APPENDIX 24

Study on the improved methods for animal-friendly production, in particular on alternatives to the castration of pigs and on alternatives to the dehorning of cattle

D.2.3.1. Report on practical recommendations at farm level for keeping horned cattle and on the use of genetic solutions

SP2: Alternatives to dehorning: To develop and promote alternatives to the dehorning of cattle.

WP2.3: Short and long term strategies for future development.

Due date of deliverable: September 09

Actual submission date: November 09

Final

S. Waiblinger, C. Menke

University of Veterinary Medicine Vienna, Austria

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1 General Part - Further development of alternatives to dehorning

The two different alternatives to dehorning in cattle - the keeping of horned cattle and the breeding for polled cattle - were reviewed in WP 2.2 with respect to their possible drawbacks and advantages. They represent two different approaches to deal with horns already being applied by farmers and being based on different attitudes towards horns and – at least partly – towards the role of the farmer and stockperson (see also 2.1.2.). One approach is to accept horns as part of cattle's nature with which one has to deal with by adapting the environment to the animals. The second approach regards horns as too problematic and uses methods to get rid of them. This can be done by dehorning or by breeding for polled cattle, i.e. taking advantage of a natural genetic variation. Thus, this approach accepts to trim or adapt by selecting the animals to the environment and the requirements of humans (see 2.1.2.). Further developments of alternatives to dehorning need to consider these underlying attitudes and ethical reasoning. Ethical considerations and attitudes of consumers also play a role when implementing alternatives to dehorning with regard to acceptability of products and farming practices in general or for product labelling.

With regard to both alternatives, further steps, which are necessary to reduce drawbacks and possibly increase their advantages to advance and implement these alternatives, will be discussed separately. However, both are also interrelated, e.g., a reduction of disadvantages when keeping horned animals might not only change attitudes towards this husbandry practice but also attitudes towards breeding for polledness, and vice versa. These interrelations and possible combination of strategies will be shortly discussed at the end.

1.1 Keeping horned cattle

First the drawbacks and advantages are discussed with respect to possible solutions. In 1.1.3. the necessary actions are listed and described in more detail.

1.1.1 Reduce drawbacks of keeping horned cattle:

The main perceived or actually experienced disadvantages and problems of renouncing to dehorn and thus keeping horned cattle (see 2.1.2. and 2.2.1.) relate to

- animal welfare
- human safety
- economic disadvantages:
    - higher investment costs and workload when keeping horned cattle
    - potential loss of subsidies when constructing a welfare-friendly spacious barn
    - milk loss due to injuries of the udder, loss of animals due to severe injuries
    - lower price for horned breeding cattle up to inaccessibility of some markets for horned breeding cattle

Animal welfare and human safety

Both, animal welfare and human safety are related to on farm conditions (housing, management, human-animal interactions). By optimizing these conditions animal welfare and human safety risks can be largely minimized, as shown by the studies mentioned in 2.2.1. Further, economic losses due to injuries of the udder should get marginal.

The main actions to overcome these drawbacks are therefore to enable and further such optimization of conditions. Farmers and other professionals working with cattle (agricultural advisors, companies for construction of cattle housing and equipment, veterinarians) should be provided with easily accessible information, advisory tools, and courses on factors that are important for keeping horned animals successfully. This also should take the important role of a positive attitude towards keeping horned animals into account. The recommendations given below as part of this deliverable D 2.3.1 describe the most relevant factors identified so far. More details about means of distribution of such knowledge see under 1.3.

Although the recommendations reflect the current knowledge and practical experience, i.e. keeping horned cattle was found to be successful through their implementation, further research is necessary. The first limitation is that research and recommendations exist mainly/only for dairy cows in loose housing systems. No specific research has been carried out on the keeping of horned young stock or beef suckler herds, Nevertheless, many beef suckler herds are with horned animals and thus practical experience exist.. Further, recommended dimension for cattle housing are hardly based on research results and looking into effects of changing dimensions could base recommendations on a sounder basis. Further, to be able to set minimum standards more data should be available. Moreover, management practices to minimise social stress need to be further developed.
As well, the possible positive effects of horns for cattle with respect to social behaviour and stress or health need to be investigated for an objective debate. The same holds true for aspects such as social stress and risks of traumas in dehorned / polled cattle. This will allow for basing the decisions about keeping horned cattle as compared to keeping of polled cattle on scientific results.

Related to the aspect of human safety are accident insurances that sometimes try to dictate dehorning to be performed. For example in Germany, farmers being members of the insurance had to fight for this right in court for several times, and court decisions clearly supported this right. Clearly, farmers need to have the right of decision.

Economic disadvantages

The implementation of the above mentioned recommendation (see Part 2 of this deliverable) regarding environmental conditions to overcome problems with animal welfare is, at the moment, related to economic disadvantages.

First, optimization of housing as well as management conditions requires more spacious housing and more careful management. It can be argued that husbandry of dehorned animals enabling high welfare differs only little from the conditions recommended for horned animals. Yet, the impact of deficiencies on cattle welfare can be much more dramatic in horned animals, also including losses to the farmer. The negative impact of keeping dehorned animals under deficient conditions (with respect to social stress) is generally less visible, e.g. bruising may happen without being recognized.

The situation can be even worse when farmers, who want to construct a barn with ample space allowance (e.g. more cubicles than cows), do not get subsidies, which they would get with less spacious and thus less

welfare friendly design. If farmers rely on such subsidies, they may even decide to dehorn against their primary wish when they feel conditions too risky for horned cattle.

Second, since keeping horned cattle is not widespread, the disadvantages when selling or willing to sell (breeding) animals may cause substantial losses in income especially for breeders of dairy animals, but may also occur in fattening animals. Horned dairy cows get much lower prices at least in some markets compared with hornless/dehorned animals of the same breeding value (e.g. in Southern Germany, http://www.lfl.bayern.de/itz/rind/08035/). In Austria some regional breeder organisations even dictate dehorning of breeding animals when animals are to be sold at auctions (e.g., Styria since 2000). In contrast, in some breeds or conditions horned cattle get better prices .

