The housing of cow and calf: An overview of barn design, management and behaviour in cow-calf housing systems

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Haltung von Kuh und Kalb: Ein Überblick über Stalldesign, Management und Verhalten in Kuh-Kalb-Haltungen

Die Anzahl der Betriebe mit Mutterkuhhaltung und Milchkuh-Kalb-Kontakt nimmt in der Schweiz zu, doch es mangelt an grundlegenden Kenntnissen über die Bedürfnisse und Verhaltensweisen der Rinder in diesen Systemen. Diese Studie bietet einen Überblick über Kuh-Kalb-Haltungen und Managementsysteme in der Schweiz. Sie bietet einen Einblick in das Verhalten und die Nutzung der Funktionsbereiche der Ställe durch Kühe und Kälber, um potenziell problematische Aspekte des Tierwohls in diesen Systemen zu identifizieren.

Insgesamt wurden 39 Mutterkuhbetriebe und sechs Betriebe mit Milchkuh-Kalb-Kontakt in der Schweiz je einmal besucht. Tierwohlrelevante Aspekte des Stallbaus wurden vermessen und die Landwirte jedes Betriebs zu Management und ihren Erfahrungen befragt. Mithilfe von Scan-Sampling (18× alle 10 Minuten über einen Zeitraum von 3 Stunden) wurden Verhaltensbeobachtungen der Tiere durchgeführt, um die Verteilung und Nutzung der Funktionsbereiche eines Stalls durch die Tiere zu analysieren.

Es wurden bedeutende Unterschiede im Management und der Haltung zwischen den untersuchten Betrieben festgestellt. Etwa die Hälfte der Betriebe verfügte über Tränken mit einer Höhe von über 60 cm, was Fragen hinsichtlich der Wasserversorgung der jungen Kälber dieser Betriebe aufwirft. Alle Betriebe verfügten über Liegeflächen für Kälber, die sich in Grösse, Anzahl und Lage unterschieden. In Betrieben mit einem vom Liegebereich getrennten Kälberbereich war die Anzahl der liegenden Kühe während der Beobachtung um 10 % geringer (n = 11; 34,5 %) als die Anzahl der liegenden Kühe in Systemen mit einem Kälberbereich direkt vor den Liegeboxen (n = 13; 44,6 %; p = .063). Kälber nutzten separate Kälberbereiche zum Liegen (30,0 %) weniger als die Kälberbereiche direkt vor den Liegeboxen (41,4 %; p = .001).

Summary

The number of farms in Switzerland with suckler cow and dairy dam-calf contact housing systems is increasing, but basic knowledge on the needs and behaviours of cattle under these systems is lacking. This study offers an overview of cow-calf housing and management systems in Switzerland to provide insight into cows and calves' behaviour and use of barns' functional areas and to identify potentially problematic aspects of animal welfare within these systems.

A total of 39 suckler cow farms and six farms with dairy dam-calf contact in Switzerland were each visited once. Welfare-relevant aspects of barn construction were measured, and the farmers on each farm were surveyed regarding their management and experiences. Animal behavioural observations were made using scan sampling (18 times every 10 minutes over a 3-hour time span) to analyse the animals' distribution and use of a barn's functional areas.

Considerable farm-specific variance was found in how the farms managed and housed their livestock. About half the farms had drinking troughs over 60 cm in height, wich raised questions about the ability of these farms' young calves to access water. All farms had installed lying areas for calves, which varied in size, number and location. In the systems with a calf creep area separated from the lying area, the number of cows lying during observation was 10 % less (n = 11; 34,5 %) than the number of cows lying in the systems with a calf creep area in front of the cubicles (n = 13; 44,6 %; p = .063). The calves used the separate calf creep areas for lying (30,0 %) less than they used the calf creep areas in front of the cubicles (41,4 %; p = .001).

This study does not provide a complete picture of cow-calf housing in Switzerland but contributes to the generation of new research questions.

Keywords: cow-calf contact, dairy dam-calf contact, housing systems, lying behaviour, suckler cow

The Housing of Cow and Calf: An Overview of Barn Design, Management and Behaviour in Cow-Calf Housing Systems

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Diese Studie liefert kein vollständiges Bild der Kuh-Kalb-Haltungen in der Schweiz, trägt jedoch zur Generierung neuer Forschungsfragen bei.

Schlüsselwörter: Kuh-Kalb-Kontakt, Milchkuh-Kalb-Kontakt, Haltungssysteme, Liegeverhalten, Mutterkuh

Introduction

In contrast to conventional beef and dairy production systems, suckler cow housing and dairy dam-calf contact (DCC) systems allow cows to have contact with their calves. Cow-calf contact (CCC) systems have a favourable reputation for animal welfare,[6,22] and animals in CCC systems are better able to express their natural behavioural patterns, with calves developing better social competencies than in conventional housing systems that separate cows and calves early (within 12h or 24h after birth).[10,18] Calves reared with CCC show more social behaviour, such as licking and head rubbing, than those separated early from their mothers[22] initiate more social interactions and engage in more solitary play than calves separated early.[2]

Recent years have seen growing consumer interest in more natural, welfare-friendly production systems and practices in dairy farming,[14] such as prolonged CCC, so dairy DCC systems are becoming increasingly popular in Switzerland. In May 2024, there were about 20 farms with such a production system,[11] in which calves remain with their mothers for several months while the cows are milked and the milk processed into dairy products. In Swiss suckler cow husbandry, cows and calves are usually kept together until the calves are slaughtered at around five months of age (veal production) or 10 months (beef production). The proportion of suckler cow farms to the total of Swiss farms has increased in recent years (from 3,1 % in 2000 to 8,4 % in 2018 %).[25] In 2023, at least 100,000 suckler cows were kept in Switzerland, distributed over nearly 6,000 farms and accounting for approximately 15 % of the country's total cattle population.[12] The increase in suckler cow farms can be explained partly by dairy farms switching to suckler cow production,[26] which often involves the conversion of former dairy barns.

