Improving quality of livestock products to meet market and community demands

Developing and implementing animal welfare assessments on extensive and intensive grassland systems: an overview

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Abstract. While several definitions of animal welfare exist, in this paper we use the concept of the Five Freedoms. The Five Freedoms are freedom from hunger, thirst and malnutrition; freedom from discomfort; freedom from pain, injury and disease; freedom from fear and distress; freedom to perform normal behavior. While the idea of the Five Freedoms has limitations, it is still a widely-used conceptualization of animal welfare and we use it here to discuss the welfare of cattle in intensive and extensive management systems in Vietnam and Australia. Compared to extensive pasture systems, intensive management systems do result in heightened animal welfare concerns. These relate particularly to metabolic diseases, discomfort due to high humidity and inadequate bedding, increased prevalence of lameness and respiratory disease and an inability to satisfy normal behavioural requirements such as manipulation of feed and access to grooming. However, an understanding of these limitations will allow increased attention to possible welfare compromise.

Keywords: Animal welfare, Australia, Vietnam, cattle farming.

Introduction
Animal welfare has recently gained major public exposure in Australia, resulting in considerable negative impact on the industries concerned. In particular, the wool industry has borne the negative impact of opposition to the operation of mulesing, while the live export of cattle to Indonesia was totally suspended in 2011 following the broadcast of footage showing cruelty imposed on Australian cattle in Indonesian abattoirs. Furthermore, in Vietnam, large numbers of dairy and beef cattle have been recently imported from Australia. The current aim is to supply 50% of the Vietnamese milk market and the Government of Vietnam is encouraging an increase in the population of dairy cows from around 200,000 in 2012 to 500,000 by 2020. Therefore, in the years to come, more and more cattle, especially dairy cattle, will be imported from Australia to Vietnam. While cattle imported from Australia have proved to be well adapted to the climate conditions of Vietnam welfare issues associated with live transport will have to be addressed.

Animal welfare is wide-ranging and several definitions have been proposed. For example, Broom (1996) defined it as the animal’s “state as it attempts to cope with its environment”, while the Farm Animal Welfare Committee (2011) defines it as “a life worth living from the point of view of the animal”. Both of these definitions embrace positive as well as negative welfare. However, while not a definition of animal welfare, one of the most widely-used concepts to frame and assess animal welfare is found in the Five Freedoms. These had their roots in the Brambell Report (Brambell 1965), a public enquiry into animal welfare in Britain following the publication of the book “Animal Machines” (Harrison 1964).

In this paper, we use the concepts of the Five Freedoms to analyse welfare of cattle at pasture and in intensive feeding situations with special references to cattle farming in Australia, where most cattle are kept grazing at pasture, and Vietnam, where most cattle imported from Australia are kept under household pen feeding systems.

The Five Freedoms
Following the publication of the Brambell Report, the Farm Animal Welfare Advisory Committee was established which was, in July 1979, replaced by the Farm Animal Welfare Council. The Five Freedoms as detailed by the Farm Animal Welfare Council (2009) are as follows:

- freedom from hunger, thirst or malnutrition by ready access to fresh water and a diet to maintain full health and vigour;
- freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area;
- freedom from pain, injury and disease by prevention, by rapid diagnosis and treatment;
- freedom from fear and distress by ensuring conditions and treatment which avoid mental suffering; and,
- freedom to perform normal behaviour by providing sufficient space, proper facilities and company of the animal’s own kind.
A detailed cattle welfare framework has been developed around the Five Freedoms that can be used on farm to assess individual or groups of animals. A modified version of the DEFRA (UK Government) template is available and there are several other mechanisms for animal welfare assessment. We will now consider the welfare of dairy and beef cattle at pasture and in intensive feeding systems under the basic framework of the Five Freedoms. In Vietnam, intensive systems include moderate sized herds tethered and fed, pen feeding systems, larger non-tethered zero-grazing feeding systems and very large intensive automated feeding systems for dairy cattle. Whether the relevant welfare provisions can be accommodated adequately in each system is also summarized. Discussion of feeding systems of calves, feeding in relation to reproduction and genetics is beyond the scope of this paper but remains a relevant topic to the selection and management of cattle and feeding systems in farming.

Freedom from hunger, thirst or malnutrition – can ready access to fresh water and a diet to maintain full health and vigour be provided?

Here, a limitation of the Five Freedoms becomes immediately obvious; hunger and thirst are perfectly normal states in an animal’s life, indicating when it needs to eat and drink. We shall address this limitation in a later section. It would also at first appear that the best state that an animal can achieve is neutrality. However, there is evidence that cattle need to forage for food rather than to have it simply placed in front of them in a concentrate format. It has also been observed, that, as young cattle approach water, they increase their speed and even change gait as if in anticipation of satiation (Kilgour unpublished observations). Therefore, at pasture, it is possible that animals can achieve positive welfare under this freedom providing there is frequent checking of adequate, clean water supply and monitoring of body condition scoring and feed supplementation during low feed or drought situations.

However, such positive welfare states may not always be achieved in animals in pen-fed situations, where food and water are presented to the animal without it having to search for them. It is possible that even when all of the nutritional requirements of an animal are satisfied, it may still be in a state of negative welfare. This has been shown to occur when the nutritional requirements are delivered to cattle in such a highly-processed ration that their foraging and ruminating times are so restricted (Table 1) that they display tongue rolling (Redbo 1990; Redbo 1982). Tongue rolling is considered to be a stereotypy, a repeated behaviour that appears to achieve no purpose, and may be an indication of frustration due to the thwarting of the normal manipulation of food (Lindström and Redbo 2000).