To overcome these economic disadvantages, appropriate actions seem necessary when trying to convey the keeping of horned cattle in that financial support or compensation for higher costs is provided to farmers by way of subsidies or label products. Definitely, disadvantages when constructing welfare friendly housing need to be prevented.

1.1.2 Increase advantages of keeping horned cattle:

Main advantages mentioned relate to

- animal welfare: more welfare-friendly husbandry (spacious, housing and management adapted according to animal needs and allowing for natural behaviour)
- ethical (integrity of the animal respected, no adaptation or trimming animals to the need of the human)

Successfully keeping horned cattle may thus get higher acceptance by consumers as a way of keeping cattle according to their needs and respecting their integrity. This may enhance accessibility to label products (DEMETER explicitly prohibits dehorning since several years). This may also justify special subsidies for farmers keeping horned animals (see above and below).
Moreover, farmers may have higher job satisfaction and self-esteem if they are able to successfully practice this husbandry.

As already mentioned further research is needed regarding possible positive effect of horns on social behaviour and stress, and cow health to enable more objective discussion and informed decisions.

Further, there is a risk that although the notion of a more welfare-friendly housing when keeping horned cattle applies if done properly, serious welfare problems can occur in case of deficiencies of management, human-animal interactions and/ or housing,. Thus, a combination with welfare assessment based on outcomes (animal based parameters; such as Welfare Quality®) may add to the quality and thus advantages.

1.1.3 Course of action to further develop and convey keeping of horned cattle:

1) Spreading of knowledge about the feasibility of keeping horned cattle in modern cattle husbandry, so that, for example, stakeholders know that change to loose housing system from tie stalls does not imply dehorning**.**

2) Farmers willing to keep horned cattle should have **easy access to qualified information** and **advice.**

These two points are supported by the following material and approaches:

- Develop special courses to provide information and try to change attitudes and behaviour of stockpeople to enable successful keeping of horned animals with low risk of accidents
  Course content should deal with:
  - social behaviour of cattle
  - recommendations for keeping horned animals (see Part 2 of this deliverable)
  - human-animal interactions

  The latter part could be covered by the recently developed course © Quality Handling (within Welfare Quality ®). It may be combined with additional material for keeping horned animals.
- Provide information to all stakeholders of the cattle production chains in order to avoid biased depreciation due to keeping horns.
- Develop proper supporting material in different languages including videos showing practical cases explained by farmers. (Part 2 of this deliverable may serve as a basis as main recommendations are included).
- Include information on keeping horned cattle in agricultural education and veterinary curricula.
- Support of demonstration farms, where successful keeping of horned animals is practiced.

3) Development and promotion in the European countries of adequate housing solutions for horned cattle based on available recommendations (see deliverable) and new research findings

4) Compensation for economic disadvantages

- Subsidies for farmers keeping horned animals as a reward for welfare-friendly farming (compensation of higher costs of optimized, welfare-friendly construction and reconstruction of barns according to recommendations, compensation of higher labour cost due to different management, compensation of lower selling prices of breeding animals)
- Guarantee that no exclusion from subsidies will occur due to spacious construction of housing.
- Promotion of certified premium food products from horned animals

5) Research into enhancements of keeping of horned animals

- Research in keeping horned animals regarding necessary space allowance, dimensions, equipment and management practices during farming, transport and slaughter
- Research on possible effects and relevance of horns for social interactions and stress, health, product quality
- Research in economic consequences of keeping horned cattle

1.2 Breeding for polled cattle

Main practical problems and limitations are reported in deliverable 2.2.2. At the moment polled bulls are generally not an option for dairy farmers due to low breeding values and few bulls available. This may be overcome by means of genomic selection as described in detail in D.2.2.2. However, this is an option only for the large main production breeds.

If breeding of polledness is based on a few ancestors, the risk of inbreeding is high and clear strategies against these need to be developed.

The existing program in Bavaria with dual purpose breed Fleckvieh has its limitation in that all polled bulls show the pathology of having a prolaps of the praeputium. The underlying cause needs to be evaluated as it might be due to inbreeding, but also might be linked to the polledness itself, which then may be found also in other breeds. Clearly, breeding for polledness should not be based on animals with health problems and appropriate actions should avoid this. In any case, inbreeding needs to be avoided as much as possible.

Further research on possible effects, both phenotypic and genetic, of polledness on health, fertility, product quality, and social behaviour and stress should be performed to base decisions on a sound basis.

In cattle for meat production several polled breeds with large population sizes already exist as well as in some dairy breeds with small population size. Thus using these breeds would be an option to avoid dehorning. Traditions with preferences for special breeds may limit this option.

Another limitation may be the acceptance by consumers. Breeding for polledness may be seen as a violation of the integrity of cattle, but on the other hand it can be seen as selecting for naturally occurring genetic variation. Consumers may accept it “if polled cattle is seen as a natural phenomenon and if the distinction between classical breeding and genetic modification is clear” (See Deliverable 2.2.2). Thus proper information is needed for increasing acceptance. As mentioned above, the use of animals without horns may be seen as a form of adapting the animals to the environment instead of offering the animals an environment according to their needs. On the other hand polled animals can be seen as an opportunity to make transfer from tie stalls to loose housing easier. The main advantage of breeding for polled cattle is that current husbandry systems where animals are dehorned can avoid this painful practice by changing to polled cattle without a need for further changes.

The acceptability of breeding polled cattle is part of the general question to what extent it is acceptable to breed for specific traits. The answer depends in part on whether breeding is at the expense of animal welfare, or to its benefit, whether natural behaviour of the animal remains possible and if the integrity of the animal in general is still intact after breeding. The debate on these points in polled cattle is still open. More information is needed on the naturalness of polled cattle and their behaviour and on the ethical implication of different breeding strategies.

1.3 Future developments and risks

To develop and implement in parallel the two alternatives, keeping horned cattle and breeding for polled cattle, would offer free choice for farmers according to their attitudes, traditions and husbandry conditions.

