Review

Quality of care in ruminants and equines

Susanne Waiblinger, Luc Mounier, Else Verbeek, Valentin Brunet

Acknowledgements

The authors thank Alison Hanlon and Xavier Boivin for the reviewing of the document.

Review
Quality of care in ruminants and equines

Susanne Waiblinger[1], Luc Mounier[2,3], Else Verbeek[4], Valentin Brunet[2]

[1] Centre for Animal Nutrition and Welfare, Clinical Department for Farm Animals and Safety of Food Systems, University of Veterinary Medicine, Vienna, Veterinärplatz 1, Wien, 1210, Austria
[2] Université Clermont Auvergne, INRAE, VetAgro Sup, UMR Herbivores, Saint-Genès-Champanelle, 63122, France
[3] Chaire bien-être animal, VetAgro Sup, 1 avenue Bourgelat, 69280 Marcy l'Etoile, France
[4] Department of Applied Animal Science and Welfare, Swedish University of Agricultural Sciences, Ulls väg 26, Uppsala, 756 51, Sweden

December 2024

This review is a publication of the European Union Reference Centre for Animal Welfare for Ruminants & Equines. EURCAW *Ruminants & Equines* was designated by the European Commission through implementing decision of 6 May 2021, in accordance with Regulation 2017/625/EU.

Disclaimer

This review can be downloaded for free at https://doi.org/10.5281/zenodo.16536104

Citation: Waiblinger, S., Mounier, L., Verbeek, E., & Brunet, V. (2025). Review - Quality of care in ruminants and equines. EURCAW Ruminants & Equines. https://doi.org/10.5281/zenodo.16536104

Each EURCAW *Ruminants & Equines* review provides background information on the biological relevance of the welfare topic. It then presents the most important key areas to focus on during welfare inspections, describes why welfare issues occur and lists specific animal-based indicators that can help official inspectors to identify these welfare issues. Finally, the review summarises good and better practices that can help to solve the previously described welfare issues, and deals with related legislative requirements.

EURCAW *Ruminants & Equines* produces its reviews according to internationally accepted scientific standards, which include an external peer review process. However, it cannot accept liability for any damage resulting from the use of the results of this study or the application of the advice contained in it.

info@eurcaw-ruminants-equines.eu

https://www.eurcaw-ruminants-equines.eu/

https://www.linkedin.com/company/eurcaw-ruminants-equines/

Designated by the EU Commission

Contents

1 Executive Summary

The quality of animal care has a major influence on the welfare of farmed ruminants and equines. It comprises a large variety of tasks including feeding, cleaning, health care, handling, and controlling the environment. A high quality of care requires caretakers with knowledge of animals' needs, behaviour and welfare, and of best management practices, with the skills and willingness to perform tasks and to implement recommendations, and with a good relationship with their animals characterised by a positive attitude, behaviour and empathy. The latter is important with respect to good handling, but is also linked with other aspects of caretaking, such as problem recognition and solving. These factors are also linked to several quantitative aspects, such as the herd size, the number of animals per caretaker, the consistency of caretakers' identity, and the frequency and duration of work in contact with the animals. There are additional factors impacting the quality of care, which, subsequently, affect animal welfare: the husbandry system, knowledge and training of caretakers, their experience and educational background, and personal characteristics (e.g. age, attitudes). We reviewed the scientific literature on all of these aspects of caretaking and provide a number of recommendations on ways to improve farm animal care.

2 Foreword

The European Union Reference Centre for the Welfare of Ruminants and Equines (EURCAW *Ruminants & Equines*) develops and disseminates knowledge and tools to assist Competent Authorities (CAs) in performing better official controls and enforcing EU animal welfare rules. It covers a range of farm animal species including those used for dairy (cows, goats, sheep, buffaloes, horses) and meat (cattle, sheep, goats, deer, horses) production and ruminants and equines kept for other purposes. Based on discussions with CAs, EURCAW *Ruminants & Equines* identified the quality of care (or stockpersonship), as an important issue for ruminant and equine welfare. The present document reviews the knowledge available and proposes recommendations to prevent poor welfare.

3 Introduction – definition and relevance for animal welfare

Farmed animals are dependent on humans keeping and caring for them (e.g. provision of food, health care) and, accordingly, these people have a large impact on animal welfare. Therefore, even under similar housing and environmental conditions, farms can differ largely with respect to the welfare of their animals, e.g. disease incidence, mortality and affective state of animals, due to differences in the quality of care. We use the term 'quality of care' instead of the often used 'stockmanship' to (i) focus more on the tasks and skills, and (ii) to avoid the term 'stock' that does not fit to all species we are dealing with. We will use 'caretaker' to refer to the people responsible for making care decisions and implementation. Thus, it refers to both owners/farmers and employees. 'Quality of care' comprises a large variety of tasks and skills (see Farm Animal Welfare Council (FAWC), 2007; Waiblinger & Spoolder, 2007). These involve, for instance, control, cleaning and maintenance of the animals' housing environment, provision of food and water, health care, reproductive and group management, and responsibility for overall animal welfare. Many of these tasks require contact with the animals, at least visually or auditorily, but handling is often also involved. The execution of tasks can differ largely, and depends on the human-animal relationship, problem recognition (e.g. identifying sick animals or dysfunctional equipment) and resolution (implementing effective treatment, repair), which all impact animal welfare substantially. In addition, the quality of care is related to personal characteristics, such as attitude or personality, knowledge and understanding of animals' needs, behaviour and welfare, and experience; many of which can be improved. This review comprises evidence for the effects of different aspects of the quality of care on the welfare of ruminants, New World Camelids (NWC) and equines. It also discusses possibilities for improvement of the quality of care. But first we will describe the legal requirements.

4 Legal requirements in the European Union for animal caretakers

At EU level, three directives set out the rules on staff competence regarding ruminants and equines. The more stringent one is the Directive 2010/63/EU on the protection of animals used for scientific purposes, which includes the need for caretakers to be adequately educated and trained. Regarding the care of farm animals, the Directive 98/58/EC concerning the protection of animals kept for farming purposes states:

"Animals shall be cared for by a sufficient number of staff who possess the appropriate ability, knowledge and professional competence." (Annex – Staffing – 1.)

"All animals kept in husbandry systems in which their welfare depends on frequent human attention shall be inspected at least once a day. Animals in other systems shall be inspected at intervals sufficient to avoid any suffering." (Annex – Inspection – 2.)

Moreover, the Directive 2008/119/EC on the protection of calves' states:

"All housed calves must be inspected by the owner or the person responsible for the animals at least twice daily and calves kept outside must be inspected at least once daily." (Annex 1 – 6.)

Thus, two main aspects are identified in these Directives regarding caretakers: the quantity of animal caretakers and their ability, knowledge and competences (i.e. their quality). Another aspect is the minimum required frequency of inspection of the animals by the responsible caretaker. Nevertheless, there are no details on the exact maximum number of animals per caretaker, nor on training or certification of caretakers in farming practices or animal welfare in the EU's legislation regarding farm ruminants and equines.

In the following parts, we briefly describe the legislative measures taken in EU countries, beyond the EU legislation. These data were obtained from CAs in 13 EU Member States in the summer of 2023. The present review focuses on farm animals, but the principles can be applied to animals used for other purposes.

4.1 Quantity of caretakers

In all the countries surveyed, the quantity of animal caretakers was not precisely addressed in the national legislation.

4.2 Required qualifications for caretakers

A few EU countries have detailed compulsory training programmes regarding animal welfare in their legislation. Portugal has created professional training courses with a specific course for ruminants and equines (Order No. 9485/2015), but there are exceptions for farms with less than 20 bovines. Spain has general requirements for equines (Royal Decree 804/2011) and a detailed training programme for bovines (Royal Decree 1053/2022). Slovenia has a detailed programme on farming practices and animal welfare, requiring training and a certification that is valid for 10 years (Animal Protection Act, 2018).

Other countries, such as Finland (new legislation based on the Animal Welfare Act 347/1996 in 2024) and France (article R214-17 of the Rural and Maritime Fishing Code), require that a person is assigned responsibility for animal care/welfare within each farm, but no specific training regarding ruminants or equines is needed. Nevertheless, people taking care of equines must have a certification of knowledge or previous experience in France (articles L211-10-1 and D214-37-1 of the Rural and Maritime Fishing Code).

Some countries have legal requirements for training or certification of knowledge for other farm animals, mainly broilers and/or pigs (e.g. Poland, Czech Republic, Ireland, Netherlands, Germany, France).

5 Quality and quantity of care: effects on animal welfare and interrelationships

The overall quality of care, how well the animals are cared for on a daily basis, affects the welfare of the animals. The highest possible welfare in a given housing and production system needs the best care practices regarding feeding, health care, cleaning, herd management, handling, etc. Overall quality of care is affected by quantitative aspects (e.g. how often a task is performed or for how many animals, such as how often animals and equipment are checked; or how many animals one caretaker is responsible for) and qualitative aspects (how well the tasks are

performed, e.g. how reliably sick animals or dysfunctional equipment are identified during checks). These aspects are linked to each other and to environmental factors (e.g. housing conditions affect the amount of time needed for equipment maintenance and the ease of checking the animals). Therefore, there is an interaction between the number of animals one caretaker can care for, the caretakers' skill and capability, and the environmental conditions (e.g. the production and housing system), although scientific studies on this topic are rare. We will first present results on the quality of care and then address the quantitative aspects of care and the link to quality.

Figure 1 gives an overview on the different aspects of quality of care, influencing factors and effects on the animals that are detailed in next sections.

