on of this milking robot allows for a higher milking frequency for the cows in early lactation. At the same time, it ensures an overall lower stress level in the milking area and allows for planning longer periods of rest without milking in concert with the cow–calf contact times. The cows enter the feeding area either from the open waiting area through a selection gate or (at milking times or upon milking allowance) via the milking robot. Through simple one-way gates, the cows can return to the lying area. The calves have no access to the cows' feeding area and, if possible, none to the waiting area. Cows from the special-needs areas can access the milking robot from a separate waiting area and are selectively, and preferably automatically, guided back to their area.

For the group 'cow without calf', the feeding alley is also the walkway to the milking system. Thus, a minimal width of 5 m or a design as outdoor run is advisable, as is the use of rubber mats. The deep-bedded area is divided in separate areas by means of partitions to increase the lying comfort and minimise the animal traffic in this area. For manure removal, swing gates should be installed so that the cows can only be in the feeding or waiting area during that time. The swing gates should be arranged in a way that they can also be used to drive overdue cows to the milking system – and thus to briefly block the lying area. Under proper operational load of the milking robot, the size of the group allows an average milking frequency of two milkings per animal and day. This frequency is adequate for the cows in this group because they are in a later lactation stage than the 'cows with calf'. The additional waiting area can be used for cows from the special-needs areas or for overdue driven cows.

The special-needs areas include places for dry cows, late-gestation cows, and heifers, single pens for calving cows, a group pen for sick animals, and a selection pen for treatments or in-seminations. All areas are principally designed as a loose housing system with deep bedding in the lying area and solid floor in the feeding area. For manure removal, swing gates should be installed; manure removal in the outdoor run and alleys depends on the floor design and can be done in various ways: mobile, with scrapers, or – in the areas without calves and the alleys

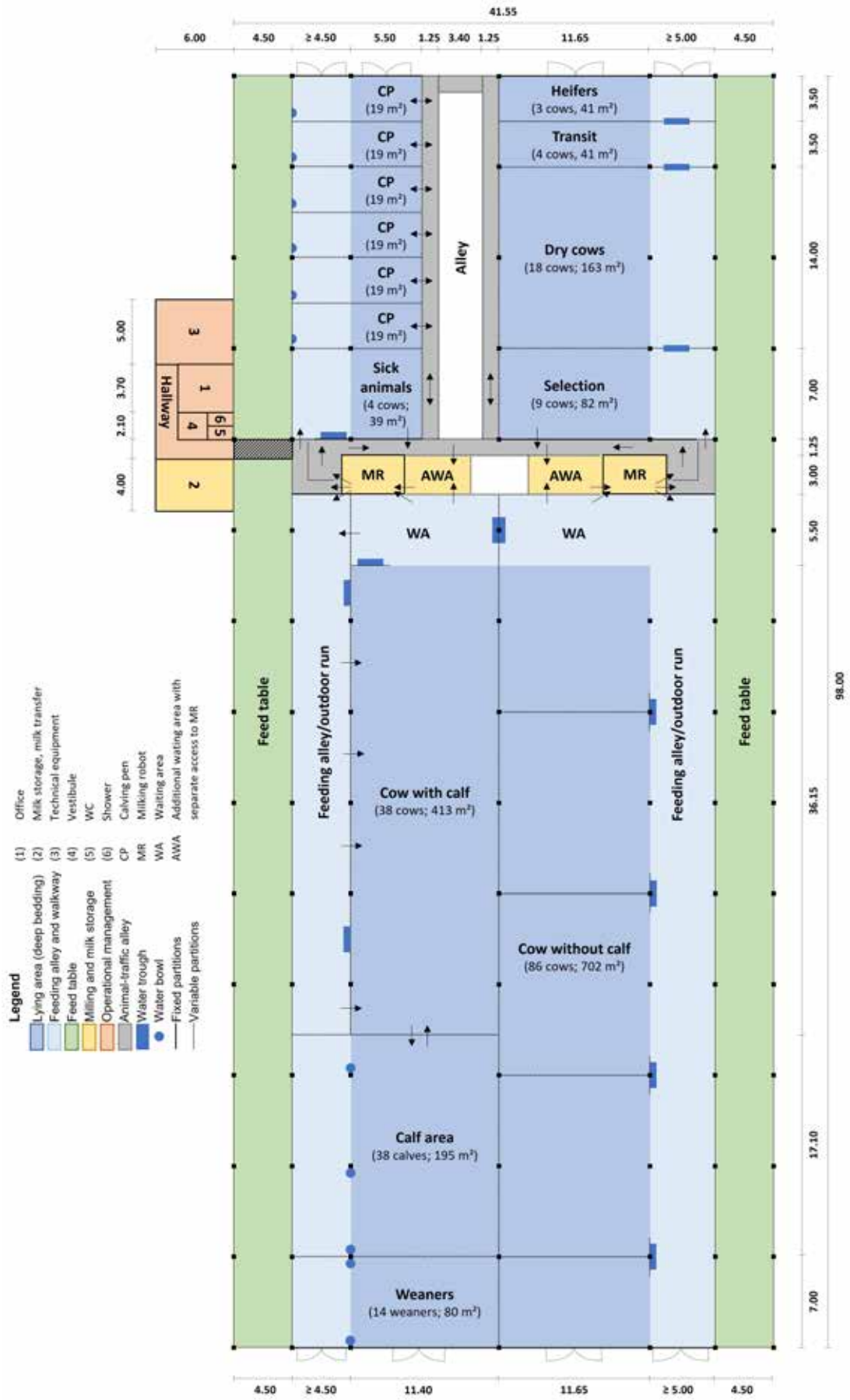
for animal traffic – with slatted floors and slurry channels and/or with a manure robot. Owing to the compact design of the whole building, the centre between the pens creates a relatively wide alley, which can be used in various ways (for example as a driveway for manure removal from individual areas) or designed as an unroofed open space.

The number of calculated animal-places per barn area, the individual space allowance in the lying area at maximal occupancy, and the resulting available feeding place width per animal are listed in the following table. You can find the path for calculating the animal-places in the appendix on Pages 101 to 103.

Number of animal-places per barn area and space allowance in the lying area in an exemplary housing system for dam rearing with whole-day or half-day cow–calf contact and a milking robot

Barn area	Number of animal-places	Space allowance per animal (lying area)*	Feeding place width per animal
Calving	6	19.0 m^2	3.50 m
Cow with calf	38	10.9 m^2	1.09 m
Calf area	38	5.1 m^2	0.45 m
Weaners	14	5.7 m^2	0.50 m
Cow without calf	85	8.2 m^2	0.76 m
Dry cows	18	9.0 m^2	0.77 m
Transit	4	10.3 m^2	0.88 m
Heifers	3	13.7 m^2	1.17 m
Selection	9	9.1 m^2	0.77 m
Sick animals	4	9.7 m^2	1.75 m

** Without barn area for feeding alleys and waiting area*



Exemplary layout of a housing system for dam rearing with whole-day or half-day cow–calf contact and a milking robot

3.4.2 Example 2: Dam rearing with short-time contact and milking robot

In this example, a freestall barn was designed for a herd size of 65 to 70 cows (see the barn lay-out on Page 60). The cows are milked with an automatic milking system that is accessible from both the freestall barn and the special-needs areas. The cows are transferred to the calving pen about one week before the calving date and stay there until the third day after birth; from the 4th to 14th day in milk, they stay together with their calves in the fresh cow pen. Afterwards, the cows are transferred to the freestall barn, and the calves move to the calf area, where they stay until weaning from the dam. Contact between cow and calf takes place in the contact area after each milking. Visual (and tactile) contact is also possible in the feeding alley between calf area and cow area. The calves have no access to the feeding and lying areas of the cows. The calf area has a size that principally allows rearing all (meaning female and male) calves for up to 90 days.

The freestall barn was designed as a four-row cubicle barn. Thus, it is possible to separate the lying and feeding areas and, for example, selectively control the access to the feed tables. The following layout shows an option that is easy to realise: The feed table on the right (mixed feed ration for low-yielding animals) is freely accessible to all cows. The feed table on the left (mixed feed ration for high-yielding animals) is selectively accessible only to cows in early lactation, for example after milking and, if applicable, after suckling of the calves. In the shown layout, the barn is designed with free access to all areas. The waiting area directly in front of the milking robot can be blocked, for example to create a collection area for cows that have to be driven to milking. An additional waiting area makes it possible to prioritise access to the milking robot from the special-needs areas. As currently designed, the exit from the milking robot selectively guides the cows into the contact area, the feeding area, or the special-needs areas. Water troughs and spacious cross alleys are included between the cubicle rows. It is important to consider that the cows can always easily access the milking system from all directions. In the illustrated example, the width of the cross alleys between the cubicles varies and, if necessary,

must be scaled according to the design and location of the roof ridge. The feeding alley must be at least 4 m wide and can be designed as an outdoor run. A feed table on both sides allows for providing at least one feeding place per animal in a compact, four-row cubicle barn with short distances to the milking robot.

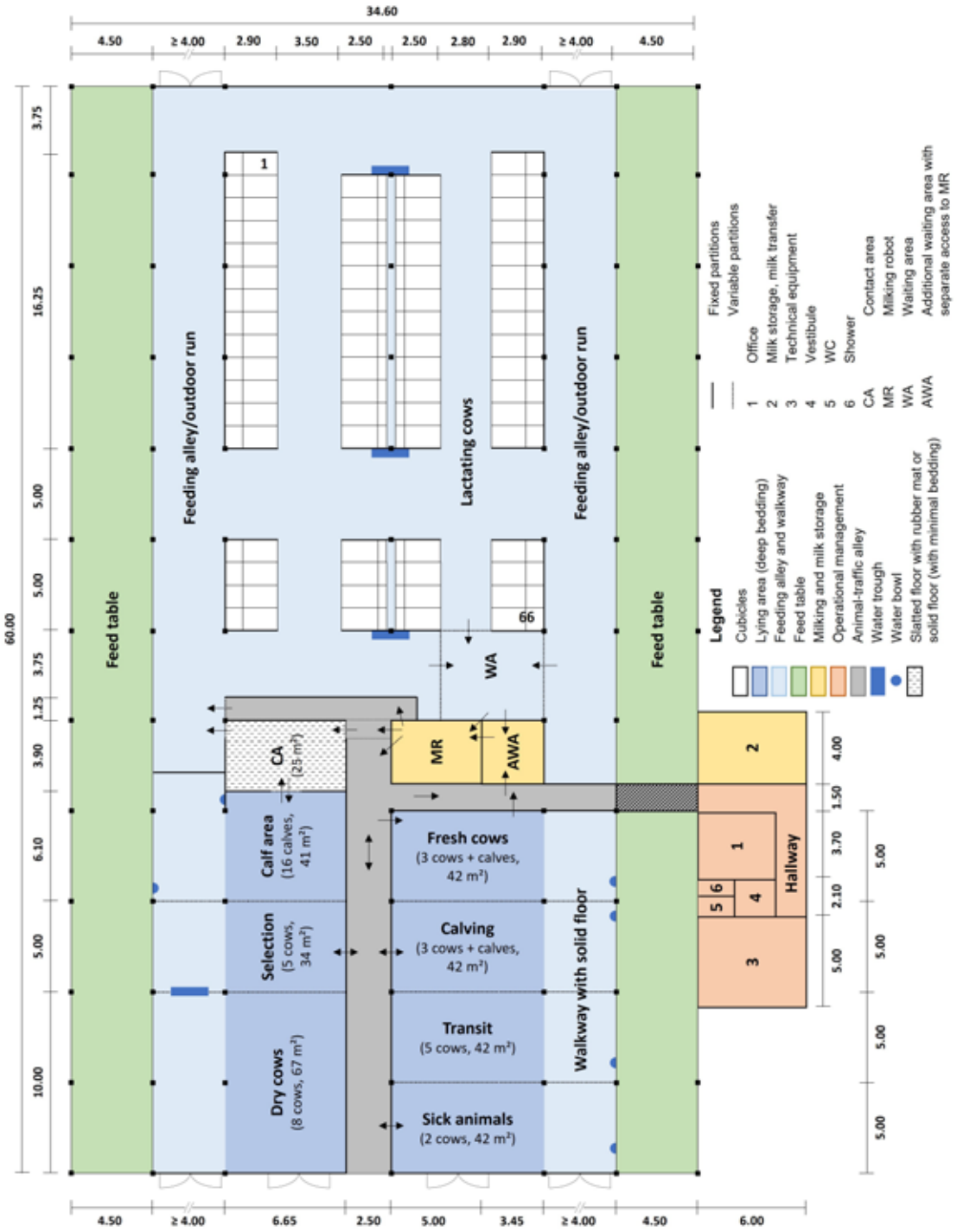
The special-needs areas include places for dry cows and late-gestation cows (transit), three group pens – one for calving cows, one for fresh cows, one for sick animals –, and a selection pen for treatments or inseminations. The special-needs areas are principally designed as a loose housing system with deep bedding in the lying area and solid floor in the feeding area. For manure removal, swing gates should be installed; methods for manure removal from the walkways and feeding alleys in both the special-needs areas and the freestall barn depend on the floor design and can be done in various ways: mobile, with scrapers, or – in the areas without calves and the alleys for animal traffic – with slatted floors and slurry channels and/or with a manure robot. The design of the central alley between the pens makes the special-needs areas easily accessible; in addition, the calves can use this alley to access the pasture.

The number of calculated animal-places per barn area, the individual space allowance in the lying area at maximal occupancy, and the resulting available feeding place width per animal are listed in the following table. You can find the path for calculating the animal-places in the appendix on Pages 101 to 103.

Number of animal-places per barn area and space allowance in the lying area in an exemplary housing system for dam rearing with short-time contact and a milking robot

Barn area	Number of animal-places	Space allowance per animal (lying area)*	Feeding place width per animal
Lactating cows	59	9.7 m^2 (including walkways in the lying area)	1.28 m
Calf area	16	2.6 m^2	0.45 m
Calving	3	14.0 m^2	1.66 m
Fresh cows	3	14.0 m^2	1.66 m
Dry cows	8	8.4 m^2	1.25 m
Transit	5	8.4 m^2	1.00 m
Selection	5	6.8 m^2	1.00 m
Sick animals	2	21.0 m^2	2.50 m

** Without barn area for feeding alleys and waiting area*



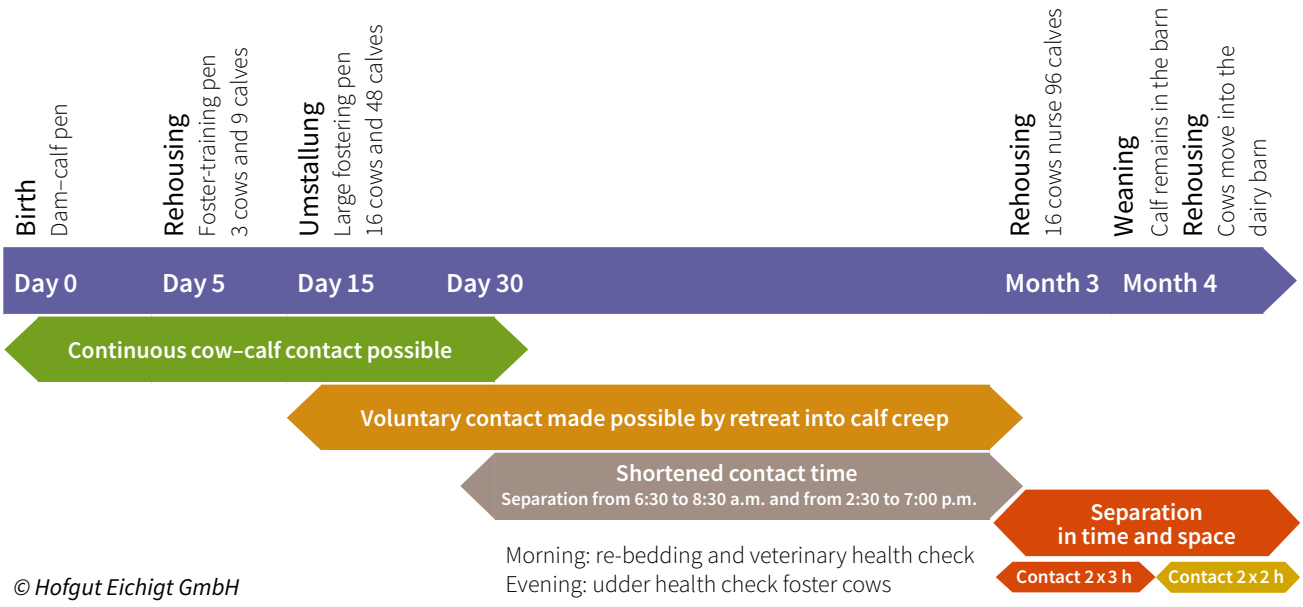
Exemplary layout of a housing system for dam rearing with short-time contact and a milking robot

3.4.3 Example 3: Rearing with foster cows on a large farm

The following example shows that cow-bonded calf rearing is not restricted to small and medium-sized farms. The description is not an actual planning guide but rather offers ideas on how to implement cow-bonded calf rearing in larger herds.