Because they keep calves together with adult animals, CCC systems differ considerably from conventional dairy or beef cattle housing systems, making it a challenge to convert conventional barns to CCC systems. Calves' needs differ from those of cows in terms of barn climate, barn hygiene, freedom of movement and barn design elements, such as slat width, drinking trough height and calf creep areas (CCAs), which are designated as resting areas for calves.[5] For farmers, keeping calves as part of the main herd requires adjustments to herd and barn management and health care. However, the specific needs of cows and calves in their shared environment are not well understood, and basic knowledge of the behaviour and welfare of animals kept in CCC systems is lacking.

This descriptive study offers an overview of existing CCC systems (suckler cow and DCC) in Switzerland and provides insight into animals' behaviour and use of functional areas in barns. For this purpose, 39 suckler cow farms and six DCC farms in Switzerland were visited, the farmers interviewed and barn measurements and behavioural observations were taken. An exploratory analysis of barn characteristics that could affect animal welfare aspects was carried out. In the light of these results, we hypothesised that (i) some barn design elements are not always sufficiently adapted to the needs of calves and that (ii) the lying behaviour of cows and calves depends on the positioning of the CCA.

Material and Methods

Ethical Approval

The animal study was reviewed and approved by the Committee of Animal Experiments of the Canton of Thurgau, Switzerland (approval no. 35148/TG03/2022) and was conducted in accordance with relevant Swiss regulations.

Data Collection and Experimental Design

Farm Selection

We visited 39 suckler cow farms and six dairy farms with DCC from December 2022 through April 2023. To ensure a high degree of comparability, we selected only farms with free stalls and with cows and calves having continuous contact (24 hours/day). We also preferred farms with lockable feeding gates, which made it easier to mark animals individually for behavioural observations (see the behavioural observations section below). As this study aimed to analyse a wide range of housing systems and to ensure that the farms met our criteria, we collaborated with the inspection agency 'Beef Control' of Mutterkuh Schweiz (the Swiss suckler cow farmer association, Lupfig, Switzerland), regarding the selection of suckler cow farms. The selection of farms with DCC was made with the help of Fachstelle MuKa (Centre for Dam-Calf Contact Rearing, Birmensdorf, Switzerland). The farmers were informed

about the ongoing study via mail through the relevant organisation. We defined 40 suckler cow farms and 10 farms with DCC as target numbers and a total of 42 suckler cow farms and 10 DCC were contacted by telephone during the course of the study (participation rate 86,5 %). For various reasons, seven farms (13,5 %) did not wish to participate in the study or were excluded, for example because they had no calves in their herd at the time of the study.

Survey

The in-person, semi-structured survey of farmers included questions about animal management, the development of the farm and barn, the marketing of calf meat and the farmers' personal experiences of housing cows and calves (see Appendix 1 for details).

Barn Construction

Barn construction was reviewed together with the farmers to identify advantages and disadvantages and understand the farmers' experiences. Details of barn construction relevant to animal welfare were then measured in the various areas of the barn (see Appendix 2 for a list of measurements taken).

Definition of Functional Barn Areas

For the behavioural observations, barns were divided into the functional areas of lying area and CCA, cow feeding and calf feeding area and activity area. The lying cubicles (including the head lunge space) or the entire deep bedded pack area were defined as the lying area. In DCC systems, a CCA often combines a feeding and a lying area for calves that is separate from the cows' areas.[8,23] This study defined the CCA as a deep bedded pack area in any part of the barn that cows could not enter, designed to be used by calves for resting, playing and forming a calf group. The calf feeding area was observed as an independent area. The feeding area of the cows was defined as two metres from the feeding gate into the feeding aisle. All other parts of the barn, i.e. the walking aisles and outdoor yard, were defined as the activity area.

Behavioural Observations

All observations were carried out by the first author, mostly between 9:30 a.m. and 2:00 p.m., but the exact times of the observations varied by the time available to the farmer. The animals were assigned to the categories of bull(s), cows, heifers (older than 12 months and not yet calved) and calves (younger than 12 months) and were individually marked with animal marking spray. On some farms, fattening bullocks over one year old were kept together with the cow-calf group; these were later included in the heifer group for analysis. On most farms, the adult cattle were locked in the feeding gate for marking, and this was possible for calves in some cases. If not, the calves were caught and marked if possible. After marking, the animals were immediately released from the feeding gate and given approximately one hour to habituate to the paint.

Behavioural data were collected from 794 cows, 659 calves and 58 heifers. The behavioural observations employed scan sampling to assess the distribution of animals in the barn and their use of different areas. The observations were made 18 times at 10-minute intervals over 3 hours. During each scan sampling unit, we recorded in each functional area the number of cows, calves and heifers standing (without activity, i.e. no locomotion, feeding, grooming, etc.), lying (ventrally or laterally), feeding (picking, chewing or swallowing any kind of food; no rumination) or being active (any other behaviour than standing, lying or feeding). An animal was assigned to a functional area if most of its body was located in that area.