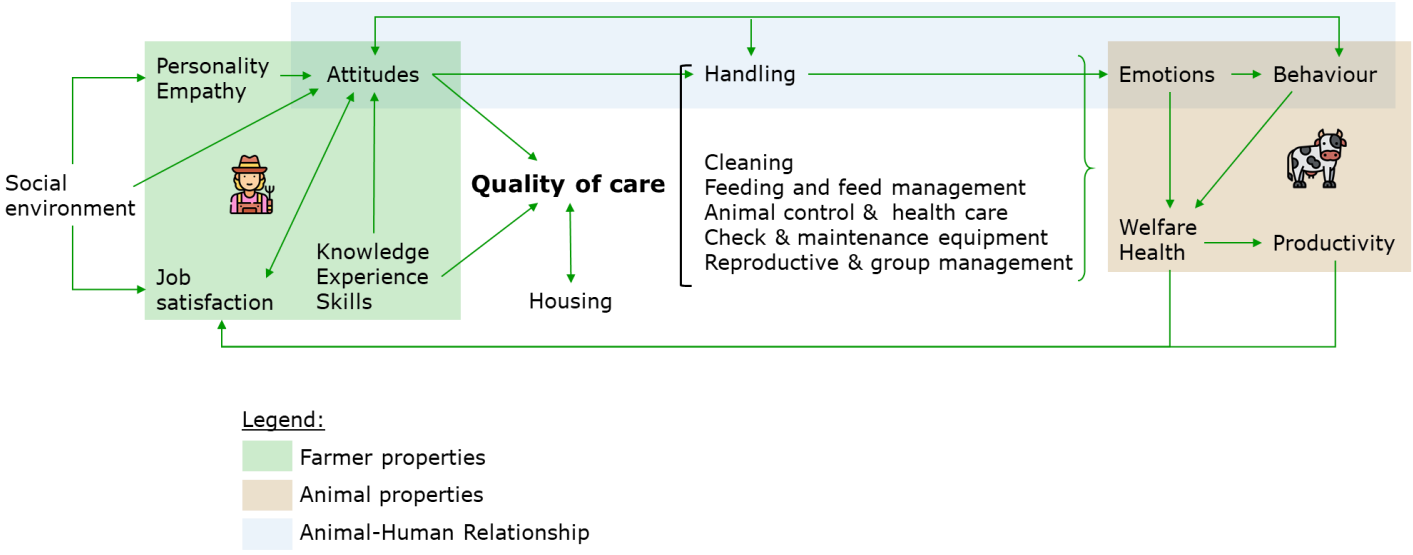

Figure 1. Simplified scheme of the main tasks of caretakers, factors of influence and effects on animals.

5.1 Quality of care, animal welfare and the human-animal relationship

The importance of **management practices as risk or success factors for health and other welfare problems** has been clearly established, for example, the frequency of cleaning or appropriate feeding on disease incidences, but details on these are out of the scope of this review. **Caretakers are crucial in the implementation of good and best husbandry practices to support animal welfare,** as confirmed in a small number of studies. On dairy cow and goat farms, the quality of care has been assessed by rating the performance of tasks (e.g. calm handling of animals, cleaning of troughs, regular feeding times), application of management recommendations, current state of care of the animals (e.g. claw trimming), and maintenance of equipment (functioning of equipment). The more best practices are implemented, the less welfare problems are found regarding health, injuries, and social stress (Bock, Molz, & Zeeb, 1988; Menke, Waiblinger, Fölsch, & Wiepkema, 1999; Waiblinger, Schmied-Wagner, Mersmann, & Nordmann, 2011). Also, sheep farmers performing best practices, such as condition scoring for parasite control, and reacting quickly in case of problems, have sheep with better welfare indicated by a lower prevalence of lameness, or better body and fleece condition (Munoz, Coleman, Hemsworth, Campbell, & Doyle, 2019; O'Kane, Ferguson, Kaler, & Green, 2017).

A good relationship of caretakers with their animals is a key factor in the quality of care and good welfare via the direct benefits of good handling and a good animal-human relationship, but also because of the indirect effects on other aspects of quality of care, namely the implementation of best practices, problem recognition and problem solving (for review see Waiblinger, 2018; Waiblinger & Lürzel, 2023).

We will first discuss the ***direct effects*** of interaction with the animals. The inevitable interaction between caretakers and animals can exert both negative and positive effects on animal welfare depending on the actual relationship. From the animal's perspective, the animal-human relationship (**AHR**) is the perception of humans by the animal based on previous interactions. The AHR can range from poor to good, characterised by negative (fear, frustration) or positive (enjoyment, relaxation) affective states involved during interactions (Rault, Waiblinger, Boivin, & Hemsworth, 2020; Waiblinger, Mülleder, Menke, & Coleman, 2006; as illustrated in Figure 1). Regular calm and gentle interactions and avoiding negative ones, allows the animals to habituate to the caretakers (perceiving them as neutral, without fear); regular positive interactions can lead to the development of a positive AHR (animals perceiving the human as a source of pleasure, for review see Waiblinger, 2018; Waiblinger & Lürzel, 2023; Waiblinger, Mülleder, Menke, & Coleman, 2006). An improved AHR, besides actual calm and gentle handling, reduces stress in animals during subsequent daily interactions, during veterinary care or other potentially aversive practices, and improves health and production (Table 1, for review see Waiblinger, 2018; Waiblinger & Lürzel, 2023). Positive interactions are mainly tactile (Ebinghaus, Ivemeyer, & Knierim, 2018; Lensink, Fernandez, et al., 2000; Lürzel, Windschnurer, Futschik, & Waiblinger, 2016; Ujita et al., 2021; Waiblinger, Menke, Korff, & Bucher, 2004; Waiblinger et al., 2006), but also visual, acoustic or manual provision of feed (Ebinghaus, Ivemeyer, & Knierim, 2018; Ginane & Rørvang, 2023; Lürzel, Windschnurer, Futschik, & Waiblinger, 2016). Manual feeding is associated with a better AHR in goats (Mersmann, Schmied-Wagner, Nordmann, Graml, & Waiblinger, 2016) and cattle (Ebinghaus, Ivemeyer, & Knierim, 2018). Conversely, negative interactions, unpredictable behaviour, and impatience have a detrimental impact on the AHR and animal welfare, such as increased prevalence of lameness (Table 1, e.g. in heifers, Breuer, Hemsworth, & Coleman, 2003; in dairy calves, Calderón-Amor, Beaver, von Keyserlingk, & Gallo, 2020, 2020; in dairy cows, Chesterton, Pfeiffer, Morris, & Tanner, 1989; Rushen, De Passille, & Munksgaard, 1999). While early positive interactions with young animals help to build the basis for a good AHR (cattle: Lürzel, Windschnurer, Futschik, & Waiblinger, 2016; goats: Boivin & Braastad, 1996; sheep: Markowitz, Dally, Gursky, & Price, 1998; horses: Lansade, Bertrand, Boivin, & Bouissou, 2004; NWC: Windschnurer et al., 2021), continuous positive interactions throughout life are necessary to maintain it (e.g. Lürzel, Windschnurer, Futschik, & Waiblinger, 2016, for review horses: Hausberger, Roche, Henry, & Visser, 2008, cattle: Waiblinger & Lürzel, 2023; ruminants and equines: de Oliveira & Boivin, 2024). Animals are able to recognise individual humans, but also generalise their experience with familiar caretakers to unfamiliar persons (cattle: Breuer, Hemsworth, & Coleman, 2003; Lürzel, Windschnurer, Futschik, & Waiblinger, 2016; Rushen, De Passille, & Munksgaard, 1999; sheep: Boivin, Nowak, Desprès, Tournadre, & Le Neindre, 1997; Markowitz, Dally, Gursky, & Price, 1998). Therefore, previous interactions that are either negative or positive will influence future interactions with other humans.

In addition to positive daily interactions, appropriate handling and facilities should be used **during management practices** to minimise stress. A lack of habituation to humans, previous negative experience, and inexperience increases stress in animals and makes handling more difficult and dangerous, by potentially eliciting 'flight or fight' responses including aggression (cattle: Boivin, Le Neindre, Chupin, Garel, & Trillat, 1992; Grandin, 2017; Le Neindre, Boivin, & Boissy, 1996; Lewis & Hurnik, 1998; sheep: EFSA, 2021; Rushen, 1986; Figure 1). Therefore, good quality of care considers the habituation of animals to handling procedures (sheep: Hall, Kirkpatrick, & Broom, 1998; cattle: Lewis & Hurnik, 1998) or even promotes positive interactions. In cattle, heifers that received gentle tactile stimulation when restrained in a chute had more behavioural improvements (Ujita et al., 2021). On the other hand, habituation to highly aversive procedures, such as shearing, is limited (Hargreaves & Hutson, 1990). It is also important to take into account the animals' preferences. For example, farmed red deer prefer dimly lit enclosures rather than brightly lit ones, and this improves ease of handling (Pollard & Littlejohn, 1994). In addition, an animals' genetic disposition of reactivity towards humans should be considered during handling and breeding selection (Destrez et al., 2013; Le Neindre, Boivin, & Boissy, 1996).

A better AHR and patient, skilful handling reduces stress, improves animal welfare, and benefits human welfare. The risk of accidents during handling is reduced due to lowered stress, aggression, flight and defensive reactions in animals (Windschnurer, Eibl, Franz, Gilhofer, & Waiblinger, 2020; for review: Waiblinger et al., 2006; for review in cattle: Waiblinger & Lürzel, 2023). Furthermore, negative interactions can increase the risk of accidents: for example, the use of a whip was associated with more accidents in steeplechase racing in horses (Pinchbeck, Clegg, Proudman, Morgan, & French, 2004).

The ***indirect effects*** of the caretaker's relationship with their animals on further aspects of quality of care are important for animal welfare as well. A better relationship, as reflected in higher frequency and quality of interactions with the animals, improves problem recognition and problem solving, and can benefit social behaviour and reduce injuries, as reported in horned dairy cows and goats (Waiblinger, Baars, & Menke, 2000; Waiblinger et al., 2011). It is likely that more intense human-animal interactions contribute to the caretakers' understanding of the animal; however, the caretakers' underlying set of attitudes, perception of the individual animal, and sense of responsibility to the animals also impact the quality of care (see also below in 6.2.1 Attitudes).

5.2 Quantitative aspects of care and link with quality

Quantitative aspects of animal care are the 'quantity of caretakers', the absolute number of persons on a farm caring for the animals, the number of animals per caretaker, and the frequency and duration of caring for the animals. According to the literature, there is high variability in the number of animals per caretaker. For example, on dairy goat farms (with loose housing and milking parlour), the average number of goats per caretaker was 50 (± 33.1, ranging from 15–150) and goats per milker ranged from 16 – 244 (76 ± 58.4, Mersmann, Schmied-Wagner, & Waiblinger, 2022). In contrast, the number of dairy cows per caretaker ranged from 4.4 to 64 (24 ± 14.4, Ebinghaus, Ivemeyer, & Knierim, 2018), while one caretaker was responsible for 32 to 1540 veal calves on 146 farms (500 ± 26, Leruste et al., 2012). The effects of the caretaker to

animal ratio are rarely considered in scientific studies. In general, the number of animals that caretakers are responsible for, and the quality of care are linked. For example, **herd size** seems to have some negative associations with aspects of the quality of care, including the AHR. As herd size increases, farmers consider animal pain and welfare less (beef cattle: Wikman et al., 2016; sheep: Kılıç & Bozkurt, 2013), have fewer positive interactions (cattle: Lensink, Boissy, & Veissier, 2000; Waiblinger & Menke, 1999), and are less able to identify individual animals (Waiblinger & Menke, 1999). Further, an increasing herd size correlates to other quantitative aspects, namely an increasing **number of animals per caretaker** and decreasing **contact time per animal** (in cows: Ebinghaus, Ivemeyer, & Knierim, 2018). Accordingly, in larger herds or farms with a higher number of animals per caretaker, a lower proportion of animals can be touched, and a higher proportion of animals show high avoidance (cows: de Boyer des Roches, Veissier, Boivin, Gilot-Fromont, & Mounier, 2016; Ebinghaus, Ivemeyer, & Knierim, 2018; Waiblinger & Menke, 1999; calves: Leruste et al., 2012). However, the association between animals' reactions towards humans and herd size or animals per caretakers is not clear-cut and remains in question, even when including a larger range of herd sizes (de Boyer des Roches et al., 2014; Destrez et al., 2018; Gieseke, Lambertz, & Gauly, 2018). In fact, the actual contact time can still differ largely between farms of the same herd size depending on other factors, such as caretaker attitude or housing design (see also 6. Factors influencing quality of care and possibilities for improvement). Furthermore, the quality is of higher importance than the quantity of caretakers' interactions, and is largely independent of herd size (Waiblinger, 2018; Waiblinger & Lürzel, 2023).