Since 2019, the organic farm 'Hofgut Eichigt GmbH' has practised fostered rearing with cows from the dairy herd, which consists of about 1,500 German Holstein cows. The cow-bonded rearing of the calves had already been considered in the planning phase of the barn construction.

On average, 120 cows are calving per month. The calving occurs in groups of maximally five cows so that the calves can meet their future foster cow(s) right away. To strengthen the bonding, from the fifth day onward the calves and the selected cows are transferred to a training pen, where they join other calves and cows. After the second week of life, the animals are transferred to the large fostering pen, where 16 cows nurse 48 calves. The cow–calf contact is only interrupted during fixed times for re-bedding and animal health checks. The calves can always retreat to a separate area and freely decide whether they visit the foster cows. After the third month of life, the weaning process begins: In another barn, fewer cows nurse the calves, and the contact time is restricted. The group of 48 calves remains constant, but now a group of 16 foster cows nurses two groups of calves during defined periods per day. Thereby, the milk supply and the cow contact are further reduced until the cows leave this barn. The calves are now four months old, and they can stay in their familiar environment. Hence, all calves – also the male ones – are nursed until the fourth month of life by foster cows and are housed in mixed-sex groups. The following diagram illustrates the whole course of events.



Course of events during the fostered calf rearing on 'Hofgut Eichigt'.

A generous space allowance is calculated. The animals are housed on straw-bedding.

Space allowance in the individual barn areas for the fostered calf rearing on 'Hofgut Eichigt'

Barn area	Number of pens	Number of animals per pen	Provided space
Dam–calf pen	5	5 cows + own calves	19.2 m^2 per cow + own calf
Foster-training pen	6	3 cows + 9 calves	32 m^2 per cow + 3 calves
Large fostering pen	8.5	16 cows + 48 calves	28 m^2 per cow + 3 calves

In the dam–calf pen, five cows can calve together.

The foster-training pen provides space for three cows and nine calves. A calf creep provides the desired microclimate for the calves.

Prerequisite for the successful management of these group sizes is a strict mode of operation. Barn hygiene is of utmost importance.

Manure removal schedule for the individual barn areas used for calf rearing on 'Hofgut Eichigt'

Barn area	Interval	Task
Dam–calf pen	Every 5th day	Manure removal, high-pressure cleaning, and disinfection
Foster-training pen	Every 10th day	Manure removal, high-pressure cleaning, and disinfection
Large fostering pen	Weekly	Manure removal, limewash if necessary, putting down bedding
Calf area	Every 14th day	Manure removal, limewash if necessary, putting down bedding

In the large fostering pens, 16 cows are housed together with 48 calves. The calves thereby have plenty of space to play and run.

The retreat space for the calves provides an adequate barn climate.

3.4.4 Example 4: Rearing with foster cows on a small or medium-sized farm

Fostered rearing on small and medium-sized farms can principally be implemented as described for large farms (see Example 3). Challenges may arise because on smaller farms, fewer calves are being reared at one time. Thus, there is a larger age difference between the calves that are nursed by the same foster cow. An optimal solution could be seasonal calving. If year-round calving is preferred, the age difference between the calves may be compensated partially by housing the calves longer in the dam–calf pen and the foster-training pen.

In the following housing example, fostered rearing was exemplarily implemented for a farm with 90 cows and year-round calving. The table on Page 65 shows the required numbers of animal-places per barn area, calculated dependent on the length of stay. The general course of events – with dam–calf pen, foster-training pen, large fostering pen, and subsequent foster cow–weaner pen – is the same as in Example 3. One foster cow shall nurse three calves until the end of their third month of life; in their fourth month of life, she will nurse three younger and three older weaners in turn, with restricted contact times. For a herd size of 90 cows and a calving interval of 365 days, about 7.5 calves per month are expected, with on average four days between two calvings.

The cows give birth in a group pen (or in single pens) and afterwards move with their calf into a dam–calf pen. Dam and calf stay there until three calves can form a group for one foster cow. Accordingly, the oldest calf in the group will have stayed with its dam for an average 10 days upon transfer to the foster-training pen, the two younger calves for shorter periods. Based on the theoretical calculation, the youngest of the three calves stays in the dam–calf pen for only one to two days. Then, one cow moves as a foster cow with 'her' three calves into the training pen; the two milked cows are transferred to the dairy barn. Afterwards, the dam–calf pen is demanured, cleaned, disinfected, and prepared for the next group.

The foster-training pen in our example provides space for two foster cows and six calves and can be divided into two areas. The length of stay is about 14 days. Afterwards, the foster cow and her assigned calves join the large fostering group (by then, the youngest calf is on average 16 days old, the oldest calf 24 days). The flexible division of the foster-training pen into two areas allows an undisturbed habituation phase for the new foster cow–calf group and eases the manure removal, cleaning, and disinfection in the temporarily empty half of the pen. During times between these events, the divider can be removed to allow the calves and foster cows to meet, which in turn eases the future integration into the large fostering group.

The large fostering pen is designed for eight foster cows and 24 calves. Foster cows and calves stay here until about the end of the calves' third month of life. During this time, the calves have whole-day free access to the foster cows and can retreat anytime to a separate calf area with their own feed table and calf-appropriate waterers. For manure removal from the large fostering pen, means to block off the feeding alley and the calf area should be included so that the animals can be in the feeding alley or the calf area without disturbance.

As in Example 3, the weaning of the calves begins with the fourth month of life. Two foster cows nurse six 'younger' and six 'older' weaners in the foster cow–weaner pen, and the calf groups now have time-restricted access to the fostering area. Milk supply and contact times thus are reduced stepwise with advancing age of the calves.

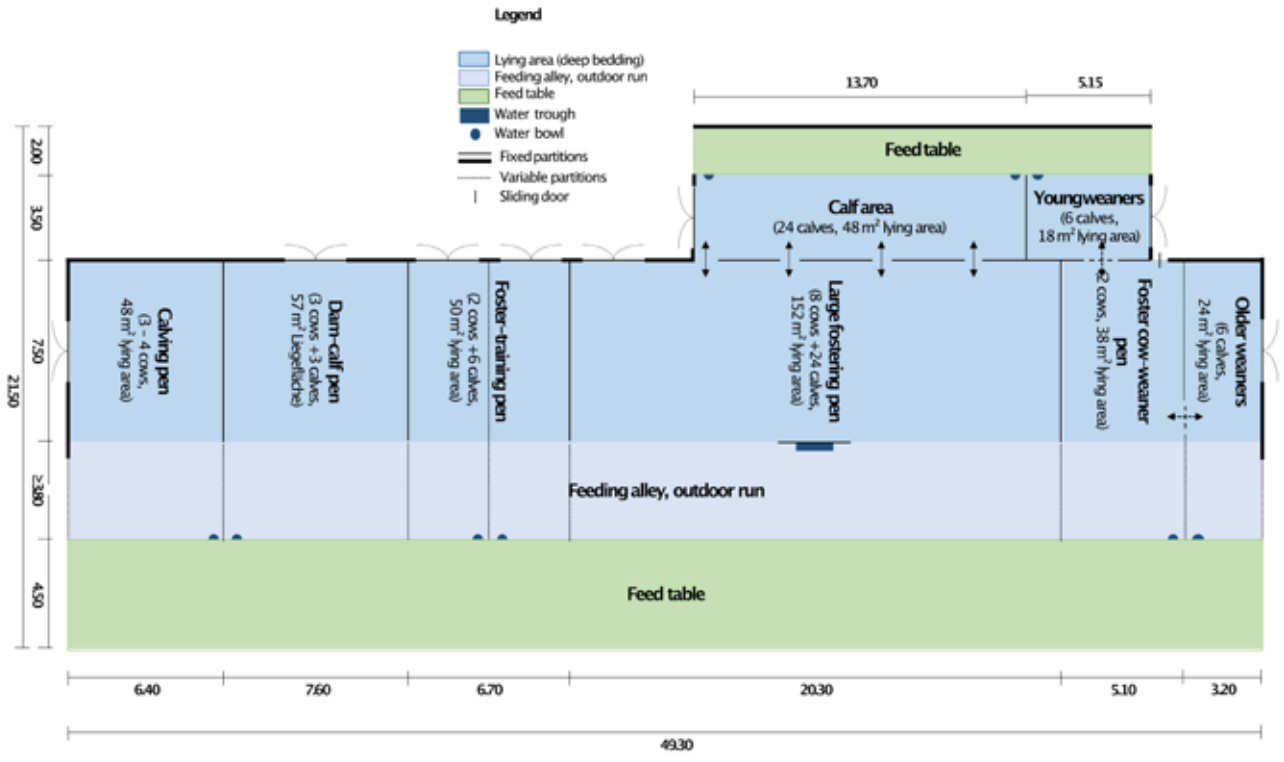
In the housing example, the calving pen, the dam–calf pen, the fostering pens, and the area for the older weaners are designed as a loose housing system with a bedded lying area and a solid-floor feeding alley. The feeding alley is of variable width and can be designed as an unroofed outdoor run. The two bedded areas for the calves and the younger weaners are next to the respective lying area of the foster cows and have their own feed table. All areas are directly accessible from the periphery. The gates allow for manure removal and, if applicable, for pasture turnout. Manure removal from the feeding alley and outdoor run can be done mobile or with a scraper.

For good air exchange, the building is designed as a pent roof construction with three closed sidewalls and a large opening to the downwind side. The west wind blowing across the roof creates the desired air exchange in the building, with supply and exhaust airflow on the downwind side (feeding alley, outdoor run). The incoming supply air moves through the feeding alley into the lying area, warms up, rises in the back of the lying area, and flows along the ceiling toward the feed table, where it leaves the building. Optimal ventilation requires a correct orientation of the barn building and a sufficiently sloped roof, with the roof tip above the feeding alley or feed table. The feeding alley may or may not be roofed; in the latter case, the adjacent feed table has its own roof. Flexible openings to the south side (calving pen, entrance gate to calf area) can additionally support the airflow.

Exemplary length of stay in each barn area
and the resulting proportion of animal-places per barn area

Barn area	Length of stay (days)	Proportion (%)	Spare places	Required animal-places	
				(per 100 cows)	(for 90 cows)
Calving Day 7 a.p. to calving	8	2.2	+ 50 %	4 cows	3 cows
Dam–calf pen Calving to day 10 p.p.	2–10	1.6	+ 50 %	3 cows, 3 calves	3 cows, 3 calves
Foster-training pen Day 10 to 24 p.p.	14	1.3	+ 50 %	2 foster cows, 6 calves	2 foster cows, 6 calves
Large fostering pen with calf area Day 24 to 91 p.p.	67	6.1	+ 30 %	8 foster cows, 24 calves	8 foster cows, 24 calves
Foster cow–weaner pen with weaner areas Day 91 to 122 p.p.	31	1.4	+ 30 %	2 foster cows, 6 younger and 6 older weaners	2 foster cows, 6 younger and 6 older weaners
Milked cows From day 91 to 122 p.p. (⅓) From day 2 – 10 p.p. (⅔)	178–298	71.8	+ 10 %	80 cows	72 cows
Dry cows From day 65 a.p.	57	15.6	+ 30 %	21 cows	19 cows
Total	365	100		120	108

a.p. antepartum (before birth), p.p. postpartum (after birth)



Exemplary layout of a housing system for fostered rearing on a medium-sized farm

3.5 Potential safety hazards for calves

The Directive on the Protection of Animals and the Keeping of Production Animals (TierSchNutztV Article 3 Section 2 Clause 1) stipulates that the design, materials, and condition of housing elements used for farm animals must exclude the risk of injury or other health hazards as reliably as possible under the current state of the art. In cow-bonded calf rearing, calves may have access to areas where otherwise only cows are housed. Thus, in furnishing and designing the functional areas, particular attention must be paid to potential sources of injury and danger for calves while excluding the risk of injury for cows as best as possible. The following table provides a checklist of common safety hazards. This checklist is not complete, and additional safety hazards may arise from site-specific conditions.

Safety hazards for a calf in a dairy barn and possible preventive measures

Safety hazard	Risk	Example	Prevention
Walkways with slatted floor	Large gaps in the slatted floor can cause claw and joint injuries in calves.		Slat widths must meet the requirements for calf claws (according to TierSchNutztV Section 2 Article 6)
	Narrow walkways, dead ends: Calves can be crushed by cows or injured by kicks.		Generous space allowance and options for the calves to get out of the way should be provided.
	A slick surface entails the risk of slipping or falling for the calf.		A rough surface provides a non-slippery floor and supports sure-footed evasive movements. Additionally, rubber mats can reduce the injury risk in falling.
Slat scraper, manure pit	Calves can fall into open manure pits.		Secure cover or partition. Installing manure pits outside of the barn area.

Safety hazard	Risk	Example	Prevention
Protruding objects	Sharp or pointed objects can cause injuries to cows or calves.		Removal of sharp-edged or pointed objects reduces the risk of cuts or chaps.
Head-to-wall or narrow cubicles; cubicle partitions	The calf can be crushed when the cow reclines in the cubicle.		Providing additional evasion space for the calves by building sufficiently large cubicles and creating options for forward flight.
Headlock feed fence	If cow and calf simultaneously stick their heads through the opening, the latching of the headlock can have a guillotine-effect on the calf's head.		A safety self-catch feed fence hinders the calf from sticking its head through.
Pasture fence	Calf-inadequate fencing entails the risk of calves escaping, which is especially dangerous near roads.		Calf-appropriate fencing, e.g. with a triple enamelled wire system. Do not use knot fence!
Pasture access	Unsurfaced or unpaved access paths tend to get soggy during increased rainfall.		Provide surfaced or paved access routes to the pastures.
Automatic concentrate feeder	If cow and calf enter the automatic concentrate feeder together, a space allowance that is too small entails the risk of unrest or crushing.		The calf must have an option for forward or sideward flight.

4 What are the incurred expenses?

The farmmanagers we visited for this project said that the reason for choosing cow-bonded calf rearing was their desire to implement a more species-appropriate husbandry system. They all described an increased level of job satisfaction. Furthermore, they said that positive side effects include an improved vitality of the calves and easier and more animal-oriented workflows.

Nonetheless, anyone who considers implementing cow-bonded calf rearing on the own farm will also have to face the question of economic viability.

Depending on the used method of cow-bonded calf rearing, the amount of marketable milk is reduced to a variable degree. Therefore, we performed a differential cost analysis as part of the EIP project on cow-bonded calf rearing to estimate the incurred expenses and thus the required extra earnings. One part of the data for this analysis was collected on the participating farms, another part relied on rule-of-thumb estimates. Various items were considered, such as on-farm milk consumption, milk composition, and the costs incurred for housing, labour, material, machinery, and feed. Because this guide addresses both organic and conventional farms, the calculations were applied to both systems.

Please note that the estimates are not intended to be exhaustive or generally valid. Our goal is rather to address relevant cost items for cow-bonded calf rearing.

4.1 Differences in the rearing costs – differential cost analysis

The differences in costs and proceeds were compared by means of a differential cost analysis. For this analysis, first the costs of the different calf rearing systems were calculated, then the costs of the respective current situation (for example common bucket feeding) were subtracted. The resulting figures are the differential costs. For each rearing method, the costs were calculated for the period covering the calves' first 90 days of life.