Having the choice between both alternatives makes dehorning unnecessary because all farmers should be able to find the solution fitting for their individual situation.

Nevertheless, the combination of both alternatives involve some risks:

1) In case breeding for polledness is very successful, the availability of horned animals in a given breed (e.g. Holstein Friesian) on the breeding market may decline rapidly. This may further decrease accessibility to breeding markets for farmers with horned animals. Even worse, horned animal may start to be not available on the breeding market, which would render problems to farmers wishing to keep horned animals. By appropriate information and further supportive action that make it financially more attractive (see 1.1.3) attitudes may change and more farmers may decide to keep horned animals. This should not get more difficult by breeding for polledness.
   Support of breeding programs or cattle markets for horned animals may help here.
2) The negative impact of keeping hornless animals under deficient conditions (with respect to social stress) is generally less visible. While in horned cattle problems get visible by increased amount of (often superficial) injuries, blunt traumas by horn butts, bruises, are more difficult to recognize. Thus, keeping polled cattle may pretend acceptable conditions and problems may be ignored. Proper welfare assessment, respective information, and further development of recommendations based on research in social behaviour and stress of polled animals seem useful actions against this.

2 Recommendations for keeping horned cattle in loose housing

The keeping of horned cattle in loose housing often is seen as too problematic, especially in dairy cows. However, an increasing number of farmers show that horned cattle in loose housing are possible. In fattening bulls keeping horned animals in loose housing is widespread, especially in Southern Europe (see 2.1.1.). To be successful in keeping horned animals knowledge about possible causes of problems and solutions is crucial. These recommendations aim to provide such information. They are separated into two main parts corresponding to the two main problematic areas mentioned when arguing for dehorning:

Part A: Animal welfare: how to avoid social stress and injuries by horn butts within the herd

Part B: Human safety: how to avoid risk of accidents and injuries of humans by horns

Although listed separately both are interrelated as you can see below. For both areas the main point is to offer the animals an environment taking into account their natural behaviour, their motivations and needs – in short to provide them with a welfare-friendly environment.

2.1 Part A: Animal welfare

2.1.1 How to avoid social stress and injuries caused by horns of animals?

With respect to keeping of horned animals we need to understand the natural social behaviour of cattle, the underlying motivations and consequences. To use this knowledge for managing cattle is crucial for successful keeping of horned animals.

The general principles of social behaviour described below apply for horned cattle and for dehorned or polled cattle. Consequently the recommendations given below for successful keeping of horned cattle (including the recommended space and dimensions) mostly apply to dehorned cattle as well and will help to avoid social stress and trauma in those. However, the consequences of butts can be more severe in horned animals especially under confined conditions. Thus the recommendations are even more crucial for horned cattle to avoid (severe) injuries and stress.

2.1.1.1 Natural social behaviour and social structure

- Cattle live in groups, they are social animals with a highly differentiated social behaviour including both aggressive and affiliative social interactions.
- The social structure of cattle is characterised by dominance relationships between pairs of individuals and a rank order in the herd as well as social bonds, friendships.
- Bonded partners prefer proximity to each other during different activities and are more often engaged in mutual social licking and head play.

- Cattle keep distance to each other, the individual distance. On pasture cattle keep an individual distance (or personal space) between 0.5 and 10 m.
- Once a dominance relationship is established by fighting, butting or just threatening the opponent, agonistic interactions with body contact (head buts) are rare on pasture, i.e. with sufficient space and resources for the subordinate animals to avoid the dominant ones; animals rarely intrude the individual distance of other animals.
- The size of the individual distance (=personal space) depends on the relationship – bonded partners accept lower distances, they are also more tolerant during competitive situations.
- In an established dominance relationship the subordinate animals signals this status by clear submissive postures and/or withdrawal from the dominant animal.
- When animals from different herds are mixed or one or few unfamiliar animals come into a herd, dominance relationships have to be established. Not all dyads have to fight for this, but nevertheless there is considerable increase in aggression potentially leading to injuries.

2.1.1.2 Situation in loose housing - Why can horns cause problems? Why do cattle butt each other?

Compared to the natural habitat the situation in loose housing differs in that there is much fewer space, resources such as feeding places and lying places are limited and relatively clumped together, and the herd is less stable. This increases agonistic interactions. Nevertheless, agonistic interactions and especially possible adverse effects such as injuries can be minimised by appropriate housing design, management and handling. Additionally one should keep in mind, that stress, pain and frustration can increase the level of agonistic interaction.

The general principles to reduce social stress, agonistic interactions and their negative effects are:

- sufficient space, so that subordinate animals are able to avoid intrusion of dominant animals' personal space as far as possible
- sufficient resources (such as lying places, feeding places, feed, drinkers) to reduce competition
- possibility for animals to withdraw from dominants (quick enough), i.e. impede situations where animals get trapped (e.g. dead ends, cubicles without exit to the front, feeding barrier where animals have difficulties to leave)
- protection of individual animals
- decrease severity of injury by a horn butt by decreasing sharpness of horns
- increase stability of the herd
- increase the welfare of the animals by enabling them positive emotions and relaxation
- avoid disturbance as far as possible

All these measures avoid injuries caused by a horn butt, e.g. a scratch of the skin or haematoma of the udder by reducing aggression or by reducing the negative effects of aggression.

Further, well-maintained, functioning equipment and good flooring properties are necessary to avoid injuries caused by (sudden) withdrawal reactions of subordinate animals, e.g. claw lesions.

In the following list/table 1 more detailed recommendations are given as well as explanations for their effects. In table 2 recommended dimensions for dairy cows are listed.

2.1.2 Housing characteristics

2.1.2.1 General characteristics and structure of the housing

1 ***Outdoor housing:*** The housing in general should support the welfare and health of cattle by optimized climatic conditions (air quality, light, temperature), thus non-insulated, naturally ventilated open barns with access to an outdoor area is preferable.
Healthy animals are less susceptible to stress, facilitating also keeping horned dairy cattle.

2 ***Good overview***: The stockpeople should be able to easily observe the animals, by this being able to detect problems with respect to social behaviour in the herd and react quickly.