Apart from AHR, herd size is not correlated with the overall animal welfare score in most studies in cows (Beggs, Jongman, Hemsworth, & Fisher, 2019; de Boyer des Roches et al., 2014; Gieseke, Lambertz, & Gauly, 2018). However, the number of people working on the farm and the ratio of caretakers to cows was not considered in these studies. Therefore, a large farm can have the same caretaker to animal ratio as a small farm although some negative associations between this ratio and herd size exist (see above in Ebinghaus, Ivemeyer, & Knierim, 2018). Furthermore, in larger herds, the herd managers or decision makers still have to oversee the whole herd, while other tasks, such as milking or cleaning, are distributed to other personnel. Thus, the number of animals per caretaker is of limited value because decision makers have a larger impact on the welfare of the animals. In a recent study, the amount of time dairy cow herd managers invested in controlling animal health, feeding, and general control of processes was negatively associated with somatic cell count, mortality, and culling rate (Hufe et al., 2022). In addition, as mentioned above, the link between the quantity of caretakers and the quality of care is more complex. The individuals' capabilities interact with external factors (general working conditions and responsibilities), so some caretakers have a high quality of care with a much larger number of animals than others. In one study, the farmer with the largest herd could identify all 92 of his cows, had regular, positive interactions with them, and had cows with a good AHR (Waiblinger & Menke, 1999). This may partly explain why the quantity of caretakers and herd size are not always related to animal welfare or are sometimes unexpectedly associated with better welfare with an increased number of animals per caretaker. Also in sheep farming, there appears to be no clear relationship between flock size and animal welfare problems. Further, more sheep per caretaker

was associated with better fleece condition and fewer sheep that had too high body condition (Munoz, Coleman, Hemsworth, Campbell, & Doyle, 2019; for details see Table 1).

The **absolute number of caretakers and their consistency** (i.e. no change in caretakers) have been confirmed to play a role in welfare outcomes, but results varied. A lower number of personnel involved in milking was associated with improved social behaviour and reduced injuries in dairy cows and goats (Menke, Waiblinger, Fölsch, & Wiepkema, 1999; Waiblinger et al., 2011) and higher milk yield (Schlichting, 1974), but had contradictory results on their reactions towards humans (Lensink, Veissier, & Florand, 2001; Mersmann, Schmied-Wagner, Nordmann, Graml, & Waiblinger, 2016; Waiblinger, Menke, & Fölsch, 2003; see details in Table 1). Also, the number of caretakers did not show a correlation to cows' AHR (Ebinghaus, Ivemeyer, & Knierim, 2018). These results suggest that the specific role of caretakers and the amount of contact with the animals are relevant, supporting the complexity of interactions between quantitative and qualitative aspects of caretaking.

Even the caretakers with the highest skills will not be able to provide high quality care if overloaded with work. Performing tasks requires a minimum amount of time. For example, sheep farmers reported that they needed 1.24 min per sheep for ectoparasite control, or 3.2 people for 56 hours per handling operation of an 850 head flock, including shearing and weaning (Morgan-Davies, Waterhouse, Milne, & Stott, 2006). However, 59% of the farmers reported to have insufficient staff available to provide such control measures (Morgan-Davies, Waterhouse, Milne, & Stott, 2006).

The quantitative aspect of **frequency and duration of caretakers' contact with animals** is associated with quality of care and animal welfare, but results are difficult to compare due to the different variables used. Caretakers used more negative and fewer positive interactions during milking of dairy cows with increasing daily working time (Waiblinger, Menke, & Fölsch, 2003). Similarly, the handling quality of beef cattle reduced with the progression of the workday in untrained caretakers (Ceballos et al., 2018). However, contact time with animals was frequently shown to improve animal welfare; the total contact time per dairy cow or goat is associated with a better AHR (Ebinghaus, Ivemeyer, & Knierim, 2018; Mersmann, Schmied-Wagner, & Waiblinger, 2022), better udder health in cows (Ivemeyer et al., 2018), and benefits to social behaviour and reduced injuries in goats (Waiblinger, Schmied-Wagner, Mersmann, & Nordmann, 2011). A subjectively higher workload was associated with higher quality of management and better housing decisions in dairy goat farmers (Mersmann, Schmied-Wagner, & Waiblinger, 2022), which may reflect that a higher time investment provides improved welfare conditions. Being either a full-time or part-time farmer seems to have no consistent effect on quality of care or welfare outcomes (Mazurek, Prendiville, Crowe, Veissier, & Earley, 2010; Mersmann, Schmied-Wagner, & Waiblinger, 2022). However, being a full-time or part-time farmer may not reflect the amount of contact time or even of total working time. Furthermore, the most influential factor on caretakers' behaviour is likely to be when they have a more or less positive perception of working with animals (see below 6. Factors influencing quality of care and possibilities for improvement).

Time pressure and a high workload likely have a negative influence on human-animal interactions and other aspects of quality of care. Time pressure was reported to negatively impact human behaviour (Seabrook, 2001), which aligns with results in psychology that stress reduces patience (reviewed in Waiblinger, 1996). A lack of time is associated with a lower frequency of monitoring the animals in beef suckler farms and higher probability of monitoring them from a vehicle instead of on foot (Destrez et al., 2018). Low monitoring frequency is not only negative for the AHR (Destrez et al., 2018) but also hampers early detection of injured or sick animals. As cited above, the amount of time for monitoring animals and process control is also related positively to animal health and production (Hufe et al., 2022).

In summary, sufficient (perceived) time for caring for, observing, and interacting with the animals is important for a good quality of care and animal welfare, but there are no clear-cut limits due to the interaction with personal characteristics of the caretaker and housing conditions.

6 Factors influencing quality of care and possibilities for improvement

6.1 Effects of husbandry systems

For most of the species considered in this review, production and husbandry systems vary largely, from intensive, only indoor housing, to extensive all-year-round outdoor systems, with many mixed systems e.g. seasonally based pasture systems. Risks to animal welfare vary with each system and caretaker understanding of the hazards and mitigation strategies are necessary.

For instance, in (semi)-extensive systems, low quality grazing is a potential hazard increasing the risk of under-nutrition. There is a higher risk of low body condition score of dairy cows during the pasture season (Armbrecht, Lambertz, Albers, & Gauly, 2019; Burow, Rousing, Thomsen, Otten, & Sørensen, 2013). This suggests that caretakers either have more difficulties in caring for animals' nutritional needs on pasture (e.g. suboptimal assessment of the nutritional value of the pasture), or that other factors cause this outcome, or a combination of both. It would be interesting to know if training in self-evaluation of animal welfare and pasture management could improve the situation.

Farming systems, especially intensive ones, are increasingly mechanised, e.g. automatic milking systems (AMS) in dairy cows, and new monitoring technologies, that can help the caretaker. In fact, automated technologies may provide dairy caretakers with additional time and increased work flexibility. AMS also changes the way that humans interact with and manage cows, as AMS do not require human intervention during milking. AMS seems to improve the AHR on some dairy farms, which may be related to changes in caretaker routine (Wildridge, Thomson, Garcia, Jongman, & Kerrisk, 2020), although in epidemiological studies there was no difference between farms with or without AMS (see above).

Appropriate facility design supports good animal handling, by easing cow movement in and out of the milking parlour, and gathering animals for handling practices (for review Waiblinger & Lürzel, 2023). On the contrary, inappropriate design or malfunction can even cause fear and/or stress

with negative effects on the manageability of the animals (e.g. stray current in milking parlours or at drinkers). Good animal care, however, is expected to identify such problems and solve them.

6.2 Personal characteristics

6.2.1 Attitudes

Attitudes are one of the most important predictors for human behaviour including handling behaviour. General and, in particular, behavioural attitudes influence caretakers' behaviour towards the animals and subsequently animal behaviour, physiology, productivity and health. Positive attitudes in caretakers correspond to positive interactions, a better AHR, calmer behaviour and better animal welfare (e.g. dairy cow: Breuer, Hemsworth, Barnett, Matthews, & Coleman, 2000; de Boyer des Roches, Veissier, Boivin, Gilot-Fromont, & Mounier, 2016; Ebinghaus, Ivemeyer, & Knierim, 2018; Hemsworth, Coleman, Barnett, & Borg, 2000; Hemsworth, Coleman, Barnett, Borg, & Dowling, 2002; Ivemeyer, Knierim, & Waiblinger, 2011; Kielland, Skjerve, Østerås, & Zanella, 2010; Waiblinger, Menke, & Coleman, 2002; Waiblinger, Mülleder, Menke, & Coleman, 2006; veal calf: Lensink, Fernandez, et al., 2000; dairy goat: Mersmann, Schmied-Wagner, Nordmann, Graml, & Waiblinger, 2016; Mersmann, Schmied-Wagner, & Waiblinger, 2022; alpaca: Windschnurer et al., 2021; for review Hemsworth & Coleman, 2010; Waiblinger, 2018). This feedback loop is illustrated in Figure 1: inappropriate caretaker behaviour elicits fear in animals, which hinders handling. Difficulties during handling can reinforce negative attitudes about animals and lead to continued negative behaviour of caretakers. On the other hand, positive handling behaviour leads to animals that are easier to handle, is beneficial to animal welfare, production outcomes and job satisfaction (for review: Hemsworth & Coleman, 2010). Training can help to promote the virtuous cycle of positive attitudes and caretaker behaviour.

Attitudes towards animals are also related to other aspects of quality of care, namely management and housing decisions. Management was of a higher quality, i.e. took the needs of animals more into account, when farmers had more positive and/or less negative attitudes regarding animal handling (Mersmann, Schmied-Wagner, & Waiblinger, 2022; Waiblinger, Mülleder, Menke, & Coleman, 2006; for review Waiblinger, 2018). Similarly, farmers with more positive attitudes towards working with cows scored higher on the criterion "absence of prolonged thirst" on the Welfare Quality® protocol, i.e. they offered their cows more and/or better maintained drinking facilities. However, owners of horses with welfare problems held positive attitudes about horses including the belief that horses make good companion animals (review: Hemsworth, Jongman, & Coleman, 2015) indicating that positive attitudes towards animals are not sufficient and should be backed up by knowledge about their needs and skills on how to provide for them (see below).