4.1.1 On-farm milk consumption

The following table shows the different expenditures for milk feeding compared between common bucket feeding, whole-day cow–calf contact, and short-time contact. The expenditures are listed for an organically and a conventionally managed farm.

As basic assumption we used a calculative milk price based on the average milk price German farmers had received for organically (47.63 cent/kg) and for conventionally produced milk (34.40 cent/kg) in 2019[1].

Average expenditure on milk per calf in cow-bonded calf rearing during the 90-day milk-feeding phase

	Bucket feeding	Whole-day contact	Short-time contact
Milk amount	468 kg	1266 kg*	900 kg*
Costs organic milk	223 €	603 €	429 €
Costs conventional milk	161 €	436 €	310 €
Difference to bucket feeding *(organic milk)*	–	380 €	206 €
Difference to bucket feeding *(conventional milk)*	–	275 €	149 €

During the first five days, the calves exclusively receive colostrum in all three methods.

** The milk amount accrues from the amount fed to the calves and the amount lost by milk ejection problems.*

The estimated amount of fed milk during whole-day contact is based on studies done by the Thünen Institute of Organic Farming.[2] The milk input for calf rearing with short-time contact between cow and calf is based on the data provided by the manager of one of the project farms. The assumed 900 kg per reared calf are the sum of 800 kg milk input for feeding and 100 kg milk loss due to milk ejection problems. The listed milk amount for bucket feeding is based on the guidelines for optimised calf rearing published by the Lower Saxony Ministry of Food, Agriculture and Consumer Protection.[3] The estimation assumed a 14-day ad libitum feeding.

1 BMEL (2020)

2 Tergast et al. (2019)

3 Lower Saxony Ministry of Food, Agriculture and Consumer Protection (2015)

4.1.2 Milk composition

Cow-bonded calf rearing has effects on the milk solids, as shown by the milk recording data in the following table. Especially the fat content can be reduced. Thus, the proportion of calf-rearing cows in the herd influences the composition of the bulk tank milk.

➟ 2.4.3 Milk ejection problems

Because dairies calculate price markups or markdowns according to the fat and protein contents of the bulk tank milk, these differences must be considered in the calculation of the milk value. The basic milk price applies to standard milk with 4.0% fat and 3.4% protein. Based on the average payments made by dairies in Schleswig-Holstein, 2.23 cent/% (fat content) and 4.70 cent/% (protein content) had to be subtracted or added for each percentage point of deviation from the standard.[1] The differences in the milk composition of calf-rearing cows (0.62% less fat and 0.13% more protein) thus resulted in a price reduction of −0.77 cent/kg for the milk delivered to the dairies.

Differences in the milk composition of cows on the project farms (calculations are based on milk recording data)

Milk component	Cows with calf	Cows without calf	Difference
Fat	3.33 %	3.95 %	– 0.62 %
Protein	3.24 %	3.11 %	+ 0.13 %

4.1.3 Costs for housing

The following table lists the average animal-place costs per calf during the first 90 days of life. On the 91st day, the nursing period of the cows is terminated for the current lactation. The calculation path starts with the assumption of new investments. Cost information on the associated investment expenditures is based on construction cost data provided by the KTBL.[2] Because the prices for animal-place costs at the time of the housing project can vary depending on the region and the design preferences of the farmers, calculations during the planning phase should always be based on the own cost assumptions. You will find detailed explanations on Page 104.

Animal-place costs per calf during the first 90 days of life

Bucket feeding	Whole-day contact	Short-time contact	Fostered rearing
39 €	63 €	117 €*	108 €**

** Calculation includes the new construction of a contact area*

*** Based on one foster cow with 6,000 L milk per year*

For the different rearing systems, different investment assumptions were made:

1 Information provided by the Schleswig-Holstein Chamber of Agriculture, 'LK Markt', 5 April 2019

2 KTBL (2020)

Bucket feeding

During the first two weeks, the calves are housed in single or double igloos. Beginning with the 15th day of life, they are transferred to group igloos. Cleaning times are also considered.

Calculation basis:

- **Calf igloos:** € 4.16 per animal. This figure is based on purchase costs of € 585 per animal-place[1], a longevity of 12 years, and 17.4 occupancies per year, calculated with 40 % spare places..
- **Group igloos:** € 34.76 per animal. This figure is based on purchase costs of € 1,016 per animal-place[2], a longevity of 12 years, and 3.6 occupancies per year. Because the calving frequency varies throughout the year, the calculation includes 25% spare places.

Whole-day contact

The calculations for planning a rearing system with whole-day cow–calf contact are based on a solid-floor dairy barn (reference: KTBL barn model MV 008[3]). Costs for an additional 10% lying area are estimated because the calves occasionally lie down in the cows' cubicles, which thus are temporarily not available to the cows. The space requirement in the calving area increases by 50% because after calving cow and calf stay longer together in the calving pen.

'The real costs for housing solutions for implementing cow-bonded calf rearing can vary greatly depending on the farm-specific conditions; therefore, the costs should be calculated specifically and in advance.'

Group igloos as separate calf area: To include a retreat area for the calves, this calculation example assumes that group igloos adjacent to the cow barn can offer such area in an easy and practicable way. If existing old buildings are used, the expenditure decreases accordingly.

Calculation basis:

- Added costs for an additional 10 % animal-places in the cow area amount to € 17.51 per animal-place based on the costs of € 6,946 per animal-place as estimated for reference barn KTBL MV 008 with a longevity of 25 years[4] and 3.2 occupancies per year.
- Added costs for enlarging the calving area by 50 % amount to € 5.73 per calf based on € 4,359 per animal- and feeding place, with a length of stay of 12 days in the calving area (7 days before calving, 3 days cow and calf, 2 days cleaning) allowing for 30.42 occupancies per year. As above, the longevity is assumed to be 25 years.
- The costs for the group igloo amount to € 39.48 per calf up until weaning after 90 days. The calculation bases are the same as those for bucket feeding. However, the possible occupancies per year with 3.17 are less, resulting in the slightly higher cost. This cost is based on 87 days of occupancy in the calf area plus 5 days of cleaning.

Short-time contact

The cost calculation for a time-restricted contact between cow and calf also draws on the specifications of KTBL barn model MV 008. As in the above example for whole-day contact, added costs include an enlargement of the calf area (with 15.87 occupancies per year) and the provision of a group igloo as a retreat area for the calves. The cost calculation for a specially built contact area is also based on the figures provided by the KTBL (investment costs of €3,216 per animal-place with 3.6 occupancies per year).

The costs for the 90-day rearing phase 'cow and calf' amount to €117 (including new construction of a contact area with €71.36 per calf). Again, the longevity is assumed to be 25 years.

1 Albert Kerbl GmbH (2021)

2 KTBL (2009)

3 KTBL (2020)

4 BMF (1996)

Fostered rearing

The calculations for planning a rearing system with whole-day fostering are based on a suckler cow barn (reference: KTBL barn model MK02001[1]). The space requirement for one foster cow plus the calves she nurses was estimated according to a cow–calf ratio considering the milk yield level of the cow. The space requirement in the calving area increases by 50% because after calving cow and calf stay longer together in the calving pen. As estimated for whole-day contact, the space needed for the calves includes a calf area.

The total costs per animal-place are composed of the cost of the space needed for cow and calves (according to the applicable cow–calf ratio) and the costs of the required feeding place enlargements for calves, the enlargement of the calving pen by 50%, and the added calf area. The costs are calculated for a rearing duration of 90 days per calf and 3.2 occupancies per year (calving pen: 24.3 occupancies). In the following calculations, the nursing period ends with the 91st nursing day in the respective lactation.

The total costs per animal-place depend on the individual milk yield of the foster cow, on whether the cow continuously nurses during lactation (or stops nursing as of the 91st day), and on the resultant cow–calf ratit. For example: For a foster cow with a milk yield of 6,000 L, the cow–calf ratio is two calves per foster cow, and the costs per calf amount to €108. A milk yield of 10,000 L per cow results in a cow–calf ratio of three calves per foster cow and consequently in costs of €93 per calf for a 90-day rearing phase. You will find calculation examples to determine the cow–calf ratio on Page 105.

4.1.4 Costs for material and machinery

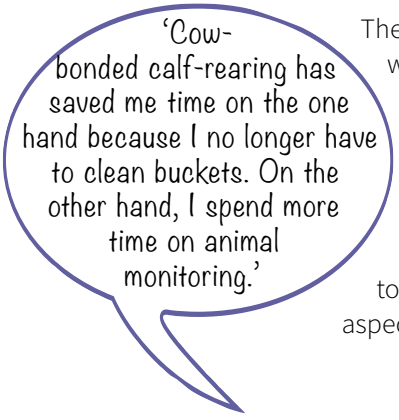
The cost estimates for common rearing are based on bucket feeding by means of a mobile milk tank (purchase costs: €5,850; longevity: 12 years), a feed bucket (purchase costs: €8; longevity: 4 rearing periods), and an immersion heater for colostrum (purchase costs: €160; longevity: 2 years). These costs items result in an expenditure of €9.04 per calf during a 90-day rearing phase.

The cost items for health care (medication, veterinary expenses), bedding, electricity, and water are assumed to be similar between the different rearing methods. Thus, they are not addressed here.

4.1.5 Costs for labour

Comparison of the systems

Owing to the constantly growing demands (along with the added bureaucratic effort) in the farming sector, the available working time has become an increasingly limiting factor. In this section, we compare the labour-related economic aspects 'working time' and 'flexibility' between the various rearing systems.



The participating farm managers measured the working time for all tasks associated with calf rearing. These measurements were projected to a rearing duration of 90 days. Data on the assumed initial situation with common bucket- or automatic feeders were taken from the relevant literature.[2]

The results, which are shown in the following table, reveal that the time input per calf slightly increases during the first 90 days of life with dam rearing. One reason, among others, is an increased input for animal health checks and animal monitoring. Because the data were collected on just a few farms, individual farm-specific aspects can strongly influence the result.

1 KTBL (2020)

2 Tergast et al. (2019)

Demands on animal care

The participating farm managers stated that the work requirements in cow-bonded calf rearing as compared with common bucket feeding change insofar as the work is more animal based and less scalable. Therefore, they consider it important to hire workers who have 'an eye for the animal' and can contribute to and identify themselves with the system of cow-bonded calf rearing. The farm managers described this system not as being more difficult but as being a method with a different approach that requires an open mind.

The labour costs for the different rearing systems listed in the following table result from the respective time input multiplied with an hourly net wage of €20.[1] The required time input was assessed on the project farms as well as obtained from a previous comparative study[2].

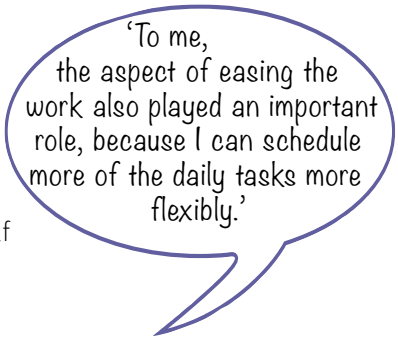
Required time input and labour costs per calf during the 90-day rearing phase

	Bucket feeding	Whole-day contact	Short-time contact	Fostered rearing
Tasks*	Feeding, cleaning, demanuring, rehousing of the calf, automatic milk tank and milk feeder, maintenance, training the calf, selecting or joining[2]	Calf health check, guiding the calves to the teats, udder health check and care, demanuring and cleaning of the calf area, nose flap fitting, feeding the calves (starter feed and roughage)	Calf health check, selecting the dams, joining and separating of cow and calf, guiding the calves to the teats, udder health check and care, demanuring and cleaning of the calf area, feeding the calves (starter feed and roughage)	Choosing the foster cow, calf health check, demanuring and re-bedding the foster cow barn, changing the foster cow, feeding the calves (starter feed and roughage)
Time input	8.00 hours	8.15 hours	9.19 hours	4.04 hours
Net labour costs at €20/hour	160 €	163 €	183 €	81 €

** You will find a detailed list of the calculated tasks in the appendix on Page 106.*

Flexibility in calf care

Besides these figures of business economics, factors that are not clearly measurable play a role in the farming practice. Some practitioners particularly emphasise the advantages of the workflow-related flexibility that cow-bonded calf rearing entails. For example, with fostered rearing and with whole-day contact between cow and calf, the timing of calf care is no longer dictated by the milking times. However, in short-time contact systems, the timing of bringing cow and calf together remains bound to the milking times.



4.1.6 Costs for feedstuff

Several studies have indicated that farms with cow-bonded calf rearing save on concentrate feed. However, this saving is associated with a reduced weight gain after weaning of the calves..[3] Farmers should therefore aim to ensure that calves reared by their dam or by a foster cow take in as much concentrate as possible. Thus, we do not consider potentially reduced intakes in the economic calculation.

1 Junge (2019)

2 Cf. Tergast et al. (2019)

3 Cf. Roth et al. (2008)

4.1.7 Proceeds from selling male calves

The proceeds that the project farms generated from selling two- to three-week-old male calves were in line with the national average. However, the farm managers reported an improved calf health and vitality.

4.1.8 Differential costs

The following table lists the differential costs of cow-bonded calf rearing for organically and conventionally managed farms with whole-day contact, short-time contact, and fostered rearing in relation to bucket feeding.

In viewing the results, please consider that

- new investments in animal-places were assumed and
- all calves stay on the farm until their 90th day of life.

➟ 4.1.3 Costs for housing

Cost difference of cow-bonded calf rearing to common bucket feeding

	Bucket feeding	Whole-day contact	Short-time contact	Fostered rearing
Barn, material, and machinery costs	48 €	+15 €	+69 €	+60 €
Labour costs	160 €	+3 €	+23 €	–79 €
Proceeds reduction due to changed milk composition*	0 €	+9 €	+12 €	0 €
Costs for milk feeding (organic)	223 €	+380 €	+206 €	+253 €
Costs for milk feeding (conventional)	161 €	+275 €	+149 €	+148 €
Total *(organic milk)*	431 €	+407 €	+310 €	+234 €
Total *(conventional milk)*	369 €	+302 €	+253€	+129 €

** Calculation basis was a delivered milk amount of 1,197 kg per calf for whole-day contact and of 1,564 kg per calf for short-time contact, each considering a milk feeding period of 85 days (+ 5 days colostrum feeding). The cost calculation for milk composition assumed a milk yield of 8.843 kg per cow (i.e., the average milk yield of 2019 in Schleswig-Holstein). The cost differences are due to the different amounts delivered, multiplied with 0.77 cent/kg.*

➟ 4.1.2 Milk composition

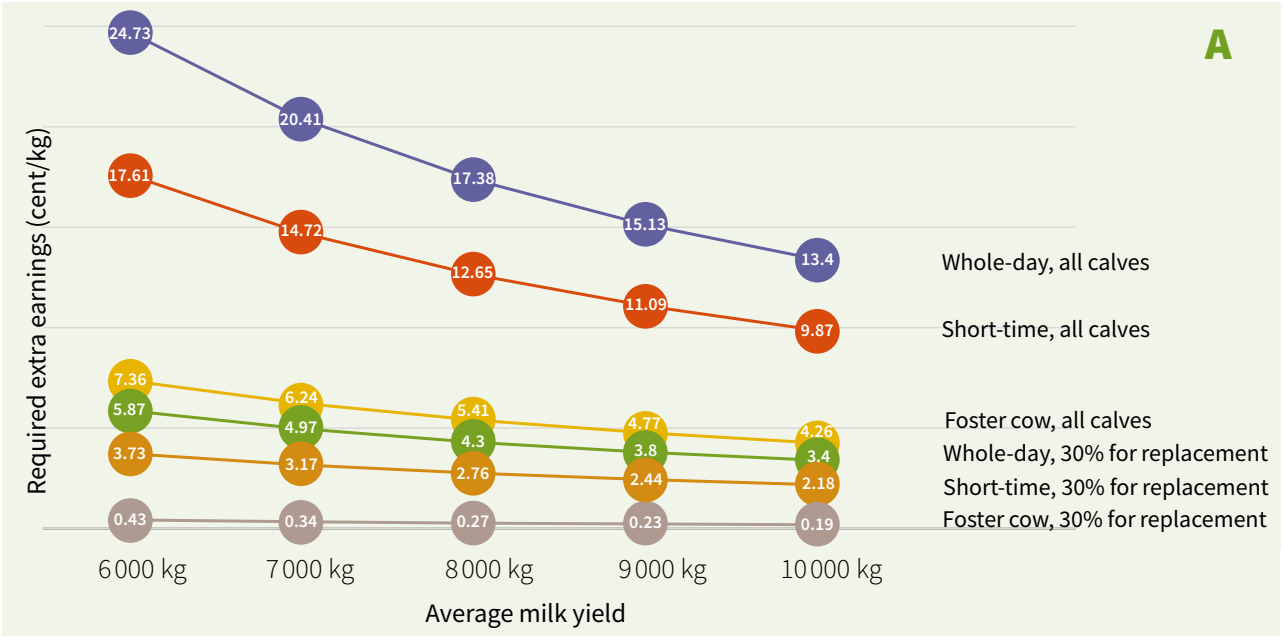
4.1.9 Required extra earnings

As you can see, the implementation of cow-bonded calf rearing on an operating farm is associated with costs that are higher than those of common bucket feeding. This cost increase must be buffered by a higher milk price in the marketing of the milk. One goal of the project was to provide information on the required extra earnings based on a differential cost analysis of the different rearing systems. For this purpose, the collected project data on on-farm milk consumption, on milk composition, and on costs for housing, labour, materials, machinery, and feedstuffs were used, and planning and market data from various sources were consulted. The following diagrams illustrate the resulting estimates of the required extra earnings (in cents per kilogramme) for each rearing method, depending on the average milk yield and the farming system. Each method is compared with an initial situation that assumes bucket feeding for 30% of the calves. All calculations are based on a rearing duration of 90 days and assume new investments in animal-places. The diagrams show that an assumed lower milk yield per cow