Data Processing and Statistical Analyses

Data were collected in handwriting, digitalised using MS Access (Microsoft, 2021, Redmond, USA) and processed with MS Excel (Microsoft, 2021, Redmond, USA). The management data were analysed descriptively by grouping the answers into categories, which enabled determining the number and proportion of farms with specific management methods. For the data on barn construction and equipment, mean values and the range across farms were calculated. Behavioural observation data were recorded as the number of animals (cows, calves, heifers) exhibiting the observed behaviours at the time of observation in each area. To compare the results between farms, the number of animals that exhibited a given behaviour was divided by the number of animals of the same category included in behavioural observations on the farm. In this way, the distribution of animals in the barn and the use of the various functional areas was expressed as the proportion of the total number of animals included in behavioural observations performing a specific behaviour in a given area of the barn.

In the exploratory analysis of the behavioural data, different barn types were compared in terms of animal distribution and the use of the functional areas. Comparing the various CCA positions revealed differences in the distribution of animals and their lying behaviour, inspiring the hypothesis that the position of the CCA may affect cows and calves' lying behaviour. Consequently, in addition to the descriptive analysis, statistical analysis was performed in R version 4.2.1 (R Core Team, 2022, Vienna, Austria)[15] to test this hypothesis on farms with a CCA in front of the cubicles (13 farms) as compared to those with a separate CCA (11 farms). The response variable was the proportion of animals lying in the lying area. Data for cows and calves were modelled separately. In the cow model, the fixed effects included only the location of the CCA (separate vs. in the head space of the cubicles). For the calf model, the fixed effects included the location of the CCA, the lying location (in the CCA or in the cubicles) and their interaction. Farm was included as a random effect in both models to account for repeated measures. Models were calculated using the

'blmer' function in R's blme package.[1] Model assumptions (normal distribution of residuals, homoscedasticity) were checked through graphical analysis of residuals. Dummy variables with sum contrasts were used for the tested factors and interactions. *P*-values were obtained by comparing the full model (including all main effects and their interactions) to models reduced by one main effect or interaction. The model comparison took a parametric bootstrap approach using the 'PBmodcomp' function in R's pbkrtest package.[4] Model estimates and confidence intervals for the full model were obtained with the 'effects' package.[3] No statistical comparison was made with the results of the behavioural observations of the barns with other CCA positions, as these were either not numerous enough or too inhomogeneous to be allocated to one barn type group.

Results

Farms

Of the 45 visited farms, 23 were located in a valley zone, 7 in a hill zone and 9 in mountain zones. Sixteen farms practiced organic farming (Bio Swiss, Knospe or Demeter labels).

Farmers' Experiences and Opinions in the Survey

With regard to general aspects of barn design, the farmers most frequently recommended a treatment chute in the barn (n = 7) and a flexible (n = 5), spacious (n = 5) barn that is easy to see into. As negative factors, farmers cited multiple levels in the barn (n = 6), dead ends (n = 5) and barns unsuitable for working with machinery (n = 7) (e.g. mucking out). Eight farmers recommended a CCA in front of the cubicles; five farmers indicated that their CCA was too small and recommended planning a large CCA. The different amounts of space available to the calves were assessed differently. For example, one farmer described the available 3,1 m² per calf as too small, while another described the size of his CCA, which provides 2,6 m² per calf, as ideal. A separate feeding area and low drinking troughs for calves were described as an advantage (n = 6). Eight farmers emphasised the importance of lockable feeding gates for cows, and five recommended them for calf feeding areas. Six farmers whose calving pens met the minimum legal requirements described their size as too small and recommended larger calving pens.

Herd Composition and Breeds

Herd composition differed between farms, and many farms separated animals into multiple groups. Nearly half the farms kept a bull in the cow-calf group, and most of these farms did not include heifers in this group (Table 1). The most common breeds on suckler cow farms were Angus, Limousin and Simmental, with Pinzgauer, Hinterwälder, Hereford and Piedmontese being less common. Nineteen farms kept only one breed, but mixed groups were more common along with crosses of beef breeds, such as Limousin with dual-purpose breeds (e.g. Original Braunvieh and Simmental). A wide variety of dairy breeds was found on the DCC farms, such as Holstein, Original Brown Swiss, Brown Swiss and various dairy crossbreeds, with Grauvieh and Jersey being rarer.

Table 1. Overview of the numbers of animals on Swiss suckler cow farms and farms with dairy DCC (presented as mean values and minimum and maximum values) and the composition of the herds as number of farms and their percentage of the total.

	Suckler cow farms (n = 39)	Farms with DCC (n = 6)	Total (N = 45)
Number of animals on farm			
Cows	31,9 (10–95)	15,5 (7–29)	29,7 (7–95)
Calves	26,5 (7–90)	7,5 (3–16)	23,9 (3–90)
Heifers	6,48 (0–25)	5,5 (0–12)	6,4 (0–25)
Number of animals observed			
Cows	18,2 (8–52)	14,2 (7–26)	17,6 (7–52)
Calves	15,8 (7–44)	6,8 (2–15)	14,6 (2–44)
Heifers	1,3 (0–8)	1 (0–6)	1,3 (0–8)
Number of farms with heifers in cow-calf group	16 (41 %)	1 (16,7 %)	17 (37,8 %)
Number of farms with bulls in cow-calf group			
Permanently	20 (51,3 %)	2 (33,3 %)	22 (48,9 %)
Partially	6 (15,4 %)	0	6 (13,3 %)
No bull	13 (33,3 %)	4 (66,7 %)	17 (37,8 %)

DCC = dam-calf contact.