Besides attitudes towards animals and animal handling, caretakers' attitudes towards other aspects of welfare, such as health, nutrition, or specific husbandry practices, are also important. For example, if sheep farmers consider body condition score, pregnancy and parasite status as important, they are more likely to check for these issues and, consequently, their sheep have better welfare (Munoz, Coleman, Hemsworth, Campbell, & Doyle, 2019). Veal calves were healthier when the farmer had a more positive attitude towards the sensitivity of the calves to human contact and the importance of hygiene (Lensink, Veissier, & Florand, 2001). Sheep farmers

who attributed a higher impact of environmental conditions (including housing, feeding, cleaning), health care, and knowledge of personnel on animal welfare, provided better living conditions for their animals and reported better sheep welfare (Kılıç & Bozkurt, 2013). These farmers attributed the highest importance for good welfare to personnel, followed by shelter conditions, and lower importance to veterinary inspections, animal emotions and feeding, although the differences were small.

However, according to the Theory of Planned Behaviour (Ajzen, 1991), additional variables interact with attitude as a driver of caretaker behaviour, influencing either the intention to perform a specific behaviour or the probability of an intended behaviour to be actually performed (for review see Hemsworth & Coleman, 2010). Such variables are, the perceived or actual behavioural control (perceived barriers or actual existing barriers to perform a behaviour), social norms, and other social aspects. Munoz, Coleman, Hemsworth, Campbell, & Doyle (2019) identified perceived behavioural control and attitude towards specific management behaviours as the two main drivers for farmer management behaviour. Social norms (e.g. advisor opinion on husbandry practice) showed some associations as well. Farmers may be less likely to apply enhanced management practices when they perceive these to be too difficult or time consuming (Munoz, Coleman, Hemsworth, Campbell, & Doyle, 2019). Sheep farmers expressing negative affective attitudes (feelings of frustration, anger and misery) towards lameness were more likely to be slow to react to lameness, which was associated with a higher risk of lameness (O'Kane, Ferguson, Kaler, & Green, 2017). This was most likely due to a lack of (perceived) behavioural control or lower problem awareness.

6.2.2 Empathy

The Farm Animal Welfare Council (2007) mentions affinity to and empathy for livestock as two of the attributes of a good caretaker. Owners of working equids that rated higher in empathy to animals, had animals with better welfare (Luna, Vásquez, & Tadich, 2019). Hanna, Sneddon, & Beattie (2009) found positive correlations of empathy towards cows in dairy farmers and milk yield of their cows; in this survey, higher empathy was correlated with higher agreeableness and conscientiousness of caretakers, two of the five personality traits described by Digman (1990) in his five-factor model of personality. Dairy farmers with higher empathy for cows with painful conditions (rating their pain higher), had cows with lower prevalence of skin lesions, but also a lower milk yield (Kielland, Skjerve, Østerås, & Zanella, 2010); farmer's experience with a painful condition increased the pain score. Farmers that gave higher pain scores for painful conditions in dairy cows were more likely to use analgesic drugs (Browne, Conneely, & Hudson, 2022). Sheep farmers' empathy towards humans was not related to the prevalence of lameness (O'Kane, Ferguson, Kaler, & Green, 2017) aligning with the results by Paul (2000) that empathy towards animals and humans are not generally related to each other.

6.2.3 Personality traits

Seabrook (1972, 1984) was the first to show associations between caretakers' personality, their interactions with animals and dairy cows' behaviour and milk yield. Later associations between personality traits and handling behaviour or animal welfare were confirmed (Figure 1). Dairy

farmers assessed by a rating tool as patient and agreeable used more positive and less negative behaviour during milking (Waiblinger, 1996; Waiblinger, Menke, & Coleman, 2002). Veterinary costs were lower on farms with more conscientious caretakers, while neuroticism was associated with higher veterinary costs and lower milk yield (Arias & Špinka, 2005). Sheep farmers with a conscientious personality were more likely to adhere to best practices and, therefore, had a lower prevalence of lameness on their farms (O'Kane, Ferguson, Kaler, & Green, 2017). These personality traits likely affect caretakers' behaviour directly. Other personality characteristics act indirectly by influencing attitude formation, in line with the Theory of Reasoned Action (Ajzen & Fishbein, 1980; for review: Hemsworth & Coleman, 2010). The more pessimistic caretakers were, the less positive beliefs about cattle they had and the more negative behavioural attitude (Waiblinger, Menke, & Coleman, 2002). For example, they rated regular positive contact with the animals as less important, had a lower intention to use patient behaviour during milking, and felt less comfortable managing cattle (Waiblinger, Menke, & Coleman, 2002). Hanna, Sneddon, & Beattie (2009) also found correlations between pessimism and attitudes.

6.2.4 Job satisfaction

Job satisfaction was shown to be associated with attitudes, quality of care and animal welfare (Figure 1). In fact, human welfare and animal welfare are closely related, and improving one generally improves the other. Sheep farmers with higher job satisfaction had a higher perception of situations that affected animal welfare (Kılıç & Bozkurt, 2013). In dairy cattle, the pride in a healthy herd is the highest motivator for reducing lameness (Leach et al., 2010). In calves, animals showed less fear of humans if farmers had higher job satisfaction (Calderón-Amor et al., 2020). Rushen & de Passillé (2021) reported that job satisfaction and equipment design, especially for handling and moving animals, are essential to avoid frustration in caretakers and the negative impact of frustration on animals. Job satisfaction is greater when the farmer is well integrated into their professional and non-professional environment (Spigarelli et al., 2021) and depending on the type of job they have (Calderón-Amor, Beaver, von Keyserlingk, & Gallo, 2020; Rennie, Bowell, Dearing, Haskell, & Lawrence, 2003). Similarly, public policies that improve the image of farmers are more likely to support adoption of corresponding behaviour by farmers (Vigors, Wemelsfelder, & Lawrence, 2023). Thus, improving influential factors (e.g. farm organisation, equipment, external factors) should improve the behaviour of farmers by changing their attitudes (Burton, Peoples, & Cooper, 2012).

6.2.5 Demographic variables

Gender was often associated with caretaker behaviour and/or attitudes. In general, female caretakers show more positive attitudes towards patient and positive interactions and use more positive behaviour and (moderately) less negative behaviour (Lensink, Veissier, & Florand, 2001; Mersmann, Schmied-Wagner, & Waiblinger, 2022; Muri, Tufte, Skjerve, & Valle, 2012; Wikman et al., 2016). Female caretakers on dairy goat farms also scored higher in general positive attitudes, including considering the needs of goats, and affective attitudes (Mersmann, Schmied-Wagner, & Waiblinger, 2022). Owners of horses with welfare problems were more likely to be male than female (for review Hemsworth, Jongman, & Coleman, 2015). In a Turkish study on sheep farmers, female caretakers had a stronger perception of welfare issues compared to male

caretakers (Kılıç & Bozkurt, 2013). This can be explained by the Feminist Ethic of Care Theory introduced in 1996 by Donovan and Adams in Beyond Animal Rights.

Effects of age are inconsistent: while older caretakers had more negative interactions on dairy goat farms (Mersmann, Schmied-Wagner, & Waiblinger, 2022), no associations were found in veal calf farmers (Lensink, Fernandez, et al., 2000). On dairy cow farms, older caretakers used more positive and neutral interactions during milking (Waiblinger, Menke, & Coleman, 2003). These inconsistencies may reflect better education and information levels in younger farmers now compared to 20 years earlier, where possibilities of internet and social media were less well developed. However, Czech dairy farms with older caretakers had lower veterinary expenses (Arias & Špinka, 2005) and older beef producers were more sensitive to cattle pain than younger producers (Wikman et al., 2016).

6.3 Knowledge and training

In addition to personal characteristics, several studies support the importance of knowledge and education, and the effectiveness of training regarding quality of care in different areas (e.g. handling, health care, nutrition, housing) and, thus, different aspects of animal welfare.

6.3.1 Education background

For leisure horse owners, it is reported that a low level of education and income is associated with welfare problems in horses. Moreover, these horse owners were not motivated to improve their knowledge (for review Hemsworth, Jongman, & Coleman, 2015). Similarly in sheep caretakers, a higher education level led to attributing a higher level of importance to management and care for animal welfare, likely reflecting higher knowledge of sheep needs (Kılıç & Bozkurt, 2013) and better welfare outcomes (Munoz, Coleman, Hemsworth, Campbell, & Doyle, 2019).

Similarly, higher agricultural education of the farmer was positively associated with a larger proportion of positive interactions. This may reflect an increased knowledge about good and best practice during animal handling (Mersmann, Schmied-Wagner, & Waiblinger, 2022).

Regarding specific knowledge, dairy farmers that had less knowledge on analgesics reported a lower use of analgesia (Browne, Conneely, & Hudson, 2022). A study in the UK found that only 11% of sheep farmers followed best practices for treatment and management of lameness (O'Kane, Ferguson, Kaler, & Green, 2017). Sheep farmers with a good understanding of the principles of transmission and prevention of foot rot were more likely to adhere to best practices and, therefore, had a lower prevalence of lameness on their farms (O'Kane, Ferguson, Kaler, & Green, 2017). Another study showed that 42% of sampled farmers in the UK did not know the laws regarding the treatment of lame sheep on farms, and 34% were unaware of transport regulations for lame sheep (Liu, Kaler, Ferguson, O'Kane, & Green, 2018), pointing to a substantial lack of knowledge increasing the risks of poor care.

6.3.2 Experience

Experience can also impact quality of care and more years of experience can be beneficial. In dairy goat farmers, more experience was related negatively to the use of negative interactions

during milking (Mersmann, Schmied-Wagner, & Waiblinger, 2022), and had beneficial effects on social behaviour and injuries of goats (Waiblinger, Schmied-Wagner, Mersmann, & Nordmann, 2011). More experienced farmers had veal calves with lower avoidance of humans (Leruste et al., 2012) and farmers with more than 10 years of experience had more cows that could be touched by a researcher (de Boyer des Roches, Veissier, Boivin, Gilot-Fromont, & Mounier, 2016). Childhood experience likely has an effect as well, although results are less clear. Caretakers that had grown up on a dairy farm acknowledged the needs of goats to a lesser extent (Mersmann, Schmied-Wagner, & Waiblinger, 2022) and had fewer positive beliefs about goats (Muri, Tufte, Skjerve, & Valle, 2012).