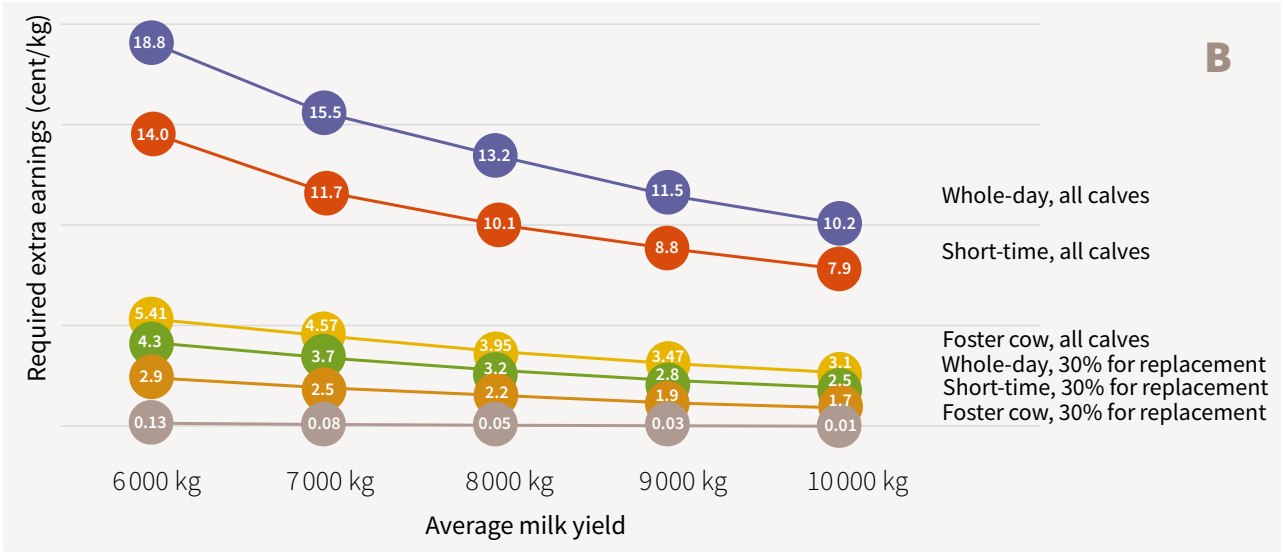
increases the required extra earnings to compensate for the differences in proceeds because, in total, less milk can be delivered to the dairies. Diagram A refers to organically produced milk, Diagram B to conventionally produced milk.

The calculations revealed that a system with whole-day contact in which all calves are reared requires the highest extra earnings to compensate for the expense. By comparison, the required extra earnings are less for rearing all calves with short-time contact. The main reason for this difference is the lower amount of fed milk. If only female calves are reared on the farm, the markedly reduced amount of fed milk leads to a correspondingly lower amount of required extra earnings. In a conventionally run system, owing to the lower costs of milk supply for calf rearing, the required extra earnings are less than in an organic rearing system.

You will find exemplary calculations for the required extra earnings depending on a specific milk yield or a specific milk price on Page 105 f.



*Required extra earnings for **organically** produced milk in comparison with common bucket feeding with 30% replacement*



*Required extra earnings for **conventionally** produced milk in comparison with common bucket feeding with 30% replacement*

4.2 Marketing

The selling of milk and milk products to a dairy is a form of marketing in cow-bonded calf rearing. Owing to the large variety in the practised rearing systems, German dairies have not yet provided specific guidelines. Milk price markups and thus an additional remuneration for the added effort would be desirable and should be negotiated or determined with the dairy.

Direct marketing of the milk allows farmers to organise the sale according to their own specific situation and preference. For instance, the products can be marketed through an own farm shop, a market booth, a milk vending station, or via community supported agriculture. Considerable added value can often be achieved with on-farm processing. Further options are sales to resellers, caterers, retailers, or wholesalers.

It is important to consider that the on-farm selling of milk products requires additional investments in terms of time, effort, and money. Cooperation with other farms may create synergetic effects.[1] In direct marketing, the required sales price is generally easy to communicate to the customers by explaining the practised rearing method of cow-bonded calf rearing.

It is a good idea to make the production visible and transparent to the consumers. The product packaging could be used as a communication tool, for example by including photos and information about the farm and the rearing method to design an attractive product. Likewise, social media (TV spots, ads, websites) can be used to communicate with the consumers. Moreover, one could subscribe to specific platforms for farms implementing this rearing method.

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1 Cf. Barth et al. (2021)

4.2.1 Marketing examples from the project farms

Direct marketing

On 'Hof Berg GbR', the produced milk is solely used for cheesemaking and is processed in the on-farm cheesery. The marketing is direct and regional, with the cheese being sold either at weekly markets or to selected cheese shops in the food retail market. Also, several gastronomic businesses and wholesale companies have included the cheese in their product line.

➟ 5.2 Farm profile

Direct marketing and delivery to a dairy

'Domäne Fredeburg GbR' owns a farm cheesery and produces various cheese creations. The milk for these products is solely from the own cows. Besides the production of raw milk cheese, the farm milk is processed into curd, cream, and yoghurt. The manufactured products are directly marketed in the own farm shop or sold to other farm shops and market booths.

Another share of the milk is delivered to a dairy.

Currently, the farm works on marketing strategies for beef from the male calves, so they can be reared on the own farm.

➟ 5.1 Farm profile

De Öko Melkburen GmbH

In 2011, the farmers Hans Möller, Achim Bock, and Heino Dwinger partnered up and established the label 'De Öko Melkburen GmbH'. The participating farms practise dam rearing designated as 'Parenting Time for Our Cows'. The produced milk is delivered to a dairy and marketed under the brand name 'Four-Season Milk'.

Furthermore, the male calves are fattened for two years on the farm-owned pastures. Thereafter, the customers can purchase the beef and processed meat products (such as salami) via an online shop.

Besides these two marketing avenues, the founding members of 'De Öko Melkburen' decided to establish community supported agriculture as part of their label. Through this producer–consumer cooperation, members are supplied with milk, beef, and other products.

➟ 5.3, 5.4, 5.5, 5.6 Farm profiles

5.1 Domäne Fredeburg GbR

Farm manager: Florian Gleissner

Breeds: Holstein Friesian, cross-bred with German Black Pied cattle

Herd size: 40 dairy cows

Housing system: Deep-bedded loose housing system

Dam rearing and fostering with short-time contact

For the first three weeks after calving, the dam and her calf stay together in a separate pen. During this time, the two are housed together with whole-day contact, and the cow leaves the pen only twice a day for milking. From the fourth week of life, the calves join a calf group and stay there until they are weaned in their 13th to 15th week of life. Twice a day after milking in which the cow is not milked out, the dams or foster cows visit the calves in a separate contact area. Here, the calves can suckle until they have emptied the cows' udders and can enjoy being licked and nursed. If a new cow joins the 'mom group', one of the other cows leaves the group. Thus, each calf is initially nursed by its dam and eventually by a foster cow. This approach dissociates the distress due to separation from the dam and the stress due to weaning from the milk.

The average cow–calf ratio is 1.3 to 1.8 calves per cow. After about one hour in the contact area, the calves are separated from the cows – the cows re-join the herd, and the calves return to their group area. During separation of cow and calf, the udders are checked to see if they have been emptied; in addition, the udders are greased with udder balm to keep the suckled teats smooth and healthy. Besides the milk feeding, the calves have continuous access to water, to their own calf pasture, and to ad libitum haylage.

Toward the end of the milk feeding period (approximately 13th to 15th week of life), the calves meet the cows only once a day, so the weaning from the milk occurs gradually and is as stress free as possible. To minimize the workload, often two to three calves are weaned at the same time. The weaned calves usually stay some extra time in their familiar calf group and thus can still smell and see the cows.

Marketing

Domäne Fredeburg GbR owns a farm dairy and produces various cheese creations made exclusively with milk from the own cows. In addition to the production of raw milk cheese, the farm milk is processed into curd, cream, and yoghurt. Approximately 500 litres of fresh milk are needed daily for the production. The manufactured products are sold directly in the own farm shop or to other farm shops and market booths.

In addition to the direct marketing, another share of the milk is delivered to a dairy.

Questions to Florian Gleissner

Since when have you practised cow-bonded calf rearing? I decided to switch to dam and foster cow rearing in 2012.

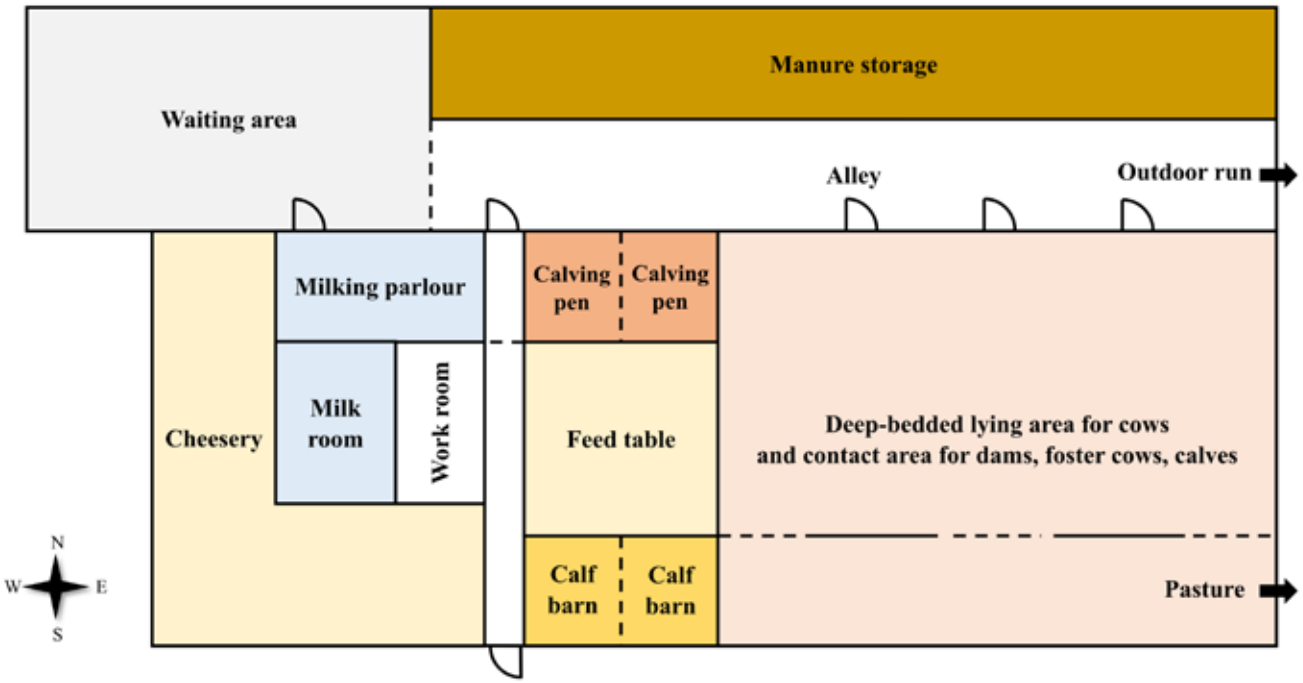
Which system did you practise before? I used buckets to feed the calves. On average, the calves were offered between 2.5 and 4.0 litres per meal.

What were your reasons to start cow-bonded calf rearing? On the one hand, I wanted to reduce the occurrence of cross-sucking among the calves. On the other hand, our customers increasingly asked for such a rearing system.

What did you modify to make cow-bonded calf rearing possible on your farm? The old barn was re-integrated for the calf rearing. In there, we have a large deep-bedded lying area where, after milking, the dams and foster cows meet the calves.

What would you do again, or differently? I would choose the same system, but I would like to have more space for the first three weeks.

What is your advice? Create the system in a way that is more fun but not more work than before.



5.2 Hof Berg GbR

Farm managers:
Meike and Falk Teschemacher

Breed: Holstein Friesian cross-bred with German Black Pied cattle

Herd size: 65 dairy cows

Housing system: Freestall barn

Dam rearing and fostering with short-time contact

The nursing cows stay in the calving pen and have whole-day contact with their calves for the first one to three days. They leave the pen only for milking. From the third to seventh day of life, the cows join their calves only during the day. With the second week of life, the calves join the calf group in the calf barn, from where they can access the calf pasture. Twice a day after milking, the calves meet the cows in the waiting area and can suckle for 30 minutes. Each calf can suckle its dam or an alien cow. In the milking parlour, the machine settings ensure that the udder is not completely emptied during milking. After the cow–calf contact time, the calves return to their group pen. In the calf barn, the calves have ad libitum access to groats, silage, and hay. This feed supply is offered to promote the early intake of roughage and concentrate feed and to ease the inevitable weaning process. The stress due to the change in diet for the calf and the distress due to separation for cow and calf can thus be reduced.

The weaning process begins with the eighth week of life. Now the calf can meet the cow only in the evening, reducing the contact from twice to once per day. This is a phase of intense habituation to roughage intake, while suckling milk remains possible. From the 85th day of life, the cow–calf contact is reduced to 15 minutes in the evening. During the next four days, calf and cow meet after every third milking. If the cow or calf experiences strong separation distress, as evident by loud vocalisation, the farmer slows down or extends the weaning process. The stress for the cow or calf can be reduced by allowing the respective animal to be in the contact area during contact times without having physical contact with the own dam or calf. Sometimes it is the calf, sometimes the cow that suffers more during the separation process.

Marketing

The produced milk is solely used for cheesemaking and is processed in the on-farm cheesery. The marketing is direct and regional, with the cheese being sold either at weekly markets or to selected cheese shops in the food retail market. Also, several gastronomic businesses and wholesale companies have included cheese from 'Hof Berg GbR' in their product line. In addition to the milk, the meat of 20 animals (mostly cows and heifers) is sold per year. These products are mainly sold as individual items or in mixed packages of 10 kg. Ninety percent of the bull calves are sold when they are 14 days old because a suitable marketing option has not yet been developed.

What do you envision for your future marketing? A constant or increased demand for products from cow-bonded calf rearing and an associated appreciation of this rearing system – that's a big wish of mine.

Questions to Falk Teschemacher

Since when have you practised cow-bonded calf rearing? We implemented this rearing system on our farm in 2016.