3 ***Well structured housing design***: Resources (e.g. feeding places, drinkers, brushes) should be well distributed in the housing to facilitate a good spread of animals. Clumped attractive resources (e.g. concentrate feeder and drinker side by side) increase the probability of many animals being present in this area at the same time.

4 ***Selection gates to avoid regrouping***: Selection gates between lying area and feeding area make it possible to keep the cow herd together throughout lactation and nevertheless feed them according to their changing nutritional needs. Separation is only necessary for calving. This reduces regrouping which is a major cause for stress and injuries.

5 ***Special facilities for sick or calving cows:*** The separation of calving or sick cows corresponds to their natural behaviour. Sick cows may decline in rank, be prone to more aggression and may thus have difficulties to compete for fulfilling their nutritional or other needs within the herd. Low-ranking calving cows may often be disturbed during calving by other cows when in the herd. Additionally, a well-littered calving box or separation box for sick cows offers better floor conditions.

6 ***Possibilities of separation in the barn***: Separation possibilities allow in short term to keep animals in visual and limited physical contact to the herd. This can be used, for example, for young fresh-milking animals or heifers before integration in the cow herd. The limited contact is supposed to support habituation and decrease the intensity of social agonistic interactions when integrating the young animals into the cow herd. The separation can also be used for dry cows to stay in contact to the herd. It is important not to create dead ends by such separation.

7 ***Separation of dry or sick cows in contact with herd:*** If a separation of dry cows is necessary contact with the herd should be possible. Reintegration of cows in the herd is the reason of considerable disturbance and results in additional agonistic behaviour. Visual and tactile contact (over a fence) may reduce the level of aggression after reintroduction.

2.1.2.2 Acitvity / walking area

8 ***Spacious alley width:*** Too narrow alleys decrease the possibility to avoid intrusion of other cows' personal space and hamper possibilities for withdrawal. Thus number of agonistic interactions and risk for inju-

ries increases. Further, accessibility of resources is hampered for lower ranking cows when alleys are blocked by dominant animals, which occurs rarely in wide alleys but quite frequently in narrow alleys.

9 ***No dead end situations:*** Lower ranking cows in alleys with dead end situation (alley width < 4.5 m) have difficulties to avoid higher ranking cows and the probability of stress and injuries is high. During re-grouping or integration of heifers these areas are especially critical.
Dead end situations can result from separation of alleys in cubicle housing (e.g. for dry cows) that were originally constructed without a dead end. To prevent dead end situations a circulation should be established (e.g. by removing of lying boxes to establish cross over alleys, or by an outdoor run area). However, if the width of cross-over alleys is too small situations similar to dead ends may occur when high-ranking animals block it.
In one-row cubicle houses (seen especially in smaller herds) alley width should be wide enough (minimum 5 m) to defuse the dead end on both sides, or access to outdoor areas on both ends may be used.

10 ***Width of one way alleys not too wide:*** If one way alleys exist, (e.g. corridor back from milking parlour, the width should allow only one animal to pass – width 1 m)

11 ***Non-slippery floor in good conditon***: Good floor conditions are essential for healthy feet. Slippery floors result in high risk of slipping of the animals, which may be relevant especially during quick withdrawal from dominant animals - or animals may fail to withdraw when quick withdrawal is hampered. Bumps, broken edges and similar bad maintenance enhance the risk of foot lesions, especially during harsh agonistic interactions.

12 ***Steps in deep litter systems wide enough and not too high:*** If the steps are too high or too small the animals easily slip – especially if they avoid dominants abruptly (steps 20 cm high, minimum width 40 cm)

13 ***Outdoor run***: Access to an outdoor run reduces agonistic interactions. An outdoor run supports locomotion, offers climatic stimuli such as sun-bathing during cold weather and thus is positive for animal health and welfare in general and by this may reduce agonistic interactions. More specifically, an outdoor run structures the housing additionally, offers additional space and may serve as a retreat area for low ranking individuals. Outdoor runs also may help to dissolve dead-end situations of the barn.

2.1.2.3 Resting area

14 ***Understocking of cubicles***: Fewer cubicles then animals increase the competition for lying places (=cubicles) and results in a higher number of social conflicts in this area, which increases distinctly the number of injuries – especially when there is no flight possibility. Even with as many cubicles as animals some animals may not be able to find an adequate lying place due to incompatibility with individuals in the cubicle neighbouring a free one. Offering more cubicles than animals helps to relax the situation and additionally better enable the animals to engage in more relaxed lying postures.

15 ***Cubicles of sufficient dimensions and appropriate flooring***: Inappropriate dimensions or flooring of the cubicle lead to increased duration of rising and lying down behaviour as well as more standing in the cubicles. This increases the danger for animals in the cubicles of being injured when another animal wants to dis-

place it from the cubicle. Animals standing in the cubicle may also be subjected to more aggression than animals lying in the cubicle.

1
16 ***Cubicles with flight possibilities to the front:*** If animals lying or especially standing in cubicles are attacked by animals in the alley, this can result in considerable stress and risk of injuries (especially at the vulva or udder) in cubicles where animals cannot flee to the front but have to leave the cubicle by walking backwards, i.e. into the direction of the attacking cow. If cubicles are equipped with a flexible neck belt or rail and a (small) alley in the front of the cubicles animals can withdraw from the aggression and the risks are minimized significantly. A (spacious) head lunge area can be used as such alley so that no additional space is needed.