6.3.3 Training

Improving the knowledge and awareness of a problem is not always sufficient to implement practices and avoid welfare problems (Hemsworth, Jongman, & Coleman, 2015). Besides the 'theoretical knowledge' that something should be done, the 'procedural knowledge' of how to do it is crucial (Hemsworth, Jongman, & Coleman, 2015). Also, the report of the Farm Animal Welfare Council on stockmanship (FAWC, 2007) states, besides personal variables, the two other aspects of good stockmanship are 'knowledge on animal needs and farming practices' and 'know-how to take care'. A lack of procedural knowledge may be a main barrier to good practices. Many sheep farmers, for example, consider body condition scoring an important factor in nutritional management, but 37% of these same farmers do not know how to properly score (Munoz, Coleman, Hemsworth, Campbell, & Doyle, 2019). Many farmers are interested in achieving more knowledge; the majority of goat farmers participating in a survey on pain perception and treatment were highly motivated to learn more about goat disease, pain and welfare (Muri, Tufte, Skjerve, & Valle, 2012). Nowadays good quality information can be distributed more easily via the internet.

Moreover, as shown above, attitudes are antecedents to caretakers' behaviour. They are learned and changeable and, thus, training programmes and education on modifying attitudes can effectively change caretakers' handling and management behaviour. For example, cognitive behavioural intervention training effectively changes handling behaviour of caretakers by targeting underlying attitudes, which, subsequently, benefits animal welfare (dairy cows: Hemsworth, Coleman, Barnett, & Borg, 2000; beef cattle: Ceballos et al., 2018). These training programmes include providing knowledge, and challenging and changing attitudes and behaviour.

Standardised self-assessments of animal welfare by caretakers using animal-based indicators (ABI) may increase the recognition of problems and implementation of solutions, because the lack of problem awareness was an obstacle for improving the situation. Online training of caretakers in ABI-assessment was as effective as in-person training (Michaelis et al., 2022), making it easy to implement on a large scale. Farmers participating in the training rated it useful for animal management providing an animal-centred focus.

Practical training may be more beneficial, especially regarding more complex tasks and animal handling than theoretical training. For example, training caretakers to perform positive

reinforcement training with goats had higher success if performed in a practical setting of a two-day workshop as compared to learning from books only. Most trainees were confident in their own skills after the practical training, but only 13% after self-instructed learning (Meier, Theby, Gygax, Hillman, & Fischer-Tenhagen, 2023). In fact, practicing tasks and training help to consolidate theoretical knowledge and gain procedural knowledge, that improve both attitudes and behaviour.

7 Assessment of quality of care

In principle, good quality of care can be inferred from ABI of welfare. The quality of handling and the AHR can be assessed by standardised tests (cattle: Waiblinger, Menke, & Coleman, 2002; Windschnurer, Boivin, & Waiblinger, 2009; Windschnurer, Schmied, Boivin, & Waiblinger, 2008; goats: Battini, Barbieri, Waiblinger, & Mattiello, 2016; Mersmann, Schmied-Wagner, Nordmann, Graml, & Waiblinger, 2016; sheep: Napolitano, De Rosa, Girolami, Scavone, & Braghieri, 2011; horses: Dalla Costa et al., 2015; Minero et al., 2018). These tests assess the level of fear or confidence in humans and reflect the past handling experience of the animals. With regard to further aspects of quality of care, existing protocols using ABI, e.g. the WelfareQuality® for cattle or AWIN protocols for sheep, goats and equines or similar systems, can be used. However, direct observation of the different aspects of care, instead of only assessing the outcome, is pivotal to identifying potential deficiencies and taking accordant preventive measures. For this, the quality of care can be assessed by subjectively rating a catalogue of tasks: this may include whether animals are handled in a calm manner (yes/no), the current state of care of the animals and maintenance of equipment (e.g. claw trimming well done, cleaning of troughs done), the management of feeding (e.g. regular feeding times, sufficient amount, quality of feed) and of technical aspects (e.g. maintenance of facilities, immediate repair of defect equipment) and health care (e.g. sick animals treated appropriately, sick pen available and used). The more the caretakers adhere to best practice, the less welfare problems are found (Bock, Molz, & Zeeb, 1988; Menke, Waiblinger, Fölsch, & Wiepkema, 1999; Munoz, Coleman, Hemsworth, Campbell, & Doyle, 2019; Waiblinger, Schmied-Wagner, Mersmann, & Nordmann, 2011).

8 Recommendations

Concluding from this review we can make the following recommendations:

8.1 Education and training

In this review, we have identified a number of aspects that need to be considered to ensure both the quantity and quality of care. One way of achieving this is to ensure sufficient training, experience, and education regarding animal welfare and its importance to all people caring for animals. This can be achieved by compulsory training of people responsible for animals (owners, caretakers, farm managers). Such training should be provided on the following topics:

- Animal needs, behaviour, emotions and sensory capacities
- Animal welfare (including basic welfare concepts and health care)
- Animal welfare risks and hazards in intensive and extensive systems
- Animal welfare indicators

- Appropriate handling including positive interactions
- Best practices of care

Such training should impart knowledge, and focus on attitudes to enhance implementation. Besides behavioural attitudes regarding practices of care, a general understanding of animals as individuals with emotions and needs to foster empathy towards animals should build the basis of the training.

8.2 Herd size and number of animals per caretaker

There is insufficient data to make a clear recommendation regarding the maximum herd size or maximum number of animals per caretaker. The quality of care is more important than the absolute quantity of care. Yet, it is important to avoid high workloads for caretakers, to allow for sufficient contact time with the animals, sufficient time for supervising the animals, and sufficient time to perform tasks. Special attention should be given to intense periods of activity such as compact calving on dairy farms or lambing. Furthermore, it is also critical that animals are recognised as individuals and single animals are not neglected.

8.3 Frequency of inspecting the animals

In EU legislation, the frequency of inspection of the animals is set to a minimum of once a day only for calves or in cases where animal welfare *"depends on frequent human attention"*. For other systems animals *"shall be inspected at intervals sufficient to avoid any suffering"*. In line with this at least once daily inspection is necessary in all species and systems to minimise prolonged suffering of the animals in case of health problems or accidents. For specifically vulnerable animals (around giving birth, neonate) the frequency should be increased.

8.4 Good practice during animal handling and welfare monitoring

Animal handling should be conducted in a way that minimises stress and fear, and that adheres to best practice principles. This includes appropriate habituation to the facilities and caretakers and applying positive reinforcement. Farms and equine holdings should have appropriate handling facilities, to enable safe restraint of animals. Good animal care and handling practices should be monitored regularly, and systems should be put into place to adjust the quality of care when necessary. For this, regular self-evaluation of animal welfare should be compulsory; such guidelines for farmers were already developed for some species in different languages (e.g. KTBL, 2020, Care4Dairy, 2024).

We recommend that there is a legal requirement for each farm or property keeping animals to assign one person to be responsible for animal care and welfare. This person would be responsible to ensure good quality of care, that all caretakers are sufficiently educated and competent, staff supervision, animal welfare monitoring, etc. Providing good working conditions for employees and avoiding a high workload is an essential part of their responsibility.

9 Are there areas that need further investigation?

The effectiveness of training courses for caretakers as recommended above should be evaluated considering different formats of the training, e.g. e-learning, live training or blended learning.

Different levels of knowledge, i.e. conceptual and procedural knowledge, and both short-term and longer-term effects should be considered, as well as supporting a culture of continuous professional development. It would also be interesting to investigate if there is a difference between compulsory and voluntary participation.

Data are lacking on the caretaker to animal ratio. Studies should be conducted taking into account the species, type of holding, mechanisation and in the case of farming, production stage.

10 Conclusions

High quality care for animals provided by experienced and competent caretakers is essential to ensure animal welfare. This review summarises some of the evidence for the main aspects contributing to quality of care. Caretakers should be knowledgeable, and experienced. They should like working with and caring for their animals, be empathic towards animals, and acknowledge individual animals and group needs. They should have observational and technical skills, be patient and conscientious and not overloaded with work. These qualities are crucial to achieve the best possible animal welfare. The high responsibility of caretakers for animal welfare calls for professionalisation and compulsory education. At the same time, easy and quick access to relevant information regarding animal health and welfare is also important.

11 References

Ajzen, I., & Fishbein, M. (1980). Understanding attitudes and predicting social behavior. Prentice-Hall. Retrieved from https://library.wur.nl/WebQuery/titel/158317

Ajzen, Icek. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Arias, J. P., & Špinka, M. (2005). Associations of stockpersons' personalities and attitudes with performance of dairy cattle herds. Czech Journal of Animal Science, 50(5), 226–234.

Armbrecht, L., Lambertz, C., Albers, D., & Gauly, M. (2019). Assessment of welfare indicators in dairy farms offering pasture at differing levels. Animal, 13(10), 2336–2347. https://doi.org/10.1017/S1751731119000570

Battini, M., Barbieri, S., Waiblinger, S., & Mattiello, S. (2016). Validity and feasibility of Human-Animal Relationship tests for on-farm welfare assessment in dairy goats. Applied Animal Behaviour Science, 178, 32–39. https://doi.org/10.1016/j.applanim.2016.03.012

Beggs, D. S., Jongman, E. C., Hemsworth, P. H., & Fisher, A. D. (2019). The effects of herd size on the welfare of dairy cows in a pasture-based system using animal- and resource-based indicators. Journal of Dairy Science, 102(4), 3406–3420. https://doi.org/10.3168/jds.2018-14850

Bock, C., Molz, C., & Zeeb, K. (1988). Auswirkungen der Haltungstechnik und der tierhalterischen Qualifikation des Betreuungspersonal auf das Tierverhalten und die Tiergesundheit bei Milchkühen in Boxenlaufställen. KTBL-Schrift, 336, 369–378.