Management and Marketing

Calving, Castration and Weaning

Table 2 provides an overview of calving and weaning management. Male calves were usually castrated in the first few days of life, with diverse castration regimes used on different farms. Some farms that never castrated male calves, maintained sex-segregated groups to prevent female calves from conceiving.

Various weaning methods were used (Table 2). Calves in the Natura Beef or Natura Veal labelling programmes must be sent to slaughter unweaned, with the standards of these programmes are monitored and guaranteed by Mutterkuh Schweiz.[13] As a result, most suckler cow farms weaned only part of their calves for restocking and a few for fattening for other labels or on-farm marketing, whereas all DCC farms practiced weaning.

Table 2. Overview of the use of artificial insemination and differing calving, castration, weaning and feeding management methods for cows and calves on Swiss suckler cow farms and farms with DCC, presented as the number of farms and the percentage of the total.

	Suckler cow farms (n = 39)	Farms with DCC (n = 6)	Total (N = 45)
Farms using artificial insemination	31 (79,5 %)	5 (83,33 %)	36 (80 %)
Calving management			
Seasonal	19 (48,7 %)	1 (16,7 %)	20 (44,4 %)
Non-seasonal	20 (51,3 %)	5 (83,3 %)	25 (55,6 %)
Calving pen type			
Single	28 (71,8 %)	4 (66,7 %)	32 (71,1 %)
Group	8 (20,5 %)	1 (16,7 %)	9 (20 %)
Flexible*	3 (7,7 %)	1 (16,7 %)	4 (8,9 %)
Castration of male calves			
All male calves	22 (56,4 %)	4 (66,7 %)	26 (57,8 %)
Some male calves	4 (10,2 %)	0	4 (8,9 %)
Depending on breeding suitability test	5 (12,8 %)	0	5 (11,1 %)
No castration	7 (17,9 %)	2 (33,3 %)	9 (20 %)
Weaning management			
Average weaning age (months)	9,6 ± 1,26	6,5 ± 2,09	9,2 ± 1,7
Weaning of all calves	0	5 (83,3 %)	5 (11,1 %)
Weaning of a part of the calves	26 (66,7 %)	1 (16,7 %)	27 (60 %)
Gradual weaning (e.g. nose flaps)	4 (10,3 %)	3 (50 %)	7 (15,6 %)
Abrupt separation	19 (48,7 %)	2 (33,3 %)	21 (46,7 %)
Other methods or combination of methods	3 (7,7 %)	1 (16,7 %)	4 (8,9 %)
No weaning	13 (33,3 %)	0	13 (28,9 %)
Feeding of cows			
Only grass/hay/straw	17 (43,6 %)	3 (50 %)	20 (44,4 %)
Concentrate**	1 (2,6 %)	1 (16,7 %)	2 (4,4 %)
Additional maize/concentrate	21 (53,8 %)	2 (33,3 %)	23 (51,1 %)
Ad libitum feeding	21 (53,8 %)	3 (50 %)	24 (53,3 %)
Total mixed ration	13 (33,3 %)	1 (16,7 %)	14 (53,3 %)
Feeding of calves			
Grass/hay/straw	12 (30,8 %)	4 (66,7 %)	16 (35,6 %)
Concentrate**	7 (17,9 %)	2 (33,3 %)	9 (20 %)
Additional maize/concentrate	27 (69,2 %)	2 (33,3 %)	29 (64,4 %)
Ad libitum feeding	25 (55,6 %)	5 (83,3 %)	30 (66,7 %)
Total mixed ration	8 (20,5 %)	0	8 (17,8 %)

DCC = dam-calf contact
* Pens were set up according to the circumstances
** As a significant part of the ration

Marketing

Most suckler cow farms mainly produced beef for the Natura Beef label and took their calves to slaughter at around 10 months. Among all suckler cow farms, four farms primarily or regularly produced Natura Veal and slaughtered their calves at around five months, but 19 of 39 farms did this only in exceptional cases, e.g. when the dam had to be culled. Of the DCC farms, four of six sold their meat and a part of their milk or milk products through on-farm marketing and did not participate in any label programme. Six suckler cow farmers and one DCC farmer regularly bought extra calves; 17 of 45 farms rarely bought extra calves (e.g. in the case of stillbirths), and 21 of 45 indicated that they never bought extra calves.

Feeding Management

In general, suckler cows and DCC cows were fed mainly forage-based (Table 2).

Barn Construction

While a selection of the results on barn construction is presented here, all the results of the measurements and surveys on this topic can be found as raw data in Appendix 3. Twenty of 45 farms had warm barns with four closed sides. On 19 of 45 farms, at least one side of the barn was open, of which six had at least three open sides. Six of the 45 farms had a combination of open and closed barn buildings, mostly after the subsequent addition of further lying cubicles in the outdoor yard. A variety of options were found for the arrangement of the functional areas. Sixteen of the 39 suckler cow farmers and 5 of the 6 DCC farmers had converted their former conventional dairy barns in the process of transitioning their production system.

Lying Area and CCA

Table 3 provides details on barn construction. On some converted farms, cubicles had been added in the barn or in the outdoor yard or had been removed to make room to install the CCA. The CCAs were positioned in various ways. In barns converted from free or tie dairy stalls, CCAs were often placed separately from the cow lying area (Figure 1A). In new buildings, they were often placed in front of the cubicles in an enlarged head lunge area, either between two rows of cubicles or between a row of cubicles and the wall (Figure 1B). Some farms with several CCAs combined separate CCAs with CCAs in front of lying cubicles. In some barns with a bedded pack area, CCAs were set up using panels or fencing in the lying area. (Table 3).