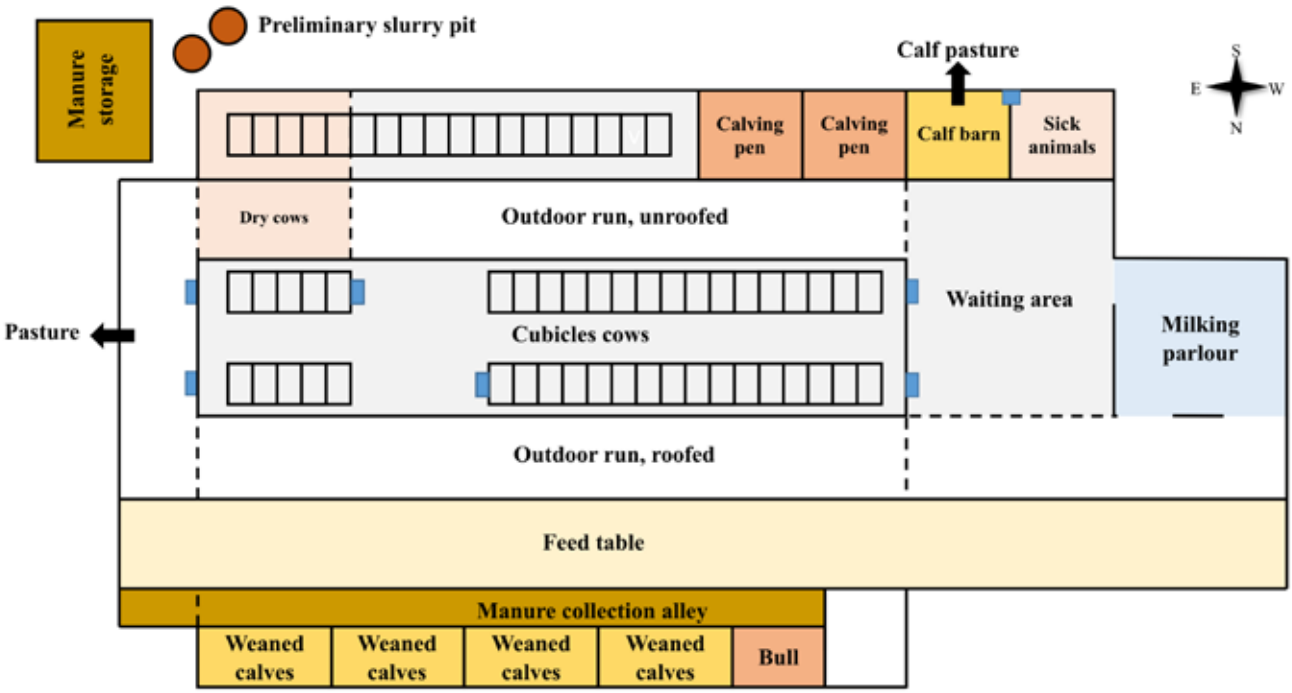
Which system did you practise before? Bucket feeding, restrictive.

What were your reasons to start cow-bonded calf rearing? I think it was a matter of the heart paired with the desire to allow social bonding between cow and calf. The early separation of dam and calf did not feel satisfying to us. The wish to improve calf health also supported our decision.

What did you modify to make cow-bonded calf rearing possible on your farm? I included the calf area in the cow barn.

What would you do again, or differently? I would start with the same system, and I think we will further modify and develop it in the coming years. It remains an exciting endeavour.

What is your advice? If the cow does not let down her milk in the milking parlour, udder health can be compromised. Some animals cannot reach a consistently high milk flow in the milking parlour; it is important to notice these 5% and wean them early on. The health of the calves is also compromised if, after milking, the cows have too little milk left for the calves. If the cow herself cannot regulate her milk flow accordingly, the milkers must pay close attention in the milking parlour and detach the milking cluster on time. Thus, the milker has a high level of responsibility.



5.3 Hof Achtern Holt GbR

Farm managers:
Achim Bock and the Kubera family

Breed: Holstein Friesian,
outbreeding toward German Red Pied cattle

Herd size: 60 dairy cows

Housing system: Freestall barn

Dam rearing with whole-day contact

In summer, the cows calve near the barn on pasture, where they are closely monitored. For the rest of the year, calving usually takes place in a calving pen. In both cases cow and calf stay together for five to seven days so they can bond before they re-join the herd.

During the nursing phase, the calf stays with its dam all day and can suckle as much as it wants. The development of the calf is closely monitored during this time. In addition, the dam is milked twice a day. At each milking, the milker examines the udder for possible injuries and disease and checks how much milk is in the udder of the nursing cow.

The weaning phase begins with the 91st day of life. The calf is fitted with a nose flap and stays in the herd with its dam for at least four weeks. The physical contact between cow and calf eases the abrupt weaning from the milk. In summer, the calves may even stay in the herd for up to three months. Afterwards, they are rehoused in small groups in the young-cattle barn in the wintertime, or they are moved to the young-cattle pasture in the summertime. For the stepwise weaning, a barn with visual and tactile contact is located next to the outdoor run of the cows, with fully separated feeding and lying areas.

All calves stay on the farm for at least three months. Since 2020, only bulls of the breed German Red Pied have been used to make the marketing of the male calves more attractive.

Marketing

In cooperation with Hans Möller and Heino Dwinger, Achim Bock established the label ‘De Öko Melkburen GmbH’. Since then, the milk has been sold under the brand name ‘Four-Seasons Milk’. The marketing of the male calves raised on the own farm is currently planned.

What do you envision for your future marketing? Definitely a higher milk price. My wish would be a standard retail price of 2 € per litre for organic milk. Another dream of mine is to establish our own farm cheesery. (Janine Kubera)

Questions to Achim Bock

Since when have you practised cow-bonded calf rearing? The first cow in this rearing system was Snowflake in early 2015 – she still is a member of the herd.

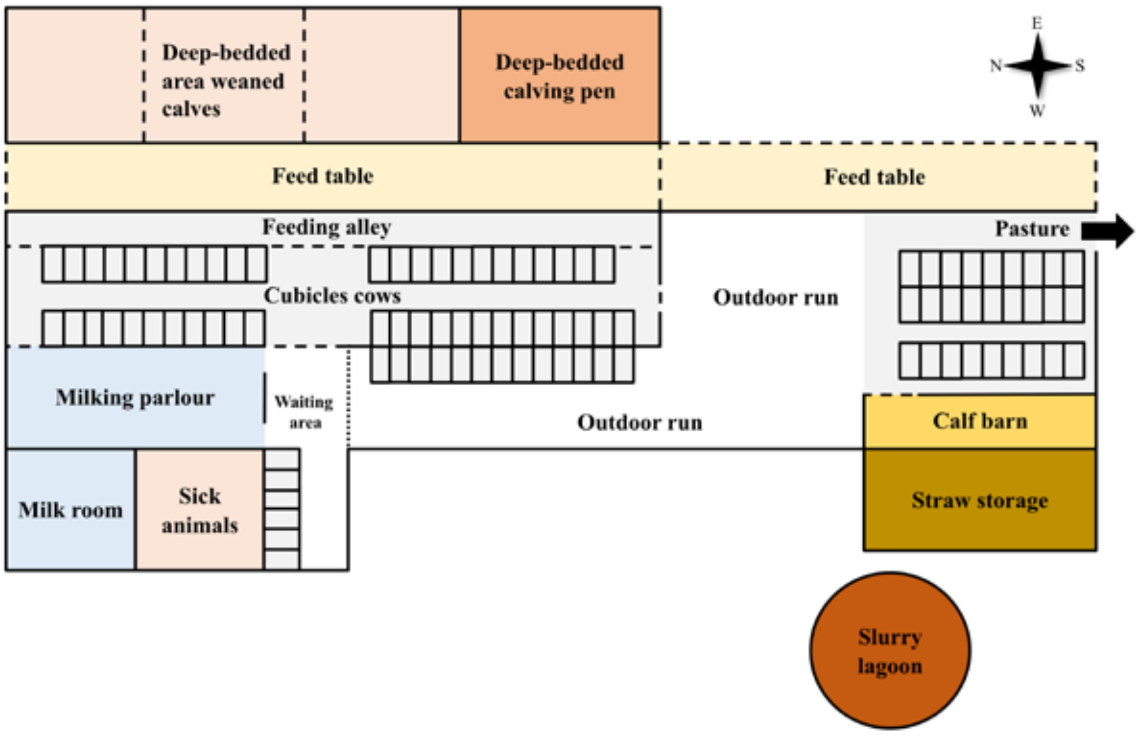
Which system did you practise before? Bucket and milk bar feeding, restrictive.

What were your reasons to start cow-bonded calf rearing? I saw this new system on another farm and approached it pretty much by chance. Why I chose the new system? I noticed that stopping the bucket feeding meant less work and gave me more time to observe the animals. The improved health of the calves was another reason for me to take this step. It dovetails nicely. Calves feel good, cows feel good.

What did you modify to make cow-bonded calf rearing possible on your farm? Not a lot. I simply built a straw-bedded calf area with a calf creep whereto the calves can withdraw.

What would you do again, or differently? The way the system is set up now is how I would always want to do it again. However, I am not yet satisfied with the weaning! The nose flap does not work as envisioned. Some of the calves manage to suckle despite wearing the nose flap.

What is your advice? It is important to closely monitor the calves and to check daily how they are doing. Calves need a retreat area where they can be with other calves. This retreat area should allow fixing the animals so they can be handled for medical treatments or nose flap fitting. Also, from our experience, calves that are struggling with cryptosporidia and still suckle their dam should receive additional milk supply.



5.4 Hof Möller

Farm manager: Hans Möller

Breed: German Black Pied cattle

Herd size: 25 dairy cows

Housing system: Year-round grazing

Dam rearing with whole-day contact

Calving happens outdoors on the dry-cow pasture. With the third to fourth day, cow and calf join the lactating dairy herd. From then on, the cow is milked. Milking is done once a day, usually in the morning. The cows are milked in a mobile milking parlour on pasture during summer and in a milking parlour in the barn during winter. In the parlour, the health state and filling degree of the udder are checked. After integration into the herd, the cow and the calf have continuous contact for the next three months. During these months, the calf can suckle its dam all day.

At the time of weaning (13th to 14th week of life), at least two calves are weaned simultaneously from their dams by means of a nose flap. These calves stay in the herd for a few more days. If there are not enough calves to form a weaner group, the calf stays with the dam for an additional month. Whenever possible, the calves move in a small group to a separate pasture with already weaned calves. Visual and audio contact to the herd remains.

Marketing

In 2011, Hans Möller partnered up with the two organic farms of Achim Bock and Heino Dwinger. Together they established the label 'De Öko Melkburen GmbH'. Here the milk is marketed under the brand name 'Four-Seasons Milk'. Curd and yoghurt are offered in addition to the milk.

Furthermore, the male calves stay on the farm and are fattened on pasture for two years. Thereafter, customers can purchase the beef and processed meat products (such as salami) via an online shop.

Besides these two marketing avenues, the founding members of 'De Öko Melkburen' decided to establish community supported agriculture as part of their label. Through this producer–consumer cooperation, members are supplied with milk, beef, and other products.

What do you envision for your future marketing? I would appreciate that the food retail market allows more space for small-scale and direct producers. Also, in my opinion the retail sector should have less influence on the pricing of agricultural products.

Questions to Hans Möller

Since when have you practised cow-bonded calf rearing? We decided for dam rearing five years agt.

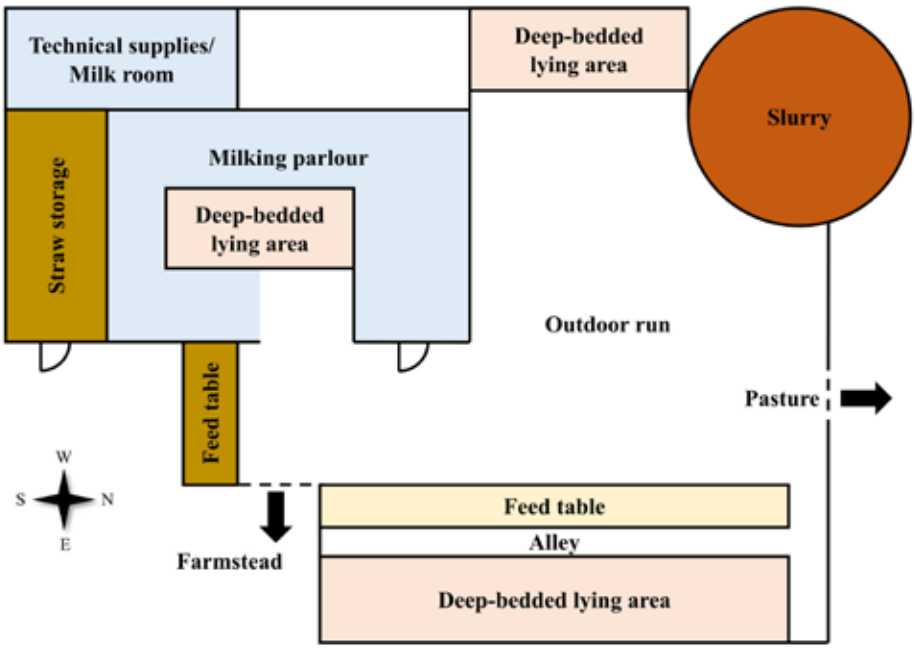
Which system did you practise before? Common bucket feeding in which we fed the calves restrictively.

What were your reasons to start cow-bonded calf rearing? The impulse for changing our system came from our customers. Several of them approached us and asked: 'Why do you feed the calves from buckets?' We took this question to heart, also considering our direct marketing options, and in the following years changed our calf rearing system to dam rearing.

What did you modify to make cow-bonded calf rearing possible on your farm? Now that I think about it, we did not modify a lot. We started with just a few calves that could stay with their dams and gave it a try for one year. Seeing that it worked well, we consequently changed the whole herd so that the calves can grow up with the cows.

What would you do again, or differently? The way I raise the calves now, together with their dams, is how I would do it again. However, in the beginning I would allow myself to be more patient, meaning I would allow two to three years for the new system to come into balance. Time and patience are significant factors.

What is your advice? Let the cows do what they do and trust that they will raise their calves in healthy ways.



5.5 Hof Elisabethheim Havetoft e. V.

Farm manager: Jens Otterbach

Breed: Angler

Herd size: 30 dairy cows

Housing system: Deep bedding on sloped floor

Dam rearing with seasonal whole-day contact

Calving occurs seasonally at the beginning of the year. Cow and calf stay in their individual calving pen for the first three to five days to form a strong bond. Afterwards they are integrated in the herd with pasture access. In the next three months, cow and calf have whole-day contact, and the calf can suckle the udder anytime. During the rearing phase, the cow is milked twice a day. Before milking, the calves are separated from the cows and moved to a separate barn area, where they stay until the end of the milking session. After milking, the cows are fixed in the feed fence and receive their feed. When the cows are released, the calves re-join them and can suckle their dams.

Weaning begins with the 12th week of age: two days before the permanent weaning, calf and dam are separated for the period from the morning milking until after the evening milking. In addition, the calves are fitted with nose flaps and re-join the cows for the nighttime. Depending on the vocalised separation distress, the separation phase may be interrupted or completed. With the 13th week of life, weaning from the cow is completed. The calf is moved to the young-cattle herd, which has access to its own pasture. Owing to the seasonal calving, weaning occurs in groups of four to seven calves.

Marketing

Jens Otterbach joined 'De Öko Melkburen GmbH' in 2020 and sells the milk to their dairy.

What do you envision for your future marketing? Own processing and regional marketing. Especially the marketing of the own bull calves.

Questions to Jens Otterbach

Since when have you practised cow-bonded calf rearing? When I took over Hof Elisabethheim in 2016, I implemented the dam rearing system on the farm. I was able to apply my experience with this system from the previous farm, where I had practised dam rearing for six years.