Boivin, X., Le Neindre, P., Chupin, J. M., Garel, J. P., & Trillat, G. (1992). Influence of breed and early management on ease of handling and open-field behaviour of cattle. Applied Animal Behaviour Science, 32(4), 313–323. https://doi.org/10.1016/S0168-1591(05)80024-3

Boivin, X., Nowak, R., Desprès, G., Tournadre, H., & Le Neindre, P. (1997). Discrimination between shepherds by lambs reared under artificial conditions. Journal of Animal Science, 75(11), 2892–2898. https://doi.org/10.2527/1997.75112892x

Boivin, X., & Braastad, B. O. (1996). Effects of handling during temporary isolation after early weaning on goat kids' later response to humans. Applied Animal Behaviour Science, 48(1–2), 61–71. https://doi.org/10.1016/0168-1591(95)01019-X

Breuer, K., Hemsworth, P. H., Barnett, J. L., Matthews, L. R., & Coleman, G. J. (2000). Behavioural response to humans and the productivity of commercial dairy cows. Applied Animal Behaviour Science, 66(4), 273–288. https://doi.org/10.1016/S0168-1591(99)00097-0

Breuer, K., Hemsworth, P. H., & Coleman, G. J. (2003). The effect of positive or negative handling on the behavioural and physiological responses of nonlactating heifers. Applied Animal Behaviour Science, 84(1), 3–22. https://doi.org/10.1016/S0168-1591(03)00146-1

Browne, N., Conneely, M., & Hudson, C. (2022). Use of non-steroidal anti-inflammatory drugs and attitudes to pain in pasture-based dairy cows: A comparative study of farmers and veterinarians. Frontiers in Veterinary Science, 9, 912564. https://doi.org/10.3389/fvets.2022.912564

Burow, E., Rousing, T., Thomsen, P. T., Otten, N. D., & Sørensen, J. T. (2013). Effect of grazing on the cow welfare of dairy herds evaluated by a multidimensional welfare index. Animal, 7(5), 834–842. https://doi.org/10.1017/S1751731112002297

Burton, R. J. F., Peoples, S., & Cooper, M. H. (2012). Building 'cowshed cultures': A cultural perspective on the promotion of stockmanship and animal welfare on dairy farms. Journal of Rural Studies, 28(2), 174–187. https://doi.org/10.1016/j.jrurstud.2011.12.003

Calderón-Amor, J., Beaver, A., von Keyserlingk, M. A. G., & Gallo, C. (2020). Calf- and herd-level factors associated with dairy calf reactivity. Journal of Dairy Science, 103(5), 4606–4617. https://doi.org/10.3168/jds.2019-16878

CARE4DAIRY. (2024). CARE4DAIRY self-assessment. https://care-for-dairy-ad27b8fba8c5.herokuapp.com/survey-intro

Ceballos, M. C., Sant'Anna, A. C., Boivin, X., Costa, F. de O., Carvalhal, M. V. de L., & Paranhos da Costa, M. J. R. (2018). Impact of good practices of handling training on beef cattle welfare and stockpeople attitudes and behaviors. Livestock Science, 216, 24–31. https://doi.org/10.1016/j.livsci.2018.06.019

Chesterton, R. N., Pfeiffer, D. U., Morris, R. S., & Tanner, C. M. (1989). Environmental and behavioural factors affecting the prevalence of foot lameness in New Zealand dairy herds—A case-control study. New Zealand Veterinary Journal, 37(4), 135–142. https://doi.org/10.1080/00480169.1989.35587

Dalla Costa, E., Dai, F., Murray, L. A. M., Guazzetti, S., Canali, E., & Minero, M. (2015). A study on validity and reliability of on-farm tests to measure human–animal relationship in horses and donkeys. Applied Animal Behaviour Science, 163, 110–121. https://doi.org/10.1016/j.applanim.2014.12.007

de Boyer des Roches, A., Veissier, I., Boivin, X., Gilot-Fromont, E., & Mounier, L. (2016). A prospective exploration of farm, farmer, and animal characteristics in human-animal relationships: An epidemiological survey. Journal of Dairy Science, 99(7), 5573–5585. https://doi.org/10.3168/jds.2015-10633

de Boyer des Roches, A., Veissier, I., Coignard, M., Bareille, N., Guatteo, R., Capdeville, J., … Mounier, L. (2014). The major welfare problems of dairy cows in French commercial farms: An epidemiological approach. Animal Welfare, 23(4), 467–478. https://doi.org/10.7120/09627286.23.4.467

de Oliveira, D., & Boivin, X. (2024). Review—Relational enrichment in ruminants and equines. EURCAW Ruminants & Equines. https://doi.org/10.5281/zenodo.7687803

Destrez, A., Coulon, M., Deiss, V., Delval, E., Boissy, A., & Boivin, X. (2013). The valence of the long-lasting emotional experiences with various handlers modulates discrimination and generalization of individual humans in sheep1. Journal of Animal Science, 91(11), 5418–5426. https://doi.org/10.2527/jas.2012-5654

Destrez, A., Haslin, E., Elluin, G., Gaillard, C., Hostiou, N., Dasse, F., … Boivin, X. (2018). Evaluation of beef herd responses to unfamiliar humans and potential influencing factors: An exploratory survey on French farms. Livestock Science, 212, 7–13. https://doi.org/10.1016/j.livsci.2018.03.011

Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. Annual Review of Psychology, 41, 417–440. https://doi.org/10.1146/annurev.ps.41.020190.002221

Donovan, J., & Adams, C. J. (1996). Beyond animal rights: A feminist caring ethic for the treatment of animals. Retrieved from https://philpapers.org/rec/DONBAR

Ebinghaus, A., Ivemeyer, S., & Knierim, U. (2018). Human and farm influences on dairy cows´ responsiveness towards humans – a cross-sectional study. PLOS ONE, 13(12), e0209817. https://doi.org/10.1371/journal.pone.0209817

EFSA Panel on Animal Health and Welfare (AHAW), Nielsen, S. S., Alvarez, J., Bicout, D. J., Calistri, P., Canali, E., … Michel, V. (2021). Welfare of sheep and goats at slaughter. EFSA Journal, 19(11), e06882. https://doi.org/10.2903/j.efsa.2021.6882

Farm Animal Welfare Council. (2007). FAWC report on stockmanship and farm animal welfare: June 2007. Farm Animal Welfare Council.

Gieseke, D., Lambertz, C., & Gauly, M. (2018). Relationship between herd size and measures of animal welfare on dairy cattle farms with freestall housing in Germany. Journal of Dairy Science, 101(8), 7397–7411. https://doi.org/10.3168/jds.2017-14232

Ginane, C., & Rørvang, M. V. (2023). Review—Sensory and feeding enrichment in ruminants and equines. EURCAW Ruminants & Equines. https://doi.org/10.5281/zenodo.7687769

Grandin, T. (2017). Livestock-handling assessments to improve the welfare of cattle, pigs and sheep. Animal Production Science, 58(3), 403–407. https://doi.org/10.1071/AN16800

Hall, S. J. G., Kirkpatrick, S. M., & Broom, D. M. (1998). Behavioural and physiological responses of sheep of different breeds to supplementary feeding, social mixing and taming, in the context of transport. Animal Science, 67(3), 475–483. https://doi.org/10.1017/S1357729800032896

Hanna, D., Sneddon, I. A., & Beattie, V. E. (2009). The relationship between the stockperson's personality and attitudes and the productivity of dairy cows. Animal, 3(5), 737–743. https://doi.org/10.1017/S1751731109003991

Hargreaves, A. L., & Hutson, G. D. (1990). Some effects of repeated handling on stress responses in sheep. Applied Animal Behaviour Science, 26(3), 253–265. https://doi.org/10.1016/0168-1591(90)90141-Y

Hausberger, M., Roche, H., Henry, S., & Visser, E. K. (2008). A review of the human–horse relationship. Applied Animal Behaviour Science, 109(1), 1–24. https://doi.org/10.1016/j.applanim.2007.04.015

Hemsworth, L. M., Jongman, E., & Coleman, G. J. (2015). Recreational horse welfare: The relationships between recreational horse owner attributes and recreational horse welfare. Applied Animal Behaviour Science, 165, 1–16. https://doi.org/10.1016/j.applanim.2014.11.019

Hemsworth, P. H., Coleman, G. J., Barnett, J. L., & Borg, S. (2000). Relationships between human-animal interactions and productivity of commercial dairy cows. Journal of Animal Science, 78(11), 2821–2831. https://doi.org/10.2527/2000.78112821x

Hemsworth, P. H., & Coleman, G. J. (2010). Human-livestock interactions: The stockperson and the productivity of intensively farmed animals (2dn ed.). CAB International.

Hemsworth, P. H., Coleman, G. J., Barnett, J. L., Borg, S., & Dowling, S. (2002). The effects of cognitive behavioral intervention on the attitude and behavior of stockpersons and the behavior and productivity of commercial dairy cows. Journal of Animal Science, 80(1), 68–78.

Hufe, P., Felgentreu, C., Wöckel, A., Wippermann, W., Waurich, B., Schneider, F., … Schären-Bannert, M. (2022). Analysis of daily activities of herd managers and interrelations with the animal production and health situation on dairy farms in eastern Germany. Presented at the World Buiatrics Congress. Retrieved from https://www.openagrar.de/receive/openagrar_mods_00081985

Ivemeyer, S., Knierim, U., & Waiblinger, S. (2011). Effect of human-animal relationship and management on udder health in Swiss dairy herds. Journal of Dairy Science, 94(12), 5890–5902. https://doi.org/10.3168/jds.2010-4048

Ivemeyer, S., Simantke, C., Ebinghaus, A., Poulsen, P. H., Sorensen, J. T., Rousing, T., … Knierim, U. (2018). Herd-level associations between human–animal relationship, management, fecal cortisol metabolites, and udder health of organic dairy cows. Journal of Dairy Science, 101(8), 7361–7374. https://doi.org/10.3168/jds.2017-13912

Kielland, C., Skjerve, E., Østerås, O., & Zanella, A. J. (2010). Dairy farmer attitudes and empathy toward animals are associated with animal welfare indicators. Journal of Dairy Science, 93(7), 2998–3006. https://doi.org/10.3168/jds.2009-2899

Kılıç, İ., & Bozkurt, Z. (2013). The relationship between farmers' perceptions and animal welfare standards in sheep farms. Asian-Australasian Journal of Animal Sciences, 26(9), 1329–1338. https://doi.org/10.5713/ajas.2013.13124

KTBL (2020) Tierschutzindikatoren: Leitfaden für die Praxis – Rind, ISBN 978-3-945088-75-3 https://www.ktbl.de/shop/produktkatalog/alle-kategorien/12630/

Lansade, L., Bertrand, M., Boivin, X., & Bouissou, M.-F. (2004). Effects of handling at weaning on manageability and reactivity of foals. Applied Animal Behaviour Science, 87(1), 131–149. https://doi.org/10.1016/j.applanim.2003.12.011

Le Neindre, P., Boivin, X., & Boissy, A. (1996). Handling of extensively kept animals. Applied Animal Behaviour Science, 49(1), 73–81. https://doi.org/10.1016/0168-1591(95)00669-9

Leach, K. A., Whay, H. R., Maggs, C. M., Barker, Z. E., Paul, E. S., Bell, A. K., & Main, D. C. J. (2010). Working towards a reduction in cattle lameness: 2. Understanding dairy farmers' motivations. Research in Veterinary Science, 89(2), 318–323. https://doi.org/10.1016/j.rvsc.2010.02.017

Lensink, B. J., Boissy, A., & Veissier, I. (2000). The relationship between farmers' attitude and behaviour towards calves, and productivity of veal units. Annales de Zootechnie, 49(4), 313–327. https://doi.org/10.1051/animres:2000122

Lensink, B. J., Fernandez, X., Boivin, X., Pradel, P., Le Neindre, P., & Veissier, I. (2000). The impact of gentle contacts on ease of handling, welfare, and growth of calves and on quality of veal meat. Journal of Animal Science, 78(5), 1219–1226. https://doi.org/10.2527/2000.7851219x