Cows' and Calves' Feeding Areas and Drinker Systems

As a lockable feeding gate was one of the selection criteria, most farms had them. The ratio of animals to feeding places ranged from 0,3 to 1,7 (0,8 ± 0,26). Special types of lockable feeding gates were widely used to prevent calves from being trapped by the movement of nearby cows when entering or leaving the feeding gate. Forty of the 45 farms had some

Figure 1: Calf creep area installed separated from the cow cubicles (A) and in front of the cow cubicles (B) in two different suckler cow barns in Switzerland. (© Agroscope, Christopher Geßenhardt)

form of calf feeding area, whether hay racks in the CCA or feeding places on the same axis or a separate axis from the cow feeding area. To prevent cows from entering, these calf feeding areas were also designed as creep areas.

The farms employed a variety of drinker systems. Concrete fountain troughs, automatic waterers, metal troughs and even old bathtubs were used, and different types of drinker system were combined. Twenty-three farms had installed drinking troughs specifically for calves. The height ranged from 30 to 80 cm (55,2 cm ± 16,5 cm). Drinking troughs for the cows were installed at a height of 50 to 100 cm (68,6 cm ± 11,3 cm).

Activity Area

All the farms had an outdoor yard. Open barns often had the yard between the feeding and lying areas, whereas in closed barns it was adjacent to the building and separated by a gate.

Animal Distribution and Behavioural Observations in the Barn

Lying constituted the largest share of behaviours in all animal categories, with calves representing the largest proportion of lying animals. Thus, the lying areas (and CCAs for calves) were the areas with the highest proportion of observed animals. Calves were the most active and used

Table 3. Design elements of the lying area and the CCA in suckler cow farms, farms with DCC and all farms visited, presented as the number of farms and the percentage of the total.

	Suckler cow farms (*n* = 39)	Farms with DCC (*n* = 6)	Total (*N* = 45)
Ratio of animals to lying places	0,86 (0,65–1,04)	0,76 (0,7–0,84)	0,85 (0,65–1,04)
Design of cows' lying area			
Cubicles	30 (76,9 %)	4 (66 %)	34 (75,6 %)
Bedded pack area	7 (17,9 %)	1 (16,7 %)	8 (17,8 %)
Cubicles and bedded pack area	2 (5,1 %)	0	2 (4,4 %)
Compost	0	1 (16,7 %)	1 (2,2 %)
Lying cubicle characteristics			
Neck band (flexible element, tension belt)	6 (15,4 %)	0	6 (13,3 %)
Neck chain (flexible metal element with plastic protection)	2 (5,1 %)	1 (16,7 %)	3 (6,7 %)
Neck rail (rigid metal element)	24 (61,5 %)	3 (50 %)	27 (60 %)
No neck element	7 (17,9 %)	2 (33,3 %)	9 (20 %)
Front band (flexible element, tension belt)	6 (15,4 %)	0	6 (13,3 %)
Front chain (flexible metal element with plastic protection)	1 (2,6 %)	0	1 (2,2 %)
Front rail (rigid metal element)	17 (43,6 %)	1 (16,7 %)	18 (40 %)
No limitation in the front	15 (38,5 %)	5 (83,3 %)	20 (44,4 %)
Number of CCAs in the barn			
One CCA	27 (69,2 %)	3 (50 %)	30 (66,7 %)
More than one CCA	10 (25,6 %)	0	10 (21,7 %)
Other*	2 (5,1 %)	3 (50 %)	5 (11,1 %)
Position of the CCA in the barn			
In front of the cubicles	13 (33,3 %)	0	13 (28,9 %)
Separate	9 (23,1 %)	2 (33,3 %)	11 (24,4 %)
Separate on bedded pack area	3 (7,7 %)	0	3 (6,7 %)
Combination of separate CCA and CCA in front of the cubicles	12 (30,8 %)	0	12 (26,72 %)
Other than mentioned position	2 (5,1 %)	4 (66,6 %)	6 (13,3 %)

DCC = dam-calf contact; CCA = calf creep area

* Other indicates a calf barn for older calves or flexible systems that can be set up according to stocking density.

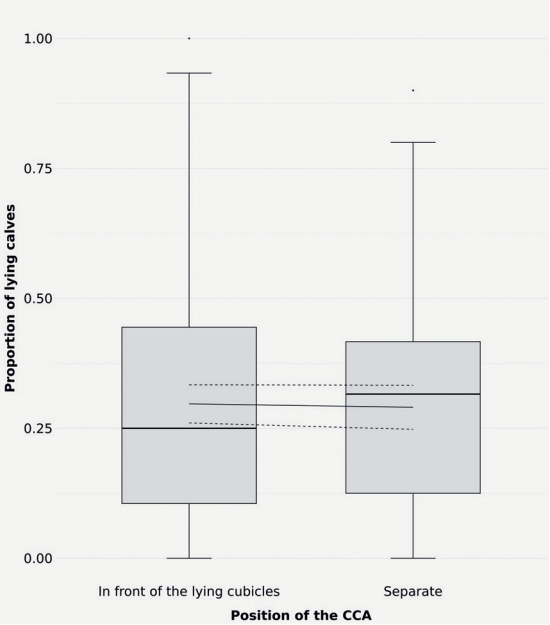

Figure 2: Observed proportions of lying cows (boxplots) in addition to general linear mixed model estimates (solid line) with 95 % CI (dashed lines) depending on the position of the CCA. CCA = calf creep area; CI = confidence interval

the barn more flexibly than the other animal categories, using for various behaviours the lying and feeding areas designed for them as well as those for cows, whereas cows mainly used the feeding area for feeding and the lying area for lying (Table 4).