17 ***Free lying areas in a rectangular shape***: In deep litter or sloped-floor pens the higher ranking cows often lie close to the rear wall. In order to reach the feeding place the animals in general use the shortest route and may cause many animals lying in or near this route to rise. In a quadratic resting area this route is longer and thus more animals are disturbed or chased up than with a more rectangular form of the resting area. The depth of the resting area should in maximum be 6 m (especially if <5 m^2/animal space in resting area).
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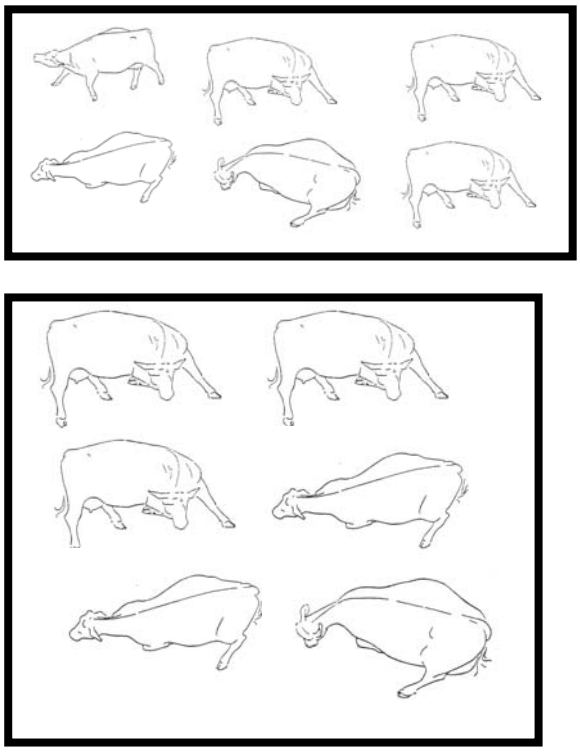

Figure 1: Scheme of a quadratic and a rectangular deep litter lying area to illustrate the length of way out to feeding or drinking.

18 ***Structuring of resting area (deep litter pen):*** Structuring a deep litter or sloped-floor resting area using some elements may reduce stress and agonistic interactions; low ranking cows may use it to retreat from dominants

2.1.2.4 Feeding area

19 ***Understocking of feeding places:*** Animals are highly motivated to feed and thus the feeding place is the area with the highest competition. By providing more feeding places than cows (and wide feeding space – see below) competition is reduced and also low ranking cows may be able to feed from the highest quality of feed directly after provision.

20 ***Feeding space wide enough:*** If feeding space is too small, subdominant animals may not feed or only feed for a limited time to avoid butts. If incompatible animals are restrained side by side both may be disturbed during feeding.

21 ***Appropriate type of feeding barriers (open at the top):*** The time to leave a feeding barrier with a bar over the neck of the animals with or without a self locking mechanism at the top rail (i.e. the cows have to pull out their head through a "hole", see Fig 2) is for horned dairy cows more difficult (they have to turn around their head to weave out) and takes longer time so that stress and the danger of being injured by horn butts increases, compared to a top open feeding rack (see Fig 3).

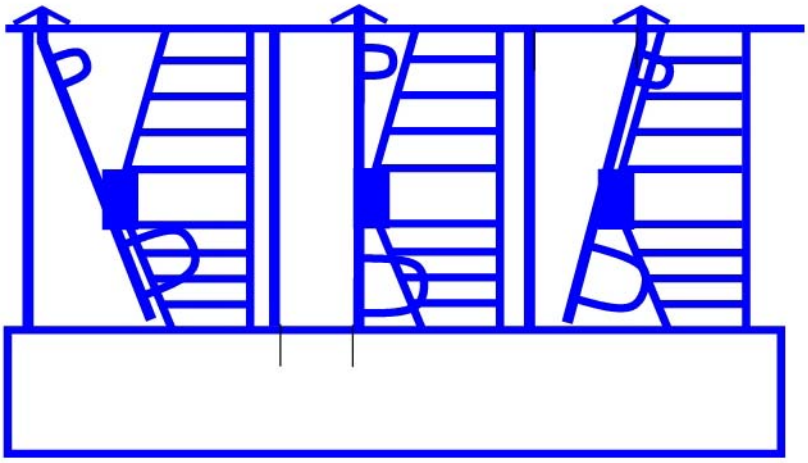

Fig 2: Feeding barrier closed at the top makes leaving for horned animals difficult

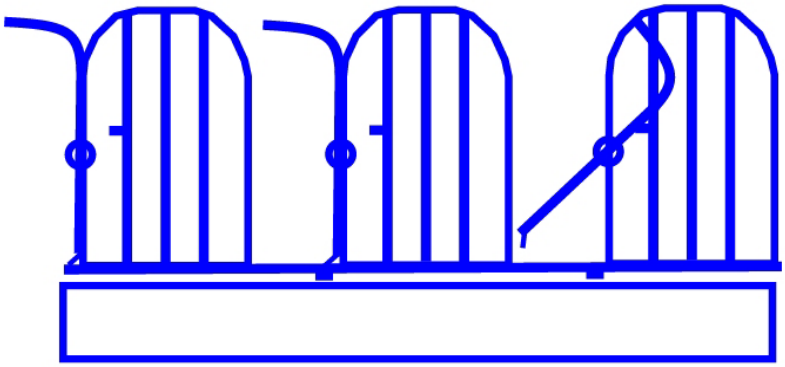

Fig 3: Feeding barrier open at the top allows horned animals to leave quickly

22 ***Self-locking feeding barrier***: Self-locking feeding barriers enable the farmer to restrain animals for some time during feeding to allow also low-ranking cows to feed undisturbed (if feeding space wide enough – see below)

23 ***Neck rail feed barrier only with ad libitum feeding:*** Neck rail feed barriers (no separation of feeding places) were shown to be associated with more agonistic interactions. They may be acceptable only in case of ad libitum feeding with evenly distributed high quality feed. The advantage of neck rail barriers is the easy withdrawal of the animals

24 ***Concentrate feeders protected***: Feeders should be equipped at least with an automatic rear door, or better with an exit at the front. Without protection, horn butts at the concentrate feeder could result in serious injuries, especially of the udder, as cows are highly motivated and thus may be quite aggressive to get access to the feeder. If cows have to leave backwards, they may be subjected to butts even during leaving, while an exit at the front avoids this.

25 ***Sufficient number of water troughs:*** Several smaller water troughs are better than only one / few big water troughs as high ranking animals can occupy a whole water trough.