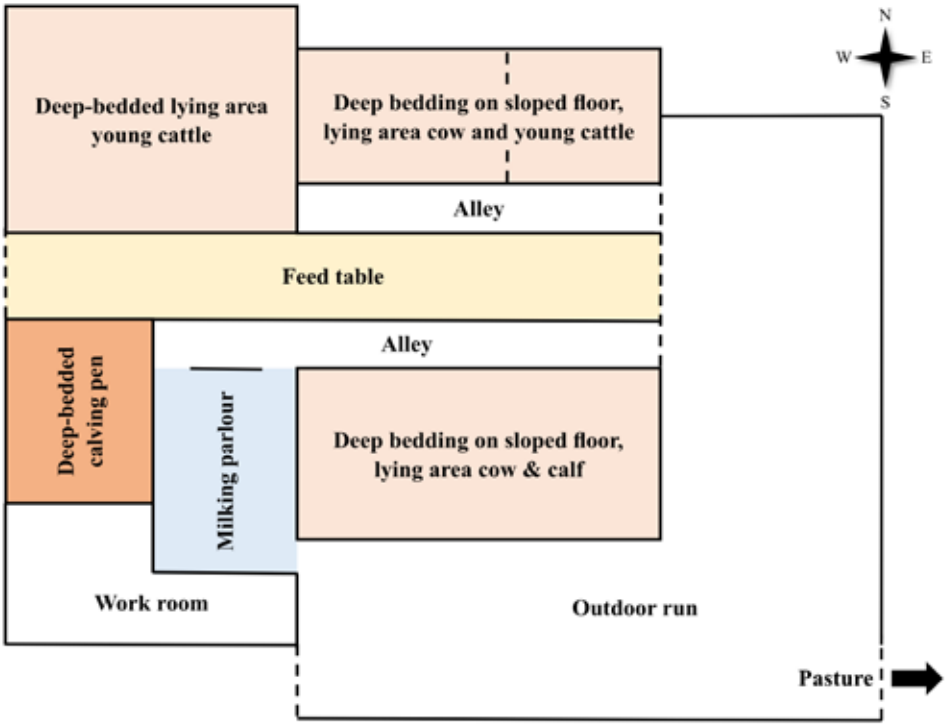
Which system did you practise before? The common one: restrictive bucket feeding.

What were your reasons to start cow-bonded calf rearing? The personal challenge and my wish for species-appropriate animal husbandry. My priority was to build a healthy herd. Here on this farm, dam rearing of the calves was the easiest option for me to apply the EU regulations for organic farming.

What did you modify to make cow-bonded calf rearing possible on your farm? After six years of experience with cow-bonded rearing on my previous farm, I could start right away.

What would you do again, or differently? I wouldn't do anything differently.

What is your advice? The entire housing environment must meet the hygiene standards for calf housing. A challenge is the setting for animal-specific milking.



5.6 Hof Dwinger

Farm manager: Heino and Sabrina Dwinger

Breeds: Simmental cross-bred with German Red or Black Pied cattle

Herd size: 50 dairy cows

Housing system: Composting barn

Dam rearing with whole-day contact and a milking robot

During the first two days after birth, cow and calf stay on the dry-cow pasture, where the calf has continuous access to the udder and colostrum. From the second to third day onward, until weaning at the age of three months, cow and calf stay together on pasture. Because a milking robot is available to the cows, the milking is not restricted timewise. Each cow decides on her own when she wants to be milked. The calves have no access to the milking robot so that the cow can be milked without disturbance.

The weaning occurs abruptly. After the first three months, the calf is completely separated from the dam, without visual or audio contact. In addition to the spatial separation, the weaning process is supported homoeopathically.

Marketing

Since 2011, 'Hof Dwinger' has been a constant part and co-founder of 'De Öko Melkburen GmbH'. The milk is marketed under the brand name 'Four-Seasons Milk'.

What do you envision for your future marketing? Guided farm tours; customers with critical questions are appreciated.

Questions to Heino and Sabrina Dwinger

Since when have you practised cow-bonded calf rearing? We have practised this system on our farm since 2016.

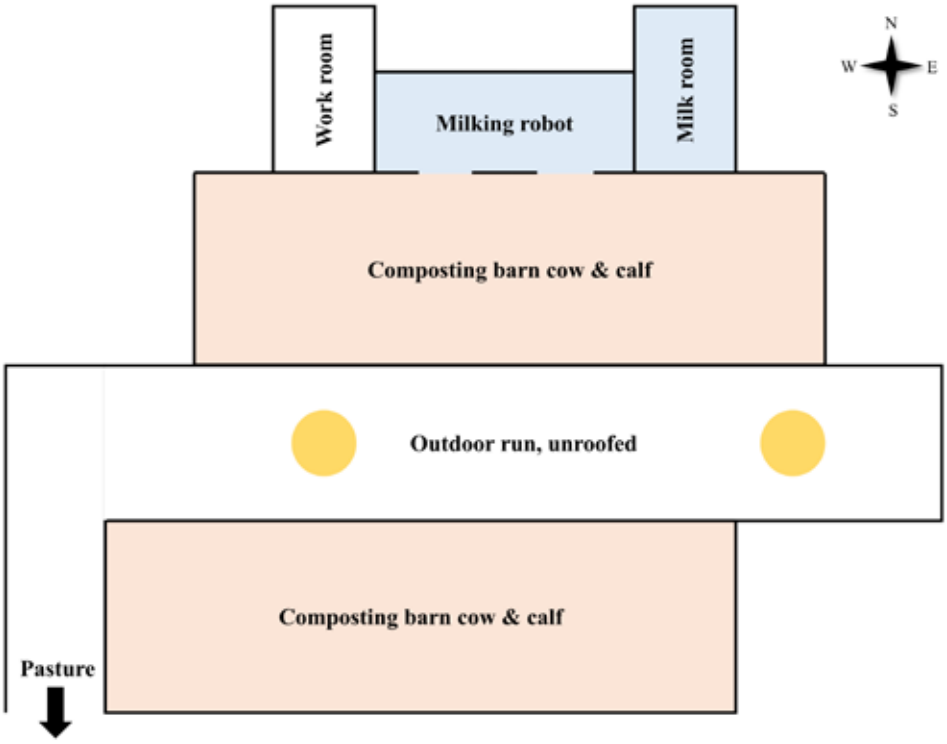
Which system did you practise before? Bucket feeding, ad libitum.

What were your reasons to start cow-bonded calf rearing? Conversations with colleagues and our customers. The marketing set things in motion.

What did you modify to make cow-bonded calf rearing possible on your farm? Nothing. However, after a fire, the barn was newly built with a more generous space allowance.

What would you do again, or differently? So far, we don't want to change anything.

What is your advice? There must be enough space for cow and calf.



5.7 Hof Jensen

Farm manager: Matthias Jensen

Breed: German Black Pied cattle

Herd size: 65 dairy cows

Housing system: Freestall barn, deep-bedded loose housing system

Fostered calf rearing with whole-day contact, without milking

During the first two to four days, the newborn calf is supposed to independently suckle colostrum from the udder of the dam. About 90% to 95% of the time, cow and calf are usually alone in a straw-bedded pen. With the fourth day, the cow returns to the lactating herd and is milked from then on. The calf stays in the straw-bedded pen for another two days and is bucket fed. Thereafter, the newborn is moved to the foster cow group. The foster cow group is composed of cows that are not milked, so their milk is completely available to the calves. From the second to eleventh week of life, the calves grow up in the foster cow group. One foster cow usually nurses two to four calves that can suckle the udder anytime.

In the next two weeks, weaning takes place individually according to each calf's needs. The weaning from the foster cow happens abruptly. The weaned calf now joins the young-cattle herd.

Marketing

The milk is sold to a close-by private cheesery.

What do you envision for your future marketing? In my view, the conditions and type of the farming system should be more appreciated and rewarded.

Questions to Matthias Jensen

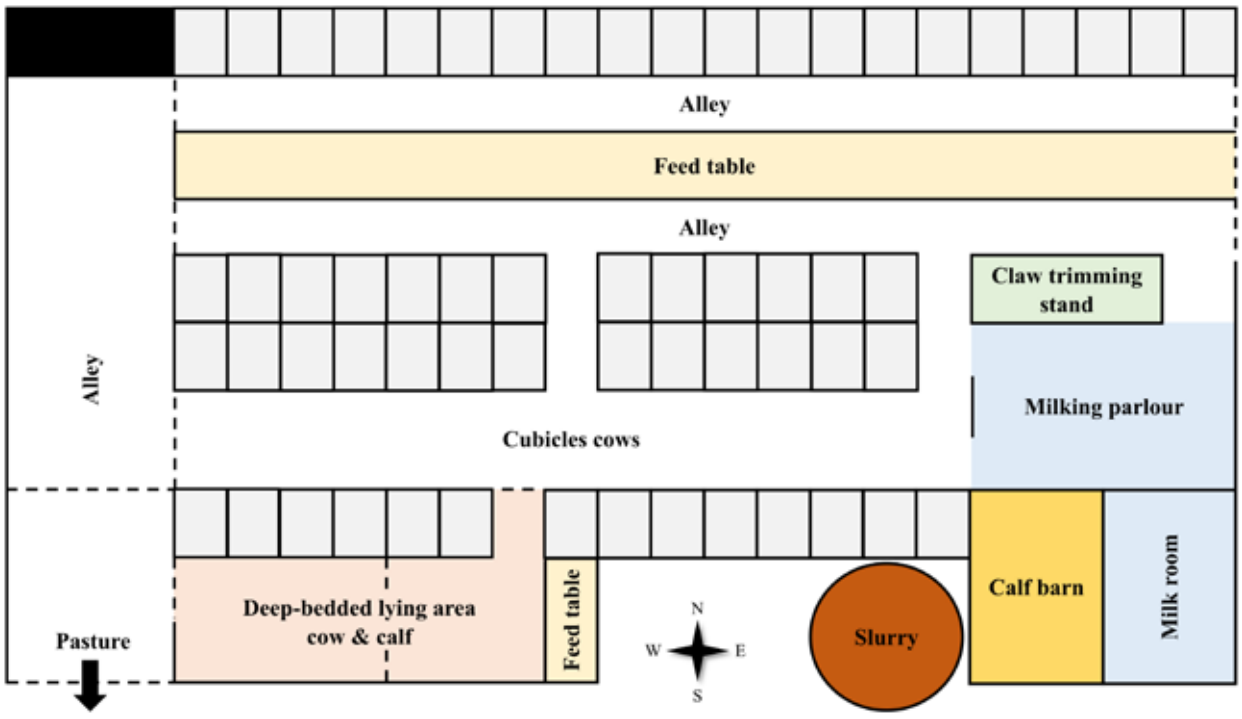
Since when have you practised cow-bonded calf rearing? I had practised fostered calf rearing a few years ago but stopped after a while. With the beginning of the EIP project, I decided to pick it up again.

Which system did you practise before? I fed the calves restrictively with a milk bar teat feeder.

What were your reasons to start cow-bonded calf rearing? In my opinion, it is the most natural form of rearing, and it reduces the workload.

What would you do again, or differently? To practise this system again, I would need much more space, also in view of grouping the animals more appropriately. In addition, I would include a calf creep for the very young calves.

What is your advice? It is important that the calves have enough space allowance with the foster cows. There shouldn't be too many calves per cow or foster cow. That would overwhelm the cow and can lead to poor udder health.



5.8 Hof Tams-Detlefsen

Farm managers: Dirk and Uta Tams-Detlefsen

Breeds: German Black Pied cattle and cross-breeds with Swiss Brown

Herd size: 70 dairy cows

Housing system: Freestall barn, deep-bedded loose housing system

Dam rearing and fostering with whole-day contact, without milking

For calving, the cow is not separated into a calving pen. Birth can occur on pasture or in the barn. The cow and her calf always stay in the dam–foster cow group for the first seven days after calving. If the cow accepts the other calves in the group, the young dam is allowed to stay, and the 'longest serving' foster cow leaves the dam–foster cow group. If a cow after calving is not interested in the other calves or overly protects her own calf, she is moved to the milked herd after seven days. The nursing dams or foster cows are not milked. They are mainly responsible for feeding the calves. For the next three months, the calves have unrestricted access to the cows and can suckle the udder of the dam or foster cow anytime.

With the 13th week of life, the calves are weaned from the cows in small groups of four to five calves. Being separated into a calf creep, the calves still have visual contact to the dam or foster cow. The calves stay in this area for three to four days until they are transferred to the young-cattle group.

Marketing

The milk is delivered to 'Gläserne Molkerei GmbH', a dairy in Dechow, Mecklenburg-Western Pomerania.

What do you envision for your future marketing? It would be nice to receive a higher price for the milk.

Questions to Uta Tams-Detlefsen

Since when have you practised cow-bonded calf rearing? We started the system that we practise today roughly eight to nine years agt.

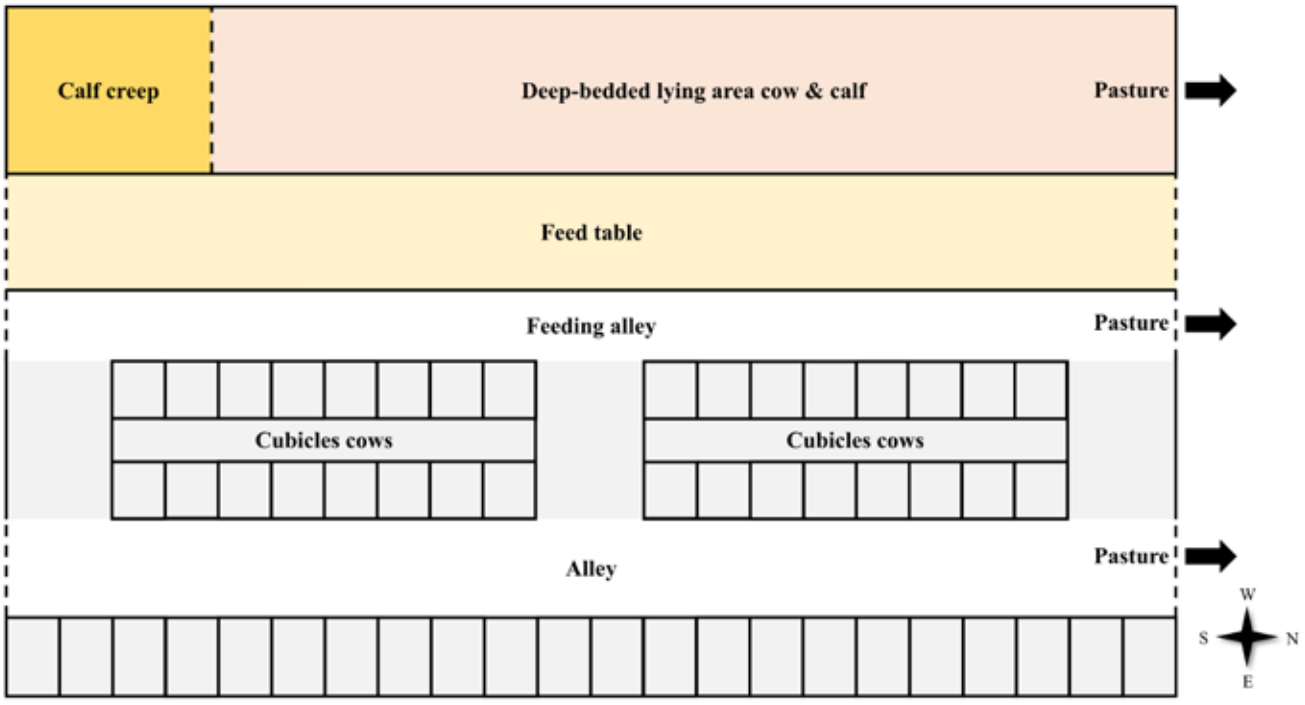
Which system did you practise before? From their first day of life, we raised the calves in a group housing system and fed them from a calf feeder.

What were your reasons to start cow-bonded calf rearing? I simply adopted it from the horses. It works well with them, so why shouldn't it work with cows? We first gave it a try with one cow and her calf and housed them together. Then two, and finally the entire herd. It worked well.

What did you modify to make cow-bonded calf rearing possible on your farm? We dissolved the group housing system and sold our calf feeder. Then we established a deep-bedded area where the dams can be housed together with their calves.

What would you do again, or differently? If we had the chance to establish this system again, we would switch to the new system all at once. However, regarding the spatial arrangement, we would want to have the different areas closer to each other and build the deep-bedded lying area closer to the milking robot. Then the fresh cows could also be milked occasionally.

What is your advice? Allow plenty of time for observing the animals. That's the name of the game. If you don't do that, you lose. Also, a calm interaction with the herd is important. Having a nervous herd can be very dangerous.