Lying Behaviour and the Position of the CCA

The proportion of lying cows was 10 % lower in systems with a separate CCA (34,5 %) than in systems with a CCA in an enlarged head lunge space in front of the cubicles, although with weak statistical support (44,6 %; p = .063) (Figure 2). Comparatively high was the average proportion of lying cows during the observations on the three farms with a CCA installed on the bedded pack lying areas (58 %). No difference was found in the proportion of lying calves depending on the location of the CCA (separate: 57,8 %; in front of cubicles: 56,9 %) (p = .81) (Figure 3), but calves used a separate CCA less (30,0 %) than a CCA in front of the cubicles (41,4 %) and lay more often in the cows' cubicles in barns with a separate CCA (separate: 27,8 %; in front of cubicles: 15,5 %; p = .001) (Figure 4).

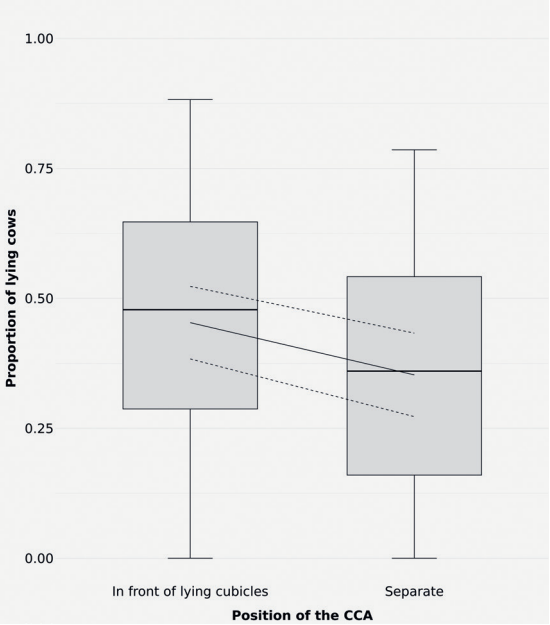

Figure 3: Observed proportions of lying calves (boxplots) in addition to general linear mixed model estimates (solid line) with 95 % CI (dashed lines) depending on the position of the CCA. CCA = calf creep area; CI = confidence interval

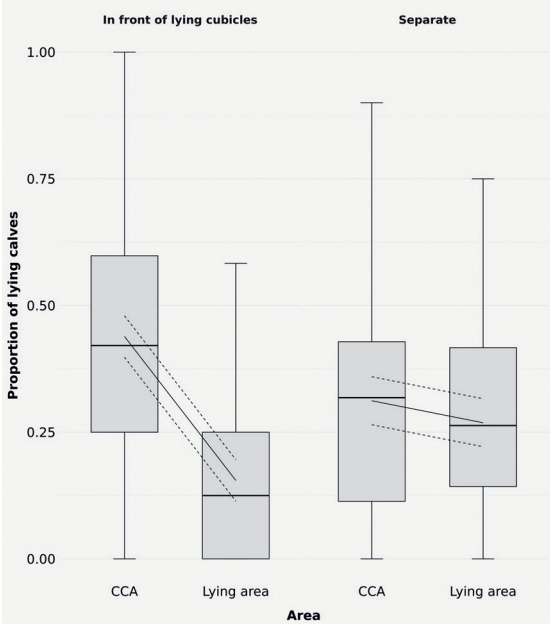

Figure 4: Observed proportions of lying calves (boxplots) in the CCA or the lying area in systems with separate CCA and systems with CCA in front of the cubicles in addition to general linear mixed model estimates (solid line) with 95 % CI (dashed lines) depending on the position of the CCA. CCA= calf creep area; CI = confidence interval

Discussion

This study discovered a great deal of multifactorial variability among farms. Common features were calf-specific parts of the barn (such as feeding gates with narrower slat widths or devices to protect calves from entrapment) and, most importantly, areas specifically designed for calves (such as CCAs and calf feeding areas). There was considerable variation between farms in animals' behaviour and distribution in barns. Overall, calves were more flexible in their use of barn areas than cows. As hypothesised, the position of the CCA influenced the lying behaviour of cows and calves. The water supply to young calves may not be ensured in many barns due to the height of the drinking troughs, indicating that some barn design elements were not always sufficiently adapted to the needs of calves.

The barns' designs and housing systems' structures depended on many factors, such as previous husbandry systems, the farms' locations (e.g. valley vs. mountain zone), financial opportunities and the size of the farmland. Management systems depended, for example, on farmers' personal preferences, time and financial resources and ambitions (e.g. part time vs. full time) as well as the production system (e.g. veal, beef, DCC). Notably, farmers' associations suggested the farms' participation, and farms participated in the study voluntarily, which suggests a potential bias in the quality of husbandry, so our findings cannot be generalised to all farms with CCC systems in Switzerland, as critical aspects of husbandry may have been overlooked.

Various farms yielded a broad range of behavioural observations in regard to the use of barns' functional areas. As the farms were visited only once and the three-hour observation period was comparatively short, it is plausible that our results are confounded by day-specific influences, such as weather or cows being in oestrus. Nevertheless, it was possible to provide an overview of how the animals used functional areas in CCC systems and to identify trends in

Table 4. Overview of observed behaviour in cows, calves and heifers' functional areas on Swiss suckler cow farms and farms with dairy DCC, presented as percentages of animals per category, behaviour and functional area.