26 **Water bowls at feeding place** (2 animals/ bowl): Water bowls at the feeding barrier on the side of the food, i.e. accessible for cows restrained at the feeding place, make a prolonged locking time possible, where low ranking cows may feed undisturbed (if sufficient feeding place width, see 20.

27 **Additional hay rack**: Offering hay apart from the main feeding place (e.g. in a rack in an outside yard) may decrease competition at the feeding place.

2.1.2.5 Milking parlour

28 Tandem milking parlour is preferable

Social stress in tandem milking parlours is lower as cows are not subjected to buts of other cows or close proximity of higher ranking animals during milking. Further, the tandem parlour offers better possibilities for human-animal-contact during milking

29 ***Separations in head zone in a herringbone parlour:*** Triangular deflectors/separations with extra palisades should be installed in a herringbone parlour. They decrease the possibilities of buts during milking – neighbouring cows are better protected and thus injuries and stress is reduced.

30 ***Milking parlour design appropriate***: The parlour design has to take into account the horns of the cows in that there is enough space for the horns and animals do not bump against partitions.

31 ***Waiting area large enough:*** Low space allowance in the waiting area increases social stress and can increase agonistic interactions directly or after milking.

2.1.2.6 Further aspects

32 ***Brushes***: Number of brushes high enough to avoid competition. Cattle like very much automatic brushes – they seem to enhance their welfare.

33 ***Enlarge feeding space for bull in herd***: If a bull is running in the herd the equipments have to be adapted (cubicle, feeding place design)

2.1.3 Management of horned dairy cows

2.1.3.1 Feeding management

34 ***High quality feed always available***: Ad libitum feeding better enables low ranking animals to get sufficient amount of feed as they can shift feeding times until less competition at feeding place occurs. Less agonistic behaviours occur with ad lib feeding. Nevertheless, the aim should be to enable all cows access to the best quality feed by providing sufficient feeding space (see 17/18??). If low ranking cows shift their feeding time they find only pre-selected feed.

35 ***Duration of fixating cows in the feeding place:*** Adapt duration of fixating cows in the feeding place to feeding regime and existing equipment. Fixation is necessary when concentrate or other limited amount of preferred food is provided in the feeding place, otherwise low ranking cows will be displaced, they will not get their ration and aggression and risk of injuries increases. Longer fixation may help low ranking cows to feed undisturbed from high quality food during this time (but provided sufficient feeding space). However, too long fixation may increase competition and thus aggression at the drinker after releasing cows, except there are water bowls available during feeding or wet food is fed:

36 ***Immediate repair of broken feeding barriers:*** In broken feeding racks animals could be restrained while others are free. This situation is extremely dangerous and stressful for the animal restrained and may result in serious injuries.

37 ***Pay attention to supplement feeding***: Unbalanced supply with nutrients, minerals and trace elements may increase aggression

38 ***Feeding after milking***: Speed up the entering and leaving of the milking parlour by feeding popular food at the feeding table after milking. A smooth process before and after milking prevents competitive situations between the animals.

39 ***No concentrate feeding in the milking parlour:*** Feeding concentrate in the parlour enhances the agitation and competition of the cows during milking and in the waiting area.

2.1.3.2 Management of social behaviour, herd structure and individual animals

40 ***Selection against aggressive animals:*** Single aggressive animals can negatively affect the social behaviour of the whole herd. As there is a genetic disposition for temperament traits such as aggressiveness, such animals should be sold and not be used for breeding.

41 ***Select carefully the bull running with the herd***: If a bull runs with the cow herd he should be calm and not aggressive. A calm tempered bull may positively affect the social agonistic behaviour of the herd, especially when cows in heat are present.

42 ***Minimize separation of cows and regrouping as far as possible***: Mixing of unfamiliar animals as well as mixing of familiar animals, which have been separated for some time, leads to fights, increased aggression and stress. This accounts for example for integration of unfamiliar animals in a herd, or reintroduction of cows after having been separated from the herd (e.g. after calving when housed in a special group during the dry period). Keeping cows in several groups according to milk yield (and thus often lactational state) may be advantageous with respect to feeding, but causes much regrouping and thus an instable social environment with stress and high risk of injuries. One solution is the use of selection gates to keep all groups in one herd (see 4?

43 ***Increase productive life span and reduce the replacement rate:*** Older animals can affect the social behaviour positively by increasing stability. Further, replacements are associated with introduction of unfamiliar animals and thus with high rate of agonistic behaviour and risk of injuries. A lower replacement rate reduces this.

44 ***Separation of cows in heat***: Cows in heat show changed social behaviour (accepting less the dominance of others, initiating aggression and reacting less to received aggression). By this and by mounting activities they often cause a lot of disturbance, agitation and frustration in the herd, increasing agonistic interactions and risk of injuries seriously (both by horn butts and falling during mounting). Cows that cause such agitation should be separated or tied up in a special, protected and appropriate area, but not where others can mount or attack her, which encompasses a high risk of stress and injuries.

45 ***Integrations of replacements in an early age:*** Due to lower weight and thus force of younger animals fights for dominance are less frequent and thus early integration (before insemination or in early pregnancy) is easier than if they are older and stronger. Thus, if possible, e.g. with regard to feeding, this measure can be recommended.

46 ***Measures during integration of animals to reduce stress:***
Integrations of new animals in the herd should at best be done at pasture. At pasture the animals are provided with more space so that animals can flee and the danger of injuries due to agonistic behaviour is lower. Also, natural ground offers better conditions to avoid claw injuries during fights.
Some days before the integration of the animals they should be placed in a separate area of the pen with contact to the cow herd. In the separate area animals can get used to unfamiliar equipment (e.g. cubicles, feeding barriers) first, so that this challenge is separated from the challenge of dealing with a new herd.
Another possibility to allow animals to habituate to and learn about equipment first before facing encounters with the herd is to put new animals in the barn during feeding when the herd is restrained at the feeding place. However, this is a quite short period and effects may be quite limited as a single practice.
Keeping heifers for some days separated with a high ranking socially tolerant cow before integration in the herd may help to reduce stress and injuries. High ranking cows can offer social support to young animals during the integration process.