Lensink, B. J., Veissier, I., & Florand, L. (2001). The farmers' influence on calves' behaviour, health and production of a veal unit. Animal Science, 72(1), 105–116. https://doi.org/10.1017/S1357729800055600

Leruste, H., Bokkers, E. A. M., Heutinck, L. F. M., Wolthuis-Fillerup, M., van der Werf, J. T. N., Brscic, M., … Lensink, B. J. (2012). Evaluation of on-farm veal calves' responses to unfamiliar humans and potential influencing factors. Animal, 6(12), 2003–2010. https://doi.org/10.1017/S1751731112001346

Lewis, N. J., & Hurnik, J. F. (1998). The effect of some common management practices on the ease of handling of dairy cows. Applied Animal Behaviour Science, 58(3), 213–220. https://doi.org/10.1016/S0168-1591(97)00150-0

Liu, N., Kaler, J., Ferguson, E., O'Kane, H., & Green, L. E. (2018). Sheep farmers' attitudes to farm inspections and the role of sanctions and rewards as motivation to reduce the prevalence of lameness. Animal Welfare, 27(1), 67–79. https://doi.org/10.7120/09627286.27.1.067

Luna, D., Vásquez, R. A., & Tadich, T. (2019). Exploring the relationship between socio-demographic background and empathy toward nonhuman animals in working horse caretakers. Society & Animals, 29(5–6), 539–558. https://doi.org/10.1163/15685306-12341607

Lürzel, S., Windschnurer, I., Futschik, A., & Waiblinger, S. (2016). Gentle interactions decrease the fear of humans in dairy heifers independently of early experience of stroking. Applied Animal Behaviour Science, 178, 16–22. https://doi.org/10.1016/j.applanim.2016.02.012

Markowitz, T. M., Dally, M. R., Gursky, K., & Price, E. O. (1998). Early handling increases lamb affinity for humans. Animal Behaviour, 55(3), 573–587. https://doi.org/10.1006/anbe.1997.0640

Mazurek, M., Prendiville, D. J., Crowe, M. A., Veissier, I., & Earley, B. (2010). An on-farm investigation of beef suckler herds using an animal welfare index (AWI). BMC Veterinary Research, 6(1), 55. https://doi.org/10.1186/1746-6148-6-55

Meier, J., Theby, V., Gygax, L., Hillman, E., & Fischer-Tenhagen, C. (2023). Why workshops work: Examining the efficacy of training trainers to train goats. Animal Welfare, 32, e76. https://doi.org/10.1017/awf.2023.94

Menke, C., Waiblinger, S., Fölsch, D. W., & Wiepkema, P. R. (1999). Social behaviour and injuries of horned cows in loose housing systems. Animal Welfare, 8(3), 243–258. https://doi.org/10.1017/S0962728600021734

Mersmann, D., Schmied-Wagner, C., Nordmann, E., Graml, C., & Waiblinger, S. (2016). Influences on the avoidance and approach behaviour of dairy goats towards an unfamiliar human—An on-farm study. Applied Animal Behaviour Science, 179, 60–73. https://doi.org/10.1016/j.applanim.2016.02.009

Mersmann, D., Schmied-Wagner, C., & Waiblinger, S. (2022). The relationships between attitudes, personal characteristics and behaviour of stockpeople on dairy goat farms. Animal Welfare, 31(4), 529–544. https://doi.org/10.7120/09627286.31.4.003

Michaelis, S., Schubbert, A., Gieseke, D., Cimer, K., Zapf, R., Lühken, S., … Knierim, U. (2022). A comparison of online and live training of livestock farmers for an on-farm self-assessment of animal welfare. Frontiers in Animal Science, 3. https://doi.org/10.3389/fanim.2022.915708

Minero, M., Dalla Costa, E., Dai, F., Canali, E., Barbieri, S., Zanella, A., … Wemelsfelder, F. (2018). Using qualitative behaviour assessment (QBA) to explore the emotional state of horses and its association with human-animal relationship. Applied Animal Behaviour Science, 204, 53–59. https://doi.org/10.1016/j.applanim.2018.04.008

Morgan-Davies, C., Waterhouse, A., Milne, C. E., & Stott, A. W. (2006). Farmers' opinions on welfare, health and production practices in extensive hill sheep flocks in Great Britain. Livestock Science, 104(3), 268–277. https://doi.org/10.1016/j.livsci.2006.04.024

Munoz, C. A., Coleman, G. J., Hemsworth, P. H., Campbell, A. J. D., & Doyle, R. E. (2019). Positive attitudes, positive outcomes: The relationship between farmer attitudes, management behaviour and sheep welfare. PLOS ONE, 14(7), e0220455. https://doi.org/10.1371/journal.pone.0220455

Muri, K., Tufte, P. A., Skjerve, E., & Valle, P. S. (2012). Human-animal relationships in the Norwegian dairy goat industry: Attitudes and empathy towards goats (Part I). Animal Welfare, 21(4), 535–545. https://doi.org/10.7120/09627286.21.4.535

Napolitano, F., De Rosa, G., Girolami, A., Scavone, M., & Braghieri, A. (2011). Avoidance distance in sheep: Test–retest reliability and relationship with stockmen attitude. Small Ruminant Research, 99(2), 81–86. https://doi.org/10.1016/j.smallrumres.2011.03.044

O'Kane, H., Ferguson, E., Kaler, J., & Green, L. (2017). Associations between sheep farmer attitudes, beliefs, emotions and personality, and their barriers to uptake of best practice: The example of footrot. Preventive Veterinary Medicine, 139, 123–133. https://doi.org/10.1016/j.prevetmed.2016.05.009

Paul, E. S. (2000). Empathy with animals and with humans: Are they linked? Anthrozoös, 13(4), 194–202. https://doi.org/10.2752/089279300786999699

Pinchbeck, G. L., Clegg, P. D., Proudman, C. J., Morgan, K. L., & French, N. P. (2004). Whip use and race progress are associated with horse falls in hurdle and steeplechase racing in the UK. Equine Veterinary Journal, 36(5), 384–389. https://doi.org/10.2746/0425164044868387

Pollard, J. C., & Littlejohn, R. P. (1994). Behavioural effects of light conditions on red deer in a holding pen. Applied Animal Behaviour Science, 41(1), 127–134. https://doi.org/10.1016/0168-1591(94)90057-4

Rault, J.-L., Waiblinger, S., Boivin, X., & Hemsworth, P. (2020). The Power of a Positive Human–Animal Relationship for Animal Welfare. Frontiers in Veterinary Science, 7. https://doi.org/10.3389/fvets.2020.590867

Rennie, L. J., Bowell, V. A., Dearing, J. M., Haskell, M. J., & Lawrence, A. B. (2003). A study of three methods used to assess stockmanship on commercial dairy farms: Can these become effective welfare assessment techniques? Animal Welfare, 12(4), 591–597. https://doi.org/10.1017/S0962728600026233

Rushen, J. (1986). Aversion of sheep for handling treatments: Paired-choice studies. Applied Animal Behaviour Science, 16(4), 363–370. https://doi.org/10.1016/0168-1591(86)90008-0

Rushen, J., De Passille, A. M. B., & Munksgaard, L. (1999). Fear of people by cows and effects on milk yield, behavior, and heart rate at milking. Journal of Dairy Science, 82(4), 720–727. https://doi.org/10.3168/jds.S0022-0302(99)75289-6

Rushen, J., & de Passillé, M. (2021). The importance of good stockmanship and its benefits to animals. In CABI Books. Improving animal welfare: A practical approach (pp. 145–159). https://doi.org/10.1079/9781789245219.0145

Schlichting, M. C. (1974). Untersuchungen über die Fähigkeiten des Betreuungspersonals in der Milchviehhaltung und dessen Einfluss auf die Milchleistung. KTBL-Schrift, Göttingen.

Seabrook, M. F. (1972). A study to determine the influence of the herdsman's personality on milk yield. Journal of Agricultural Labour Science, 45–49.

Seabrook, M. F. (1984). The psychological interaction between the stockman and his animals and its influence on performance of pigs and dairy cows. The Veterinary Record, 115(4), 84–87. https://doi.org/10.1136/vr.115.4.84

Seabrook, M.F. (2001). The effect of the operational environment and operating protocols on the attitudes and behaviour of employes stockpersons, In: Hovi, M., Bouilhol, M. (Eds.), Human-animal relationship: stockmanship and housing in organic livestock systems. Proceedings of the 3rd Workshop of the Network for Animal Health and Welfare in Organic Agriculture (NAHWOA). Clermont-Ferrand 21.-24. Oktober 2000, University of Reading, pp. 23-32. http://www.veeru.reading.ac.uk/organic/ProceedingsFINAL.pdf

Spigarelli, C., Berton, M., Corazzin, M., Gallo, L., Pinterits, S., Ramanzin, M., … Bovolenta, S. (2021). Animal welfare and farmers' satisfaction in small-scale dairy farms in the Eastern Alps: A "One Welfare" approach. Frontiers in Veterinary Science, 8. https://doi.org/10.3389/fvets.2021.741497

Ujita, A., Seekford, Z., Kott, M., Goncherenko, G., Dias, N. W., Feuerbacher, E., … Mercadante, V. R. G. (2021). Habituation protocols improve behavioral and physiological responses of beef cattle exposed to students in an animal handling class. Animals, 11(8), 2159. https://doi.org/10.3390/ani11082159

Vigors, B., Wemelsfelder, F., & Lawrence, A. B. (2023). What symbolises a "good farmer" when it comes to farm animal welfare? Journal of Rural Studies, 98, 159–170. https://doi.org/10.1016/j.jrurstud.2023.01.009

Waiblinger, S. (1996). Die Mensch-Tier-Beziehung bei der Laufstallhaltung von behornten Milchkühen. [The human-animal relationship on farms keeping horned dairy cows in loose housing systems]. Tierhaltung Bd. 24, Ökologie Ethologie Gesundheit, Universität/Gesamthochschule Kassel, pp 129.