6 Appendix

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6.2 Legal requirements

German Animal Welfare Act, as amended on 10 August 2021 (BGBl. I, p. 3436)

Directive on the protection and housing of animals kept for farming and production purposes (German designation: Tierschutz-Nutztierhaltungsverordnung, TierSchNutztV) of 29 January 2021 (BGBl. I, p. 2043), in its current version

Directive on the enhancement of the quality of raw milk of 11 January 2021 (German designation: Rohmilchgüteverordnung, RohmilchGütV) (BGBl. I, p. 47), in its current version

Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007

Commission Implementing Regulation (EU) 2020/464 of 26 March 2020 laying down certain rules for the application of Regulation (EU) 2018/848 of the European Parliament and of the Council as regards the documents needed for the retroactive recognition of periods for the purpose of conversion, the production of organic products and information to be provided by Member States

Commission Implementing Regulation (EU) 2021/1165 of 15 July 2021 authorising certain products and substances for use in organic production and establishing their lists

Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs (ABl. L 139 of 30 April 2004)

Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for 'on the hygiene of foodstuffs of 29 April 2004' (ABl. L 226 of 25 June 2004, p. 22)

Regulation (EC) No 183/2005 of the European Parliament and of the Council of 12 January 2005 laying down requirements for feed hygiene (ABl. L 35 of 08 February 2005, p. 1)

6.3 Further information

www.weide-parasiten.de

www.provieh.de/kuh-plus-kalb

www.terrabc.org/p/tiere/tierhaltung/muttergebundene-kaelberaufzucht-milchvieh

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Please copy the URLs and paste them in the address bar of the browser window!
(A click on the link in the PDF document often leads to an error message.)

6.4 Templates and calculation formulas

6.4.1 Animal health

Checklist calf health

Date: ______________ Time: ______________ Assessing person: ______________

Calf	General condition	Coughing	Nose	Eyes	Ears	Soiling	Navel	Temperature	Notes

Temperature measurement (critical value: morning: **>39.1 °C**; evening: **>39.5 °C**)
Score 2: If the calf shows progressing disease symptoms, the farm veterinarian must be consulted.

Criteria and scores for calf health assessment

Body region		Score	Comment
General condition	Normal (active)	0	
	Slightly limited activity	1	
	Severely limited activity	2	
Coughing	No coughing	0	
	Occasional coughing	1	
	Repeated coughing	2	
Nose and nasal discharge	No discharge	0	
	Watery discharge or dry nose	1	1 or 2 nostrils affected
	Purulent discharge	2	1 or 2 nostrils affected
Eyes	Normal	0	
	Both eyes slightly watery	1	Note if only 1 eye is affected or if purulent discharge is visible
Ears	Upright	0	Note if 1 or both ears
	Droopy	1	Note if 1 or both ears
Soiling in anal region	Clean	0	
	Soiled, dry	1	Calf recently had diarrhoea
	Soiled, wet/humid	2	Calf currently has diarrhoea
Navel	Navel normal	0	
	Navel swollen, without discharge	1	
	Navel swollen, with purulent discharge	2	

All shaded scores require temperature measurement (critical threshold value: morning: **>39.1 °C**; evening: **>39.5 °C**)

Checklist for assessment of teat and udder health

Date: _____ Time: _____ Assessing person: _____

Cow	Dry skin **0** smooth skin **1** rough, dry skin				Chap injuries **0** no chaps **1** chaps				Hyperkeratosis **0** no hyperkeratosis, smooth **1** small white ring **2** large white ring **3** red ring **4** red or fringy ring				Scab formation **0** no scab **1** scab				Schalm test (California mastitis test) **0** negative **1** weakly positive **2** notable slime formation **3** viscous to gelatinous slime formation				Comment
	FL	BL	BR	FR	FL	BL	BR	FR	FL	BL	BR	FR	FL	BL	BR	FR	FL	BL	BR	FR	

Template for calculating the required animal-places
Dam rearing of all calves (Example 1)
Dam rearing of only the female calves (Example 2)

Housing area		Variable		Formula	Example 1 (all calves)	Example 2 (only female calves)
Calving	1	Days per year	Days		365	365
	2	Mean calving interval[1]	Days		365	365
	3	**Calvings per cow and year**		*Days per year* **(1)** ÷ *mean calving interval* **(2)**	**1.00**	**1.00**
	4	Number of dairy cows			100	100
	5	**Number of calvings per year**		*Number of dairy cows* **(4)** *x number of calvings per cow and year* **(3)**	**100**	**100**
	6	Days with calvings per year[2]	Days		365	365
	7	**Number of calvings per day**		*Number of calvings per year* **(5)** ÷ *days with calvings per year* **(6)**	**0.27**	**0.27**
Calves per day	8	Mean number of calves per cow			1	1
	9	**Number of calves per day**		*Number of calvings per day* **(7)** *x mean number of calves per cow* **(8)**	**0.27**	**0.27**
Animal-places for dry cows	10	Length of stay in dry-cow barn	Days		58	58
	11	30% spare places		*(100 + 30) ÷ 100*	1.3	1.3
	12	**Number of animal-places for dry cows**		*Number of calvings per day* **(7)** *x length of stay in barn* **(10)** *x spare places* **(11)**	**21**	**21**
Animal-places for calving cows	13	Length of stay of cow in the barn **before** calving	Days		7	7
	14	Length of stay of cow and calf in the barn **after** calving	Days		3	3
	15	Days for cleaning and disinfection	Days		2	2
	16	50% spare places[3]		*(100 + 50) ÷ 100*	1.5	1.5
	17	**Number of animal-places for calving cows**		*(Length of stay before calving* **(13)** *+ length of stay after calving* **(14)** *+ days for cleaning and disinfection* **(15)***) x number of calvings per day* **(7)** *x spare places* **(16)**	**5**	**5**

1 The value is generally variable and can be filled in according to the farm specifics; the given 365 days are rule-of-thumb figures of the KTBL for organic farming (KTBL, 2015).

2 All calvings in the herd occur within 12 months; depending on seasonality (seasonal calving), the days can be filled in variably.

3 If the calving interval is long and the replacement rate is high, an additional 1 to 2 calving places may be necessary per 100 animals in the herd.

Fixed value
Farm-specific value

Housing area		Variable		Formula	Example 1 (all calves)	Example 2 (only female calves)
Percentage and duration of dam rearing[4]	18	Duration **long**, e.g. only female offspring or all calves	Days		90	90
	19	Percentage of long-reared calves	%		100	30
	20	Duration **short**, e.g. male calves	Days		14	14
	21	Percentage of short-reared calves	%		0	70
Animal-places 'cow and calf'	22	Length of stay in barn for long rearing	Days	*Days long rearing* **(18)** *– length of stay after calving* **(14)**	86	86
	23	Spare places long rearing[5]	%		25	25
	24	**Number of animal-places 'cow and calf', long rearing**		*Number of calvings per day* **(7)** *x (percentage of long-reared calves* **(19)** *÷ 100) x length of stay in barn long* **(22)** *x ((100 + spare places long* **(23)***) ÷ 100)*	**30**	**9**
	25	Length of stay in barn for short rearing	Days	*Days short rearing* **(20)** *– length of stay after calving* **(14)**	10	10
	26	Spare places short rearing[5]	%		50	50
	27	**Number of animal-places 'cow and calf', short rearing**		*Number of calvings per day* **(7)** *x (percentage of short-reared calves* **(21)** *÷ 100) x length of stay in barn short* **(25)** *x ((100 + spare places short* **(26)***) ÷ 100)*	**0**	**3**
	28	**Number of cow-places**		*Number of animal-places 'cow and calf', long rearing* **(24)** *+ Number of animal-places 'cow and calf', short rearing* **(27)**	**30**	**12**
Separate calf area	29	Number of calves with long length of stay		*Number of animal-places 'cow and calf', long rearing* **(24)** *x mean number of calves per cow* **(8)**	30	9
	30	Number of calves with short length of stay		*Number of animal-places 'cow and calf', short rearing* **(27)** *x mean number of calves per cow* **(8)**	0	3
	31	**Number of calf-places**		*Number of calves with long length of stay* **(29)** *+ number of calves with short length of stay* **(30)**	**30**	**12**
Animal-places for lactating cows without calf contact	32	Percentage of cows with calves in dam rearing	%	*Percentage of long-reared calves* **(19)** *+ percentage of short-reared calves* **(21)**	100	100
	33	Percentage of cows with calves in non-dam rearing	%	*100 – percentage of cows with calves in dam rearing* **(32)**	0	0
	34	Length of stay after **long** dam rearing	Days	*Calving interval* **(2)** *– (length of stay in dry-cow barn* **(10)** *+ length of stay before calving* **(13)** *+ days of long rearing* **(18)***)*	210	210

	35	Length of stay after **short** dam rearing	Days	*Calving interval* **(2)** *– (length of stay in dry-cow barn* **(10)** *+ length of stay before calving* **(13)** *+ days of short rearing* **(20)***)*	286	286
	36	Length of stay of cows in **non**-dam rearing	Days	*Calving interval* **(2)** *– (length of stay in dry-cow barn* **(10)** *+ length of stay before calving* **(13)***)*	300	300
	37	10 % spare places		*(100 + 10) ÷ 100*	1.1	1.1
	38	**Number of animal-places for lactating cows without calf**		*Number of calvings per day* **(7)** *x ((percentage of long-reared calves* **(19)** *÷ 100 x length of stay after long dam rearing* **(34)***) + (percentage of short-reared calves* **(21)** *÷ 100 x length of stay after short dam rearing* **(35)***) + (percentage of cows without dam rearing* **(33)** *÷ 100 x percentage of cows without dam rearing* **(36)***)) x spare places* **(37)**	**63**	**79**
Sick animals	39	**Number of animal-places for sick animals (3%)**[6]		*Number of dairy cows* **(4)** *x 3%*	**3**	**3**
Selection places	40	**Number of animal-places for selection (7%)**[6]		*Number of dairy cows* **(4)** *x 7%*	**7**	**7**
Animal-places for heifer rearing	41	Age at housing (e.g. weaning)	Days		90	90
	42	Age at leaving (e.g. age at first calving)	Days		820	820
	43	Length of stay in barn per heifer	Days	*Age at leaving* **(42)** *– age at housing* **(41)**	730	730
	44	Replacement rate (e.g. 30%)	%		30	30
	45	**Number of animal-places for heifers**		*Number of dairy cows* **(4)** *x mean number of calves per cow* **(8)** *x length of stay in barn per heifer* **(43)** *x replacement rate* **(44)** *÷ 100 ÷ days per year* **(1)**	**60**	**60**

4 Rearing duration and percentage of calves with long or short dam rearing, e.g. 90 days for female offspring and 14 days for calves to be sold.

5 Calculate 25% spare places for three months, 50% for two weeks. The shorter the length of stay, the higher must be the percentage of spare places.

6 Figures according to KTBL (2018).

Fixed value
Farm-specific value

6.4.3 Economics

The following formulae and calculations were used in **Chapter 4 'What are the incurred expenses?'**

Housing costs per animal-place for bucket feeding

Single calf igloos + calf area

Stay single igloo: 15 days (14 days in individual pen, 1 day cleaning), **spare places single igloo:** 40%, **stay group igloo:** 81 days (76 days in group pen, 5 days cleaning), **spare places group igloo:** 25%, calculative interest rate: 4%*, **repairs and insurances:** 2%, **longevity (N_1):** 12 years

Housing costs per animal-place for whole-day contact

(Enlargement of cow-places by 10%) + (enlargement of calving pens by 50%) + calf area

Stay calving pen: 12 days (7 days before calving, 3 days cow & calf, 2 days cleaning), **stay calf area:** 92 days (87 days cow & calf, 5 days cleaning), **spare places calf area:** 25%, **calculative interest rate:** 4%*, **repairs and insurances:** 2%, **longevity calf area (igloos) (N_1):** 12 years, **longevity cow-places and calving pen (N_2):** 25 years

Housing costs per animal-place for short-time contact

(Enlargement of calving pens by 50%) + calf area + contact area

Stay calving pen: 23 days (7 days before calving, 3 days cow & calf, 11 days fresh cow group cow & calf, 2 days cleaning), **stay calf area:** 81 days (76 days cow & calf, 5 days cleaning), **spare places calf area:** 25%, **calculative interest rate:** 4%*, **repairs and insurances:** 2%, **longevity calf area (igloos) (N_1):** 12 years, **longevity calving pen and contact area (N_2):** 25 years

Housing costs per animal-place for fostered rearing

(Cow-place + feeding place calf) + (enlargement of calving pens by 50%) + calf area

Stay calving pen: 14 days (7 days before calving, 5 days cow & calf, 2 days cleaning), **stay calf area:** 90 days (85 days cow & calf, 5 days cleaning), **spare places calf area:** 25%, **calculative interest rate:** 4%*, **repairs and insurances:** 2%, **longevity calf area (N_1):** 12 years, **longevity cow-place, feeding place, and calving pen (N_2):** 25 years

* The calculative interest rate is multiplied with the average interest-bearing asset value (0.5); cf. Junge (2019).

Costs single igloo:

$$\frac{\frac{AV\ single\ igloo}{N_1} + AV\ single\ igloo \times 0{,}5 \times 0{,}04 + 0{,}02 \times AV\ single\ igloo}{Number\ of\ occupancies\ per\ year}$$

Costs cow-places + 10%:

$$\frac{\frac{AV\ cow\text{-}places \times 0{,}1}{N_2} + (AV\ cow\text{-}places \times 0{,}1) \times 0{,}5 \times 0{,}04 + 0{,}02 \times AV\ cow\text{-}places}{Number\ of\ occupancies\ per\ year}$$

Costs calving pens + 50%:

$$\frac{\frac{AV\ calving\ pen \times 0{,}5}{N_2} + (AV\ calving\ pen \times 0{,}5) \times 0{,}5 \times 0{,}04 + 0{,}02 \times AV\ calving\ pen}{Number\ of\ occupancies\ per\ year}$$

Costs calf area:

$$\frac{\frac{AV\ group\ igloo}{N_1} + AV\ group\ igloo \times 0{,}5 \times 0{,}04 + 0{,}02 \times AV\ group\ igloo}{Number\ of\ occupancies\ per\ year}$$

Costs contact area:

$$\frac{\frac{AV\ per\ animal\text{-}place}{N_2} + AV\ per\ animal\text{-}place \times 0{,}5 \times 0{,}04 + 0{,}02 \times animal\text{-}place\ costs\ (for\ housing)}{Number\ of\ occupancies\ per\ year}$$

Costs cow-place:

$$\frac{\frac{AV\ cow\text{-}place}{N_2} + AV\ cow\text{-}place \times 0{,}5 \times 0{,}04 + 0{,}02 \times AV\ cow\text{-}place}{Number\ of\ occupancies\ per\ year} \Big/ \frac{Milk\ yield / 1{,}266\ L}{4}$$

Costs for feeding place calf:

$$\frac{\frac{AW\ AV\ feeding\ place}{N_2} + AV\ feeding\ place \times 0{,}5 \times 0{,}04 + 0{,}02 \times AV\ feeding\ place}{Number\ of\ occupancies\ per\ year}$$

AV = acquisition value
For simplification, we did not consider a recovery value; thus, we assumed that the recovery value for each asset is zert.

Calculation example cow–calf ratio, adjusted according to milk yield and duration of service as foster cow

Milk yield of the herd	6,000 kg	7,000 kg	8,000	9,000	10,000
Formula for foster cow service all year[1]	(6,000/1,266)/4	(7,000/1,266)/4	(8,000/1,266)/4	9,000/1,266)/4	(10,000/1,266)/4
Cow–calf ratio	**1.18**	**1.38**	**1.58**	**1.78**	**1.97**
Formula for foster cow service 90 days/year[2]	2,600/1,266	2,850/1,266	3,100/1,266	3,350/1,266	3,600/1,266
Cow–calf ratio	**2.05**	**2.25**	**2.45**	**2.65**	**2.84**

1 The amount of the respective annual milk yield is divided by the assumed fed amount of 1,266 litres per calf. The result equates to the number of calves per foster cow. Because the rearing duration per calf is a quarter of a year, this result is divided by four to calculate the cow–calf ratit.

2 Milk amount of the foster cow in 90 days based on the milk yield divided by the assumed fed amount of 1,266 litres per calf.