47 ***Rounding the tip of the horns:*** Horns can have an extremely sharp tip so that even buts with low force can result in injuries of the animals. Rounding the horn tip by filing (1-2 cm) effectively reduces this risk and is unproblematic (no sensible tissue affected)

2.1.4 Human-animal relationship

Human-animal interactions influence the social behaviour and thus risk of injuries by two pathways: 1) directly via interactions causing stress or relaxation or 2) by enabling the stockpersons to better know their animals and understand their needs.

48 ***Good handling practices:*** Calm, positive, predictable and self confident handling of animals reduces the animal's fear of humans and thus stress during interactions and can even lead to a positive human-animal relationship where the human contact can be further stress reducing (see B). This also affects social behaviour positively. Negative emotions (fear, frustration, pain) due to inappropriate human-animal interactions enhance stress and agonistic interactions within the animals.

49 ***Avoid negative interactions:*** Interactions and situations that are perceived as stressful, aversive should be avoided as far as possible. For example dogs for herding cause agitation, often fear and stress and should not be used for herding cows, especially indoors.

50 ***Careful selection and education of staff:*** To safeguard good handling practices staff should be selected and educated accordingly.

51 **Constant care**: Changes in stockpeople and/or several different stockpeople 1) reduce the predictability of human behaviour for the cows and thus increase stress, disturbance and subsequently agonistic interactions, and 2) reduce the intensity of contact of single stockpeople with the animals and thus the recognition and solution of problems in the herd (see below)

52 ***Clear responsibilities***: More people responsible may be problematic with regard to problem recognition and problem solving.

53 ***Sufficient time to observe animals:*** Good knowledge of the animals by observing them enables stockpeople to recognize and solve problems more quickly and more easily.

2.1.5 Additional aspects for beef suckler herds

The general principles of housing design and details important for reducing agonistic behaviour and risk of injuries also apply for beef suckler herds, but the fact that the herd is age-heterogenous should be kept in mind.

54 ***Special areas for calves***: Calves should have access to resting and feeding areas exclusively for calves/young cattle (no adults can follow) to enable undisturbed feeding and resting.

2.1.6 Additional aspects for young stock

The general principles of housing design and details important for reducing agonistic behaviour and risk of injuries also apply to young stock. The problem often is, that young cattle often are housed in quite small, age-homogenous groups, where animals cannot really flee (a) dominant animal(s).

55 ***Pens large enough – groups not too small***: Young cattle often are housed in quite small groups with very limited possibilities to withdraw from dominant animals due to the low total space allowance and often dead end situations (especially in cubicle housing). Larger groups with higher total space allowance and less structured pen design (no cubicles, or large alley in cubicle houses or circulation possibilities) may improve the situation.

56 ***Housing of young stock in contact to the cow herd:*** Being housed in contact to the cow herd may help during integration (see above)

57 ***Mixed-age groups with some regrouping during rearing:*** In stable, age-homogenous groups animals may not learn different social roles and develop less social skills. Groups with animals of different age, and some (few) regroupings during rearing, so that individuals can experience both being subdominant and dominant, may help in developing social skills.

2.1.7 Additional aspects for fattening bulls

The general principles of housing design and details important for reducing agonistic behaviour and risk of injuries also apply to young stock. Again, often very low space allowance can be found.

58 **Keeping horned and hornless animals separately:** In the usually crowded conditions of fattening bulls hornless animals may suffer especially from horn butts.

59 ***Sufficient space allowance***: More space reduces agonistic interactions and stress as well as enhances comfort (e.g. more spacious lying postures). Minimum standards of different countries are too low (in general) and thus higher space allowance should be offered..

2.1.8 Space allowances

For fattening bulls in fully slatted floor pens (at least covered with rubber mats): a space allowance of 3,5 m² / bull from 400 kg on should be offered to allow for comfortable lying postures and avoid other behavioural restrictions (increasing with every 100 kg by 0,5 m²).

Recommended space allowance and dimensions for keeping horned dairy cows are summarized in table 1. It has to be stressed, that these are not minimum standards, but recommendations to ease keeping of horned cattle by better enabling them to perform elements of their natural social behaviour such as respecting the individual distance of dominant animals. In principle keeping horned dairy cows is possible also with somewhat lower space allowance or dimensions (as shown in epidemiological studies). But then management is especially important. Supporting farmers to construct their barn according to the recommendations below will largely help keeping horned cattle successful, although management never looses the important role.

Table 1: Recommended dimension and space allowance in housing for keeping horned cattle. Dimensions refer to average adult dairy cow (≥700kg) of most common breeds (Holstein Friesian, Brown Swiss, Simmental cattle). Note that single factors are interrelated. E.g. when offering only one feeding place per animal the feeding place width of 85 cm should be further increased to compensate the lacking possibility to avoid specific animals. As well, the number of crossovers and thus length of alleys interferes with the necessary width (very long alleys should be avoided)

	recommend dimensions
Feeding place width (per animal)	85
Alley width behind feeding place	4.50 m / 5 m 5 m: when three rows of cubicles or when cubicles are entered from the alley behind feeding place 4.50 m: when in the alley no entrance to any other functional area (no direct access to cubicles from alley, no water trough or concentrate feeder)
Animal/feeding-place ratio	1:1.1
Concentrate feeder	Protection at entrance (rear of cow) by door, exit to the front
Animal/water troughs ratio	10:1, at least two troughs/group even in small groups
Alley width between cubicles	3,50 - 4.00 m
Crossover with water trough	3,00 – 4,00 bm
One way alley	1,00 m
Cubicle length (rows towards walls)	3.00 m (incl. 100 cm get-up-zone)
Cubicle length (double rows)	2.70 m
Animal/cubicle ratio	1:1.1-1.2
Lying area per animal (unstructured area)	8.00 m^2
Outdoor run: area per animal	2.00 - 4.50 m^2 (with larger herdsize space can be reduced to 2=)

2.2 Part B: Human safety

2.2.1 How to minimize risk of accidents and injuries

It is important to be aware of the fact that cattle are large, strong animals that can and sometimes do cause serious injuries to humans regardless of the presence of horns. The aim thus should be to minimize the risk of accidents in general. Nevertheless, additional attention is necessary when handling horned animals, especially close to the head, as horn strikes, be it voluntarily or by accident, e.g. due to startling, bear a high risk of injuries.