Waiblinger, S. (2018). Agricultural Animals. In: Hosey, G.; Melfi, V.: Anthrozoology: human–animal interactions in domesticated and wild animals. Oxford University Press, Oxford, 32-58. (Oxford, 2018; online edn, Oxford Academic, 21 Feb. 2019) DOI: 10.1093/oso/9780198753629.003.0003

Waiblinger, S., Baars, T., & Menke, C. (2000). Understanding the cow-the central role of human-animal relationship in keeping horned dairy cows in loose housing. Proceedings of the 3rd Workshop of the NAHWOA. Clermont-Ferrand, France. Retrieved from https://pure.au.dk/ws/files/1484065/NAHWOA-3rd-ProceedingsFINAL.pdf#page=68

Waiblinger, S., & Lürzel, S. (2023). The human-animal relationship and cattle welfare. In M. Haskell (Ed.), Cattle Welfare in Dairy and Beef Systems: A New Approach to Global Issues (pp. 225–263). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-21020-4_9

Waiblinger, S., & Menke, C. (1999). Influence of herd size on human—Cow relationships. Anthrozoös, 12(4), 240–247. https://doi.org/10.2752/089279399787000156

Waiblinger, S., Menke, C., & Coleman, G. (2002). The relationship between attitudes, personal characteristics and behaviour of stockpeople and subsequent behaviour and production of dairy cows. Applied Animal Behaviour Science, 79(3), 195–219. https://doi.org/10.1016/S0168-1591(02)00155-7

Waiblinger, S., Menke, C., & Coleman, G. (2003). Human-Animal Interactions During Milking-Influencing Factors and Effects on Behaviour and Milk Yield of Dairy Cows. KTBL SCHRIFT, 125–133.

Waiblinger, S, Menke, C., & Fölsch, D. W. (2003). Influences on the avoidance and approach behaviour of dairy cows towards humans on 35 farms. Applied Animal Behaviour Science, 84(1), 23–39. https://doi.org/10.1016/S0168-1591(03)00148-5

Waiblinger, S., Menke, C., Korff, J., & Bucher, A. (2004). Previous handling and gentle interactions affect behaviour and heart rate of dairy cows during a veterinary procedure. Applied Animal Behaviour Science, 85(1), 31–42. https://doi.org/10.1016/j.applanim.2003.07.002

Waiblinger, S., Mülleder, C., Menke, C., & Coleman, G. (2006). How do farmers' attitudes impact on animal welfare? The relationship of attitudes to housing design and management on dairy cow farms. Proceedings of the Importance of Attitudes, Values, and Economics to the Welfare and Conservation of Animals, 55–56.

Waiblinger, S., Schmied-Wagner, C., Mersmann, D., & Nordmann, E. (2011). Social behaviour and injuries in horned and hornless dairy goats. Retrieved from https://www.cabidigitallibrary.org/doi/full/10.5555/20113295892

Waiblinger, S., & Spoolder, H. (2007). Quality of stockpersonship. In On farm monitoring of pig welfare (pp. 159–166). Wageningen Academic. Retrieved from https://brill.com/downloadpdf/edcollchap/book/9789086865918/BP000026.pdf

Waiblinger, S., Boivin, X., Pedersen, V., Tosi, M.-V., Janczak, A. M., Visser, E. K., & Jones, R. B. (2006). Assessing the human–animal relationship in farmed species: A critical review. Applied Animal Behaviour Science, 101(3–4), 185–242. https://doi.org/10.1016/j.applanim.2006.02.001

Wikman, I., Hokkanen, A.-H., Pastell, M., Kauppinen, T., Valros, A., & Hänninen, L. (2016). Attitudes of beef producers to disbudding and perception of pain in cattle. Animal Welfare, 25(4), 429–438. https://doi.org/10.7120/09627286.25.4.429

Wildridge, A. M., Thomson, P. C., Garcia, S. C., Jongman, E. C., & Kerrisk, K. L. (2020). Transitioning from conventional to automatic milking: Effects on the human-animal relationship. Journal of Dairy Science, 103(2), 1608–1619. https://doi.org/10.3168/jds.2019-16658

Windschnurer, I., Boivin, X., & Waiblinger, S. (2009). Reliability of an avoidance distance test for the assessment of animals' responsiveness to humans and a preliminary investigation of its association with farmers' attitudes on bull fattening farms. Applied Animal Behaviour Science, 117(3), 117–127. https://doi.org/10.1016/j.applanim.2008.12.013

Windschnurer, I., Eibl, C., Franz, S., Gilhofer, E. M., & Waiblinger, S. (2020). Alpaca and llama behaviour during handling and its associations with caretaker attitudes and human-animal contact. Applied Animal Behaviour Science, 226, 104989. https://doi.org/10.1016/j.applanim.2020.104989

Windschnurer, I., Fischer, L., Yanagida, T., Eibl, C., Franz, S., & Waiblinger, S. (2021). Caretaker attitudes and animal training are associated with alpaca behaviour towards humans—An online survey. Applied Animal Behaviour Science, 236, 105224. https://doi.org/10.1016/j.applanim.2021.105224

Windschnurer, I., Schmied, C., Boivin, X., & Waiblinger, S. (2008). Reliability and inter-test relationship of tests for on-farm assessment of dairy cows' relationship to humans. Applied Animal Behaviour Science, 114(1), 37–53. https://doi.org/10.1016/j.applanim.2008.01.017

12 Annex

Table 1: Summary of the aspects of quality and quantity of care and influencing factors reported in the literature and their effects on animal welfare. Studies identified either positive (=beneficial) associations or effects on welfare (+); both positive and negative associations or effects on welfare (+/-); negative associations or effects on welfare (-) or no associations or effects (=). Results come from either an on farm epidemiological study or studies (On), experimental study (Exp), a survey (Sur), or a review (Rev).

	Aspect of quality and quantity of care or influencing factors	Linked outcomes of animal welfare	Cattle – dairy	Cattle - beef	Cattle - calves	Sheep	Goat	Other (Species)
Quantitative aspects of care	Lower number of animals per caretaker	Body and hair condition				**On +**		
		Animal-human relationship			**On +**			
	Lower absolute number of caretakers/milkers	Animal-human relationship	**On +**		**On +/-**		**On +**	
		Social affiliative interactions	**On +**					
		Social agonistic interactions					**On +**	
		Injuries					**On +**	
		Production	**On +**					
	Smaller herd size	Health (other than lameness)	**On +**		**On -**	**On -**		
		Lameness	**On +**			**On +**		
		Animal-human relationship	**On +**		**On +**			
		Social agonistic interaction	**On -**					
		Body condition score	**On -**			**On -**		
		Global welfare score	**On +**					
	Higher consistency of caretakers	Animal-human relationship	**On +**				**On -**	
		(Udder) Health	**On +**					
		Social agonistic interactions	**On +**					
	Additional job	Animal-human relationship			**On +**			
	Longer working time in contact[1] to animals	Social agonistic interactions					**On +**	
		Animal-human relationship	**On +**					
		Injuries					**On +**	
		Udder health	**On +**					
		Physiological stress/Cortisol	**On +**					

Qualitative aspects of care	Better ability to identify individual animals	Animal-human relationship	**On +**					
		Social affiliative interactions	**On +**					
		Social agonistic interactions	**On +**					
	More positive (tactile) interactions / contact / training / patient handling or less negative interactions	Animal-human relationship	**On +**		**On +**	**On +**		
		Social affiliative interactions	**On +**					
		Ease of handling	**On +**		**On +**	**On +**		**On +** (NWCamelids[2])
		Physiological stress responses	**On +**	**On +**	**On +**	**On +/-**		
		Good health / immune response / lower mortality	**On +**		**On +**	**On +**		
		Reproduction	**On +**					
		Productivity	**On +**		**On +**			
		Restlessness	**On +**					
	Habituation to procedures	Stress response				**=**		
	Higher frequency of manual feeding	Animal-human relationship	**On +**				**On +**	
	Better problem recognition / solving / awareness	Social agonistic behaviour	**On +**				**On +**	
		Injuries	**On +**				**On +**	
	Cleaning / adding litter	Animal-human relationship	**On +**					
	Active management style (following recommendations)	Health				**On +**		
Influencing factors	Training (online or live)	Animal-human relationship	**On +**		**On +**			
		Production	**On +**					
	More knowledge on animal needs / management	Global welfare score						**Rev +** (Horse)
	Higher education	Global welfare score						**Rev +** (Horse)
	Higher "job" satisfaction	Animal-human relationship			**On+**			
		Production	**On +**					
		Global welfare score	**On+**					
	More positive and/or less negative attitudes towards animals & towards interactions	Production	**Sur+**					
			On+					
		Animal-human relationship	**On+**	**On+**	**On+**		**On+**	
		Ease of and low stress during handling						**On +**

	or towards animal welfare or best care practices							**Sur +** (NW-Camelids)
		Health	**On+**		**On+**	**On +** **Sur +**		
		Global welfare score	**On +**	**On +**				
	Higher empathy	Production	**On+** **Sur+**					
		Health - lesions	**On+**					
	Gender (female caretaker)	Animal-human relationship			**On+**			
	Age (older caretakers)	Health	**On+**					
	Longer experience	Animal-human relationship	**On+**		**On+**			

[1] contact here refers to the situation that the person is in the barn / the same room as the animals and thus may or may not interact with the animals
[2] New World Camelids

About EURCAW *Ruminants & Equines*

EURCAW *Ruminants & Equines* is the third European Union Reference Centre for Animal Welfare. It focuses on ruminant and equine welfare and legislation, and covers the entire life cycle from birth to the end of life. EURCAW *Ruminants & Equines*' main objective is a harmonised compliance with EU legislation regarding welfare in EU Member States. This includes:

- Directive 98/58/EC concerning the protection of animals kept on farms;
- Regulations 1/2005/EC and 1099/2009/EC concerning their protection during transport and slaughter;
- Directive 2010/63/EU concerning the protection of animals used for scientific purposes;
- Directive 2008/119/EC laying down minimum standards for the protection of calves.

EURCAW *Ruminants & Equines* supports:

- Inspectors of Competent Authorities (CAs);
- Ruminant and equine welfare policy workers;
- Bodies supporting CAs with scientific expertise, training, and communication.

Website and contact

EURCAW *Ruminants & Equines*' website offers relevant and actual information to support enforcement of ruminant and equine welfare legislation.

We offer a 'Questions to EURCAW' service for official inspectors, policy workers, and other personnel providing advice or support for official controls of ruminant and equine welfare in the EU. For more information go to https://www.eurcaw-ruminants-equines.eu/questions-to-eurcaw/.

Activities of EURCAW *Ruminants & Equines*

- Coordinated Assistance
  Providing support, networking and Questions to EURCAW;
- Welfare indicators, Assessment & Best Practice
  Identifying animal welfare indicators, including animal based, management based and resource-based indicators, that can be used to verify compliance with the EU legislation;
- Scientific and technical studies
  Preparing Scientific Reviews of knowledge on welfare topics and identify research needs;
- Training
  Developing training materials and training standards for official inspectors;
- Communication and Dissemination
  Increasing awareness of our outputs via the website, twitter, and newsletter;

Partners

EURCAW *Ruminants & Equines* receives funding from DG SANTE of the European Commission and represents a collaboration between the following six partner institutions:

- Swedish University of Agricultural Sciences, Sweden
- Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "G. Caporale", Italy
- French National Institute for Agriculture, Food, and Environment, France
- University of Natural Resources and Life Sciences, Vienna, Austria
- University College Dublin, Ireland
- Ellinikos Georgikos Organismos-Dimitra/Veterinary Research Institute, Greece