Examples for calculating the required extra earnings

Required extra earnings on organic farms with different rearing systems
Calculation example: **milk price**[1]: 47.6 cent/kg milk, **milk yield per cow**[2]: 6,988 kg/cow and year

	Initial situation	Assumption: new housing design					
Percentage of reared calves	30% for replacement	All calves			30% for replacement		
	Bucket feeding	Whole-day	Short-time	Foster cows	Whole-day	Short-time	Foster cows
Milk use for calf rearing (kg per calf)	192	1,266	900	1,266	519	369	519
Delivered milk per cow (kg)	6,796	5,721	6,088	6,988	6,469	6,619	6,988
Milk proceeds per cow (€)	**3,237**	**2,725**	**2,900**	**3,328**	**3,081**	**3,153**	**3,328**
– Costs for milk feeding (€)	91	603	429	521[4]	247	176	214[4]
– Costs for changed milk composition (€ per cow)	0	5	8	0	2	3	0
– Costs for housing per calf (€)	16	63	117	103	26	48	42
– Costs for material and machinery per calf (€)	4	0	0	0	0	0	0
– Costs for labour per calf (€)	66	163	183	81	67	75	36
= Balance (€)	**3,060**	**1,890**	**2,163**	**2,624**	**2,739**	**2,851**	**3,037**
Difference to initial situation (€)		–1,170	–897	–437	–321	–210	–24
Required extra earnings[3]		**20.4 cent/kg**	**14.7 cent/kg**	**6.25 cent/kg**	**5 cent/kg**	**3.2 cent/kg**	**0.34 cent/kg**

1 Reference milk price according to BMEL (2019)
2 Average milk yield per cow according to Volling (2020)
3 Difference to the initial situation per kilogramme of delivered milk
4 Different from dam rearing, the foster cows are not milked during the nursing phase. Therefore, we calculated with a milk price reduced by 6.5 cent; cf. Pommer (2014).

Required extra earnings on organic farms with different rearing systems
Calculation example: **milk price**[1]: 47.6 cent/kg milk, **milk yield per cow**[2]: 6,988 kg/cow and year

	Initial situation	Assumption: new housing design					
Percentage of reared calves	30% for replacement	All calves			30% for replacement		
	Bucket feeding	Whole-day	Short-time	Foster cows	Whole-day	Short-time	Foster cows
Milk use for calf rearing (kg per calf)	192	1,266	900	1,266	519	369	519
Delivered milk per cow (kg)	8,651	7,576	7,943	8,843	8,324	8,474	8,843
Milk proceeds per cow (€)	**2,976**	**2,606**	**2,732**	**3,042**	**2,863**	**2,915**	**3,042**
– Costs for milk feeding (€)	66	436	310	353[4]	179	127	145[4]
– Costs for changed milk composition (€ per cow)	0	9	12	0	4	5	0
– Costs for housing per calf (€)	16	63	117	95	26	48	39
– Costs for material and machinery per calf (€)	4	0	0	0	0	0	0
– Costs for labour per calf (€)	66	163	183	81	67	75	36
= Balance (€)	**2,825**	**1,936**	**2,111**	**2,512**	**2,588**	**2,660**	**2,822**
Difference to initial situation (€)		−889	−714	−312	−237	−165	−3
Required extra earnings[3]		**11.7 cent/kg**	**9.00 cent/kg**	**3.53 cent/kg**	**2.80 cent/kg**	**1.90 cent/kg**	**0.03 cent/kg**

1 Reference milk price according to BMEL (2019)
2 Average milk yield per cow according to Volling (2020)
3 Difference to the initial situation per kilogramme of delivered milk
4 Different from dam rearing, the foster cows are not milked during the nursing phase. Therefore, we calculated with a milk price reduced by 6.5 cent; cf. Pommer (2014).

Work routines in the rearing systems considered for calculating the required time input

Whole-day contact	Short-time contact	Fostered rearing
Colostrum milking, freezing, thawing; colostrum provision (teat bucket)		
Guiding the calf to the teats		
	Additional feeding with the teat bucket	
	Rehousing the calf to the group pen (calf area)	Changing the foster cow if not suitable
	Habituation to outdoor run with electric fence	
Checking calves		

Whole-day contact	Short-time contact	Fostered rearing
Feeding calves		
Bedding the group pen (calf area)		Bedding the fostering pen
Demanuring the group pen (calf area)		Demanuring the fostering pen
	Uniting cow and calf in the outdoor run after each milking	
	Calf and udder check during nursing time after about 10 minutes	
	If necessary, guiding calf to another cow	
	Separating cow and calf after nursing	
Teat care for cows (greasing with udder balm)		
Fitting nose flap	Uniting cow and calf beyond the regular contact time because of weaning	Feeding the calves upon weaning
Rehousing to the weaners		

6.5 Instructions for the avoidance distance test

The avoidance distance test is done as follows:

- Before the test, one should make sure that the animal notices the assessing person.
- From a 2-m distance, the assessor approaches the animal from the front.
- At a standardised walking pace (one step per second), the assessor calmly walks toward the animal. While doing so, the assessor extends one arm forward in a 45° angle, with the palm facing down.
- The distance between the muzzle and the hand is estimated at the moment the animal withdraws (distance in 10-cm steps).
- The withdrawal can be defined as any backward or sideward movement or as the animal first turning the head away and then walking away.

Definition of the scores[1]

0	1	2	3
The assessor can touch the animal.	The assessor can approach to less than 50 cm but cannot touch the animal.	The assessor can approach to between 50 cm and less than 100 cm.	The assessor cannot approach closer than 100 cm.

A short avoidance distance can be interpreted as a good animal–human relationship. The larger the distance between the human and the animal, the greater seems to be the fear reaction of the animal to the human. Regular positive contact to humans will help still the animal's fear.

1 Welfare Quality® Consortium (2009)

6.6 Frequently asked questions (FAQ)

6.6.1 General

What would be feasible first steps to try out cow-bonded calf rearing?

First, you should decide if you want to implement dam rearing or fostered rearing.

Dam rearing: Let one to three calves stay with their dams. Pay attention to the colostrum intake after calving and enable the animals to go through a bonding phase of four to six days in a separate area. If the calves shall be with the dams for the whole day or for several hours per day (half-day contact), barn and pasture must be calf appropriate. In this case short-time contact is also possible, during which the calves can visit the cow barn for a limited time, for example after milking or feeding. If the barn is not calf appropriate, a cow- and calf-appropriate contact area must be available in which the two can meet, for example an outdoor run or the waiting area in front of the milking parlour.

Fostered rearing: Instead of the dam, an alien cow (foster cow) nurses one to three calves. The foster cow is usually not milked additionally. In terms of organisation and housing design, fostered rearing is more flexible than dam rearing. You can find answers to specific questions regarding fostered rearing in Part 2 of this chapter.

In any case, you need to decide if the nursing animals should also be milked. If so, the milking parlour should be close to or included in the cow barn. ➟ 1.2 Which systems are available?

Will the behaviour of my cows change when I switch to cow-bonded calf rearing?

Like all changes in management, the switch to cow-bonded calf rearing will affect the animals. If the calves after calving can stay longer with the dam, her maternal behaviour can be more pronounced. So, be mindful of maintaining positive animal–human interaction. Animals that can harm humans are not suitable for this system. If the nursing cows are not milked, contact to the cows is nonetheless important to establish a good animal–human relationship. The same is true for the calves in all rearing systems. However, a relationship is much easier to realise in systems in which the calves have repeated contact with humans, for example if they are brought to the cows twice a day.
➟ 2.7 Weaning and separation ➟ 2.9 Preventing wild behaviour

I would like to change my herd management to dam rearing. However, I cannot imagine that the calf will know to solely suckle its dam.

On-pasture animal observations done at the Thünen Institute have shown that the calves usually suckle their own dams. Suckling on an alien cow will occur if the calves cannot all reach their own dams at the same time, for example if the cows one by one enter the contact area where the calf group already awaits them, or in case there is not enough space. Also, older calves sometimes suckle other dams if these cows let them.

I practise fostered rearing and would like to switch to dam rearing. What do I need to consider?

There is no general answer. However, each dam principally nurses her own calf, and the management must be modified according to the farm-specific conditions. One aspect to consider is if the contact between cow and calf shall be continuous or restrictive. The focus must be on the required housing design, such as a calf-appropriate dairy barn for a continuous cow–calf contact system.

Can cow-bonded calf rearing easily be combined with the milking robot?

Yes, that's possible. Here it is important that the used milking system can reliably detect already emptied udder quarters while still milking the other quarters of the cow. Milking termination

due to empty quarters leads to a significant increase in time input because the animals must be milked separately. Alternatively, one could switch to a rearing system in which the nursing cows are not milked.

➟ 2.4 Milking

Is cow-bonded calf rearing suited for farms practising social agriculture?

For social agriculture cow-bonded calf rearing is indeed recommendable. The work and the interactions in the holistic system of cow-bonded calf rearing allow for directly experiencing a well-functioning relationship of cow, calf, and herd. Thus, the participants can become motivated to no longer distinguish tasks as being 'important', 'inconvenient', or 'avoidable' but instead perform all tasks well and carefully for the purpose of animal welfare. To ensure workplace safety, we recommend defining the contact in space and time according to the capabilities of the participants.

How do I arrange the weaning if the animals are grazing jointly?

If you do not want to use an anti-suckling device, you can arrange fence-line contact on pasture to prevent suckling (or you could combine both methods: first fitting a nose flap for a few days, then separating with a fence). Thus, the cows and calves can still have some contact. Nonetheless, the animals will likely show some reaction (such as calling).

➟ 2.6 Grazing management ➟ 2.7 Weaning and separation

How do I decide whether to milk the cows?

In dam rearing the cows are usually milked, otherwise it would be like the typical suckler cow rearing that is common in beef cattle husbandry. In fostered rearing, farmers often do without milking so that the produced milk is available to several calves. If only one calf suckles, farmers usually dispense with the extra production during the first lactation months. In addition, one suckling calf will not completely empty the udder, which can lead to negative feedback effects: the cow simply produces less. Furthermore, the cow may later have difficulties getting used to the milking machine. It will be best to consider the whole system and evaluate the effects of milk sales, time input, the structural conditions, etc. to find an appropriate solution for the farm.

➟ 2.4 Milking

Are the nursing cows always milked?

Not. In fostered rearing systems, the milking is often foregone because one foster cow can nurse several calves, and thus milking would not pay off.

How far away can the pasture be so that the calves can go along with the cows?

To date, no critical distance is known. If predators pose a risk, we recommend the use of pastures nearby the barn.

➟ 2.6 Grazing management

6.6.2 Fostered rearing

How do I begin?

First, you need a separate area in which the foster cow group can be housed. This area must also be calf appropriate. Depending on the herd size and the calving regime (seasonal or year-round), you have different options to get started.

With a small herd and year-round calving, it is easiest when two cows have just calved, and then one calf is 'foisted' on one of the two cows. This small group of one cow with two calves is then housed separately. If after a while another cow calves, she and her calf can join that group given that she tolerates other calves around her. The older calves in the group may even try to suckle this cow. When the next cow and her calf join the group, the first cow can leave the group, and two cows now nurse four calves. Based on the milk yield of the cows, the system can be continued in this way until the optimal cow–calf ratio is reached. With seasonal calving or larger herds, several cows can calve in a group pen, and a certain number of cows is removed until the adequate cow–calf ratio is reached.

Please remember: Different cows may show different reactions. So do not be discouraged if the system is not running smoothly right away. Most farmers try out various strategies until they will have found the optimal system for their farm

➟ 3.4.3 / 3.4.4 Housing examples fostered rearing

Can I do that with every cow – or: How do I select the foster cow?

The foster cow should show a friendly response to alien calves or at least tolerate them. If she reacts aggressively, she is not suited. The same is true for cows with a low-hanging udder, which is hard to reach for the calves. In any case, the cows should be healthy.

➟ 1.2 Which systems are available?

Is it better to use cows in early lactation or cows in late lactation?

Cows in late lactation that only know machine milking are not easily trained to the nursing of calves. Also, cows in early lactation more readily accept other calves.

Are primiparous cows suitable for starting the system?

There are no confirmed findings on this question. The reported practical ex periences vary greatly. Here, too, we encourage you to be patient and give it several trials.

How do I determine if a cow is suited for being a foster cow?

Generally, the alien calf should be housed with the foster cow as soon as possible after calving. If the cow shows strong defensive movements toward the calf, she is not suited for a fostering system.

How can I support the habituation of the foster cow to an alien calf?

As always, bear in mind: Patient interaction with the animal raises the success rate. Thus, all co-workers should be trained accordingly. It works best if the alien calf is brought to the foster cow while she is nursing her own calf. If the foster cow does not immediately allow the calf to suckle, always plan for milk feeding with a feeding bottle or a teat bucket.

How could I arrange the transition from dam to foster cow?

Here, too, patience is the key to success. You can, for example, support the process by gently guiding the calf to the foster cow when it is searching for its own dam and by motivating it to approach an alien udder from the rear. Occasionally, you simply need to accept that the calf may refuse one or two meals until it is so hungry that it will accept the alien udder.

It is important to consider that after calving, the bonding strengthens with increasing contact time to the dam, leading to more stress upon separation.

What happens if for several days a foster cow is not suckled all the way until the udder is empty?

Principally, the udders of the foster cows should be checked every day. If these checks reveal that the foster cow is not suckled enough, the reasons must be found: Does she refuse being suckled by alien calves? Does she suffer from mastitis or some other disease that causes her pain? Does she not (or no longer) accept being a foster cow? In all cases, intervention is needed, the animal should be removed from the group and, if necessary, examined by a veterinarian. It is also possible that the cow–calf ratio is incorrect, thus leading to an excessive milk supply. Then an appropriate cow should leave the group, for example the 'longest serving' one.

What are the advantages and disadvantages of dam rearing and fostered rearing if compared with each other?

A fostered rearing system can be designed more flexibly. However, dam rearing is considered an especially species-appropriate system and is favoured by most customers. The effects on the management are shown in detail in the table on Page 13. ➟ 1.3 Which system suits my farm?

6.6.3 Design of the housing system

What must be considered when designing the calf area?

It is important to design a calf area into which the calves can be separated when necessary. Of course, the calves must receive calf-appropriate feed and water supply. The microclimate in the calf area should promote calf health. Especially air draught must be prevented. The design of the areas for animal traffic and exercise must be calf appropriate.
➟ 3.2 Design of the functional areas

Where should the calf area be located?

In selecting the location, you should especially consider workflow-related aspects and barn-climatic conditions. ➟ 3.4.Housing examples

Where should the calves be feeding?

You first need to clarify if the calves can feed at the main feed table or if they shall have their own feeding area in the calf area. More feasible is a calf-appropriate section at the main feed table to induce imitative behaviour. However, this option requires more space at the feed table. Feed provision in the calf area is also possible. A calf area close to the main feed table can ease the weaning because the calves can still see the cows. ➟ 3.4.Housing examples

I cannot design my barn calf appropriately. What can I do instead?

If re-designing is not possible, you could check if you could create a contact area in the barn, with access to a calf area (calf creep). Calf igloos would be a suitable option for that. If an old building is available, it might be used to house a foster cow–calf group. In any case we recommend talking to experienced colleagues and/or hiring a consultant for housing design.

6.7 Keyword index

Closing remarks

I read the guide – now what?

In the best case, you now know whether cow-bonded calf rearing is an option for your farm. If you are not quite sure yet, we recommend the following: Try out with a few animals first if the system that you would like to implement suits your farm. Give yourself and the animals some time – and brace yourself for setbacks. All the farms that successfully practise cow-bonded calf rearing have developed their system in many small steps over several years and continue doing so.

Which leads us to practical application. A book can only describe a few systems and give food for thought. Now it's time to act: Connect with practising farms, visit as many as possible to see design solutions, and do not worry about contradictory testimonials. The systems vary greatly, and thus the effects on individual criteria vary as well. What helps is testing it yourself and gaining experience. Even if you decide to continue with the familiar system of bucket feeding, we hope that this guide can offer you suggestions on the further development of your calf rearing system.

What finally matters is the improvement in animal welfare and the personal job satisfaction – so we wish you good luck with implementing and testing!

Sincerely,

Operational Group 'Cow-Bonded Calf Rearing'

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