To minimize risk of accidents and injuries we need to be aware of the main underlying reasons for accidents.

Major causes of accidents are:

- fearful animals
- startle reactions of the animals
- lack of knowledge regarding appropriate handling
- inaccurate human behaviour
- inappropriate handling facilities and housing

These aspects are interrelated, e.g. startling reactions occur more easily in fearful animals and due to inappropriate human behaviour. Further, inappropriate human behaviour may increase fear of humans. Inappropriate facilities may cause animals to be fearful and more difficult to handle, thus provoking inappropriate behaviour, further increasing fear, stress and handling difficulties.

The **key to reduce risk of accidents and injuries** thus is appropriate human behaviour, i.e.

- **good handling practices,** including regular positive contact, and by this
- **improved cattle-human relationship** with **low levels of fear of humans**, as well as
- **appropriate handling facilities** and **housing**.

This is explained below more detailed. Further important aspects are the environment, the handling facilities and housing. For example slippery floors, crowded situation, lack of escape possibilities for the human and insufficient barriers can impose high risk. As well some features ease handling of cattle by using their natural behaviour or complicate it by inducing fear.

2.2.2 What are good handling practices and how can cattle-human relationship improve?

Human behaviour towards cattle is a major factor affecting their fear of or confidence in humans. Our behaviour towards cattle can be classified as either:

- **Positive behaviours**, i.e. gentle and calm tactile or vocal interactions such as pats, stroking, hand resting on the animal's back, talking smoothly, slow and deliberate movement
- **Negative behaviours** i.e. behaviour that is perceived aversively, as it causes pain, stress or just discomfort: such as hits, slaps, shouting, fast and sudden movement. Additionally, many husbandry procedures are negative as they cause stress, pain or discomfort, e.g. artificial insemination.

Cattle's relationship to humans develops from previous experiences of positive or negative nature. The more positive experiences cattle made in the past and the least negative, the better is their relationship to humans implying a lower level of fear of humans.

Regular positive contact improves the relationship to humans: Having experienced regular positive contact for some time, especially stroking, makes cattle approaching humans more readily and accepting humans in closer distance, which eases manipulations, reduces fear-related behaviour including defensive behaviour and thus reduces risk of accidents.

Positive contact can calm cattle directly, e.g. stroking cattle at the neck can relax and calm them down, and reduce stress and defense reactions during handling. However, it is necessary that animals were used to contact with humans before.

Negative contact has been shown to increase fear of humans in cattle, which results in animals being stressed in the presence of humans. Negative contact also often directly makes handling more difficult as it increase fear and stress in the animals handled.

Besides this general quality of interactions, it is important that human behaviour is **predictable**. (i.e. always same behaviour in the same situation) and understandable for the animal by using **clear signals**.

To be able to react appropriately in handling situations and thus avoid negative interactions it is also **important to understand and anticipate cattle behaviour**. Cattle show **species-specific behaviour** in potentially dangerous situations and have species-specific **sensory capacities** that underlie their behaviour. Humans handling cattle need to be aware about these behaviours and need to be able to read the signals of cattle to be able to anticipate their behaviour and react appropriately. It is important to realize that **cattle perception of the world is different from ours** and developed to optimize, under others, to avoid predation and enable survival. This explains many dangerous behaviours such as startling, baulking, fleeing, attack.

Most important behaviour important in the context of handling are:

Fear-related behaviour:

- Fear is a natural emotional response to danger. It helps to protect the animal by eliciting specific behaviours: **avoidance** and **flight**, or **defence** and **aggression**. Fear elicits also strong physiological stress responses. Novelty, suddenness, and aversiveness are inducing fear, especially when combined (e.g. a sudden, aversive noise when the animal is in a novel environment)
- Animals need time to explore and to familiarise themselves with new objects or locations. To allow for **exploratory behaviour** is important for acquainting animals with their surroundings and reduce fear and stress.
- Animals keep distance to frightening objects and also to humans, they have a flight zone. This flight zone or avoidance zone is dependent of the level of fear. Animals confident in humans, showing low levels of fear can be approached until touching or very closely, while fearful animals may have a flight zone of many meters. Intruding the flight zone leads to fear related behaviour.

Social behaviour

- Cattle are social animals. Isolation is a strong stressor and makes animals more difficult to handle.
- Cattle use **body postures** and **vocalisations** to communicate with herdmates. They use the same postures to communicate with the human. Humans handling cattle should well know these postures, as threatening postures may indicate danger if not acting appropriately. Adducted head with presenting the front or horns is a threatening posture and approaching this animal may be dangerous. A lowered head with stretched neck indicates submission or solicitation of stroking.

Thus to improve cattle relationship towards humans, and subsequently increase ease of handling, reduce risk of accidents as well as increase productivity, the following **recommendations** should be followed

- Use positive behaviours whenever the opportunity arises (e.g., during daily watching)and always to a large percentage of total interactions
- Use negative behaviours only when absolutely necessary
- Give life-long regular positive contacts starting with birth, especially also a sufficient amount of body contact (stroking)
- Keep calm and patient in any handling situation
- Be predictable and give clear signals
- Use positive behaviours as reward and to counterbalance necessary aversive handling
- observe the animals and adapt your handling behaviour (e.g. give time for exploration in fearful animals in novel environment)

Additionally take into account to arrange for

- constant care: changes in stockpeople and/or several different stockpeople reduce the predictability of human behaviour for the cows and thus increase stress
- careful selection and education of staff: To safeguard good handling practices staff should be selected and educated accordingly

Selection for docility and/or against aggressive animals may additionally help. However, the main factor for the relationship of animals towards humans is the frequency and quality of human animal interaction.