Behaviour	Area	Percentage of cows (n = 794)	Percentage of calves (n = 659)	Percentage of heifers (n = 58)
Active	Activity area	7,9%	11,6%	5,2%
	Feeding area	1,9%	1,6%	0,7%
	Calves' feeding area	0,0%	0,7%	0,1%
	CCA*	0,3%	4,0%	0,2%
	Lying area	1,4%	3,1%	0,6%
Active total		**11,5%**	**21,0%**	**6,8%**
Feeding	Activity area	0,1%	0,1%	0,00%
	Feeding area	21,8%	4,4%	14,2%
	Calves' feeding area	0,3%	6,3%	8,3%
	CCA	0,1%	0,3%	0,0%
	Lying area	0,0%	0,0%	0,0%
Feeding total		**22,3%**	**11,1%**	**22,5%**
Lying	Activity area	0,1%	0,4%	0,2%
	Feeding area	0,2%	0,1%	0,1%
	Calves' feeding area	0,0%	0,0%	0,0%
	CCA	0,9%	34,1%	6,4%
	Lying area	38,2%	24,3%	29,5%
Lying total		**39,4%**	**58,9%**	**36,2%**
Standing	Activity area	16,3%	6,2%	9,1%
	Feeding area	1,5%	0,6%	1,9%
	Calves' feeding area	0,0%	0,5%	1,2%
	CCA	0,5%	1,0%	1,2%
	Lying area	6,1%	2,7%	6,2%
Standing total		**24,4%**	**11,0%**	**19,6%**

DCC = dam-calf contact

*CCA = calf creep area

the animals' time budget. On average, 39 % of cows were observed lying, 24 % standing and 22 % feeding. Interpreted as a daily time budget, this is comparable to those reported in studies on dairy cows.[8,16,21] The shorter lying and feeding durations reported in this study may be related to the brief observation period of three hours, which did not account for the cows' circadian rhythm. Therefore, we may have missed both the main resting time at night[16] and the main feeding time, as we conducted observations after the morning feeding.

As with cows, the behaviour of calves differed considerably between farms. On eight farms, calves were not observed resting in the CCA, whereas calves were not observed lying in the cows' lying area on three other farms. On one farm, only 1,4 % of calves showed activity in the activity area, but almost half the calves were active in their activity area on a different farm; still, calves' total lying time varied less than that of cows. Our results indicate that calves used the barn more flexibly, and their behaviour appeared to depend less than that of cows on barn construction and management. The calves themselves chose where to lie down and usually decided themselves how long to lie.[9] Importantly, the calves' ages were not recorded in the evaluation of our behavioural data. In the first few days of a calf's life, lying may consume 80 % of the day, but this decreases with increasing age.[9] In the present study, both newborn and 10-month-old cattle were categorised as calves, which does not accurately reflect the differences between age groups due to differing calving managements.

Daily lying time is an important physiological parameter in lactating cows,[17,20] so it was interesting to observe that cows in systems with a CCA separate from the lying cubicles lay down less (10 %) than those in systems with the CCA in front of the cubicles. Because calves in systems with a separate CCA more frequently used the cows' lying cubicles, it may be assumed that the calves occupied the cubicles and blocked adult cows' access. It is also possible that cubicles where calves lay frequently were less hygienic and therefore less attractive to cows. However, the bedding hygiene of the lying areas was not systematically assessed and compared in this study. In addition, the fact of the calves being in a separate CCA that was away and in a less visible area may have made the cows more restless. Assuming that lying in close proximity to their calves or at least knowing their location is a behavioural need of cows, separate CCAs could lead to stress, which may be relevant with regard to cows' welfare in these housing systems. The higher incidence of CCA in front of the cubicles in newer barns, which may have better quality lying areas, may have been a factor influencing lying behaviour. It should be mentioned again that the hypotheses were formulated following the exploratory data analysis. The sample size calculation was tailored for the initial explorative part of the study. It was not feasible to adjust the sample size thereafter, in order to generate a sufficient statistical power for the second part. Future research could evaluate resting time, movement behaviour and the distance chosen by the cow and its calf in both systems to draw conclusions about the effect of the CCA's positioning on the behaviour and welfare of cow and calf.

Because of the large number of converted barns, we assumed that some of their structural aspects were not sufficiently adapted to calves' needs. According to the Swiss Animal Welfare Ordinance, calves in suckler cow husbandry must have access to water at least twice a day,[19] but there are no regulations regarding the height at which drinking troughs must be installed. The Swiss suckler cow association Mutterkuh Schweiz recommends a maximum drinker height of 0,6 metres for young calves and indicates that it is currently considering reducing this to 0,4 metres, comparable to the recommended hay trough height for calves (personal communication with Wollenberg Martínez, Meike, head of Beef Control, 01.11.2023). Only 22 of 45 farms had installed calves' drinking troughs below the recommended maximum height of 60 cm, so it is uncertain whether calves on the remaining farms had sufficient access to water. The importance of water supply for young calves in suckler husbandry is unclear due to the lack of studies on suckler calves' water intake behaviour. Studies on artificially reared dairy calves show that they consume water from the first days of life and that daily weight gain and milk intake decrease when water is not available. This is also observed, although to a lesser extent, among calves fed milk *ad libitum*,[7,24] which are most comparable to suckler calves.

In conclusion, Swiss cow-calf farming employs diverse housing and management systems. Calves use the housing systems more flexibly than cows and evidently can adapt to different systems. Considering that the number of suckler cow and DCC farms in Switzerland is increasing, further research should focus on the water intake of calves in CCC systems and investigate how the CCA's position affects cow behaviour and welfare.

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Élevage mère-veau: aperçu de la conception des étables, de la gestion et du comportement dans les systèmes d'élevage mère-veau

En Suisse, le nombre d'exploitations pratiquant l'élevage de vaches allaitantes et de vaches laitières laissées en contact avec leurs veaux est en augmentation, mais les connaissances manquent sur les besoins et les comportements des bovins dans ces systèmes.

Cette étude offre un aperçu des élevages mère-veau et des systèmes de gestion en Suisse. Elle permet de mieux cerner le comportement des vaches et des veaux ainsi que leur utilisation des zones fonctionnelles des étables. Elle permet également d'identifier les aspects potentiellement problématiques, en termes de bien-être animal, de ces systèmes de détention. Au total, 39 exploitations de vaches allaitantes et six exploitations où les vaches laitières sont laissées en contact avec leurs veaux ont été prises en compte, à raison d'une visite par exploitation. Les chercheurs ont évalué les aspects du bien-être animal influencés par la conception des étables et ont interrogé les exploitants sur leur gestion et leurs expériences. L'étude s'est fondée sur l'observation du comportement des animaux par scan-sampling (18 fois toutes les 10 minutes sur une période de 3 heures) pour analyser la répartition des animaux dans l'étable et leur utilisation des zones fonctionnelles. Les chercheurs ont constaté d'importantes différences entre les exploitations étudiées, en termes de gestion et de détention du bétail.

Près de la moitié des exploitations disposaient d'abreuvoirs placés à plus de 60 cm de hauteur, ce qui soulève des questions quant à la capacité des jeunes veaux à accéder à l'eau
.
Toutes les exploitations disposaient d'aires de repos pour les veaux. Celles-ci se distinguaient par leur taille, leur nombre et leur emplacement. Dans les exploitations où l'aire de repos des veaux était séparée de celle des vaches, le nombre de vaches couchées durant l'observation était inférieur de 10 % (n = 11; 34,5 %) à celui des vaches couchées dans les systèmes où l'aire de repos des veaux est située directement devant les logettes (n = 13; 44,6 %; p = .063). Pour se coucher, les veaux utilisaient moins volontiers les aires de repos séparées (30,0 %) que celles situées directement devant les logettes (41,4 %; p = .001). Cette étude ne permet pas de dresser un tableau complet de l'élevage mère-veau en Suisse, mais elle contribue à la formulation de nouvelles questions de recherche.

Mots clés: contact mère-veau, contact vache laitière-veau, systèmes d'élevage, comportement de couchage, vache allaitante

Detenzione di vacche e vitelli: panoramica della progettazione della stalla, della gestione e del comportamento nei sistemi di stabulazione vacche-vitelli

In Svizzera il numero delle aziende con detenzione di vacche madri e contatto vacche da latte–vitelli è in aumento, ma mancano le conoscenze di base sulle esigenze e sul comportamento dei bovini in questi sistemi.

Lo studio offre una panoramica dei sistemi di stabulazione e di gestione vacche–vitelli in Svizzera. L'obiettivo è far conoscere il comportamento delle vacche e dei vitelli e il loro utilizzo delle aree funzionali delle stalle per identificare gli aspetti potenzialmente problematici per il benessere degli animali in tali sistemi. È stata effettuata una visita in ognuna delle 39 aziende di vacche madri e delle sei aziende con contatto vacche da latte–vitelli. Sono stati misurati gli aspetti della costruzione di stalle rilevanti per il benessere degli animali e consultati gli agricoltori di ogni azienda in merito alla gestione e alle loro esperienze. Le osservazioni sul comportamento degli animali sono state effettuate mediante la tecnica dello scan sampling (18x ogni 10 minuti su un intervallo di 3 ore) per analizzare la distribuzione e l'utilizzo delle aree funzionali di una stalla da parte degli animali. Sono emerse notevoli differenze nella gestione e nella detenzione degli animali tra le aziende esaminate.

Circa la metà delle aziende aveva abbeveratoi a un'altezza di oltre 60 cm, il che solleva qualche dubbio in merito alla capacità dei giovani vitelli di queste aziende di accedere all'acqua. Tutte le aziende avevano giacigli per i vitelli che variavano in dimensioni, numero e ubicazione. Nelle aziende con una vitellaia separata dalla zona dei giacigli, il numero di vacche sdraiate durante l'osservazione era inferiore del 10 % (n = 11; 34,5 %) al numero di vacche sdraiate nei sistemi con una vitellaia direttamente davanti ai box (n = 13; 44,6 %; p = .063). I vitelli utilizzano meno le vitellaie separate per sdraiarsi (30,0 %) delle vitellaie poste direttamente davanti ai box (41,4 %; p = .0001). Lo studio non fornisce un quadro completo dei sistemi di stabulazione vacche–vitello in Svizzera, tuttavia contribuisce a sollevare nuovi interrogativi per la ricerca.

Parole chiave: contatto vacca–vitello, contatto vacca da latte–vitello, sistemi di stabulazione, comportamenti di riposo, vacca madre

The Housing of Cow and Calf: An Overview of Barn Design, Management and Behaviour in Cow-Calf Housing Systems

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