An appropriate balance of fibre, concentrates and minerals is also important for the avoidance of metabolic diseases as is the provision of comfortable resting areas for adequate rumination and digestion. The prevalence of metabolic diseases associated with a lack of calcium, magnesium or energy or an excess of concentrated energy (resulting in milk fever, grass tetany, ketosis, acidosis, fatty liver respectively) in smallholder or intensive farms in Vietnam is unknown but likely significant. The impact of metabolic disease is likely exacerbated by tropical grasses due to low energy content, a lack of ad lib water especially with tethered animals, zero-grazing prohibiting self modulation of energy intake, lack of supplements, poor farmer education in relation to the key signs of metabolic diseases and ability to readily access good veterinary treatment and preventative advice. Heat stress associated with genetics, a lack of access to water and other factors later discussed, is also an issue with imported dairy cattle in Vietnam.

Providing feed of a type and in a delivery system that stimulates their feeding behavior is also important. Cattle synchronize their feeding to a large extent (Benham, 1982; Potter and Broom 1987) and competition for feed access can be very stressful and unproductive. Social hierarchy plays an important part in reducing access to feeding troughs, increasing avoidance walking behaviours and taking much longer to finish feeding (Broom 1981). To minimize such welfare problems, which are often associated with poor weight gain, farmers should provide enough feeding spaces for all individuals to eat at once, preferably with physical separation between individual spaces (Broom, 2004). Where this cannot be achieved, reduced stocking rates and streamlining of cattle in pens according to their condition provides adequate feed or drought situations.

While freedom from major thirst and hunger can be provided under normal conditions in both systems, the impingement on normal feeding behavior in penned or intensive feeding systems needs special attention to ensure this does not contribute to poor welfare and production (see also below). Similarly, careful conditioning of intensive feeding systems and provision of ad lib water and fibre, amongst other needs, are essential for the welfare of intensively-housed cattle.

Freedom from discomfort – can an appropriate environment including shelter and a comfortable resting area be provided?

This freedom particularly refers to the maintenance of an environment that avoids extreme temperatures and associated discomfort, excessive changes of diet and provision of a comfortable resting area. This latter is all the more important for penned or feedlot animals who spend more time recumbent, resting and ruminating. At pasture, climatic extremes can be a welfare concern, compromising feeding and weight gain if some form of shade or shelter is not provided. It is well established that dairy cow appetite and production is reduced with elevated temperatures and high humidity. Shade and cooling by natural or artificial means can be very important while shelter from wind, sustained rain and cold temperatures, especially in Northern or mountainous Vietnam, are important to protect cows and calves at

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pasture. Resting areas at pasture are usually comfortable if adequate grass coverage and space is available. This can be a challenge in the monsoon season or during and after heavy flooding.

Similarly in feedlot or pen systems, adequate ventilation (natural or artificial) is important for dairy and also beef animals to minimize risks of respiratory disease and heat stress. Spray cooling systems for cattle that may be suitable in drier climates are not suitable in humid situations as they further contribute to humidity and inhibit evaporative cooling. This can compound the issue of wet or moist bedding and contribute to fungal or bacterial proliferation in bedding systems if not well managed.

Slippery, sharp, slatted or concrete flooring can lead to difficulties in standing or lying (Andrea and Schmidt 1982) while other problems with flooring including inadequate stall dimension and hygiene can lead to lameness, neck injuries, tail tip necrosis, broken tails and dirty udders (Zubrigg et al. 2006). Poor drainage can further compound poor design (Wierenga and Peterse 1987) as can a lack of suitable bedding. Cattle have shown a strong preference for and reduced pain and injury with deep bedding systems such as straw. Subsequently, many of the adverse behaviours and lameness seen in housed bulls have been reduced with deep bedding systems (Graf 1984). Rubber mat resting areas can be a viable alternative but must be adequate in number and length to ensure comfort for all and separate from dunging areas. However, in a free choice experiment, Fregonesi and Leaver (2002) found that dairy cows showed a strong preference for a straw yard system over a cubicle housing system at both high and low space allowances.

Long term tethering in any feeding or farming system is also a source of significant discomfort and behavioural concern, contributing to reduced production. Tethering is common in small and medium sized farms in Vietnam. Tethering is associated with discomfort from higher rates of teat injuries and mastitis, poor fertility, lameness, ketosis and indigestion, plus stereotypes (Pfefferli 1994; Simensen et al. 2010). Tethering also inhibits some natural behaviours, preventing others and will be discussed further under the fifth freedom.

In summary, if well understood, the necessary provisions for freedom of discomfort can be provided in either system without tethering, up to a point. The provisions for shade and shelter, ventilation, cooling and comfort must be enough for all cattle to be protected and rested to maximize welfare and production. In general, it seems dairy cow housing systems and cubicles in particular, do not provide an environment to which cows can adapt easily. Open deep straw based barns with a limited number of cattle in stable groups seem most successful as they enable cattle to control their interactions with the environment (Broom 2004). Optimum temperatures, especially for dairy, group size and space allowance has been the subject of much animal welfare science as has the space and design for beef feedlots. It is proposed, there is a point at which large, zero-grazing systems cannot be adequately managed for welfare, cost-efficiency and disease control. This is an issue of significant current research and debate.

Freedom from pain, injury and disease – can rapid diagnosis and treatment be provided?

Injury and disease can occur in pasture systems and ease of monitoring, diagnosis and treatment may be a challenge. This is particularly the case in semi-tethered or free ranging village pasture based systems, compounded by lack of money to secure diagnosis and treatment. In such systems, animals are at greater risk of liver fluke, toxic plants and misadventure. Knowledge of pasture rotation for worm control and deworming may be very limited though important for fenced pasture or pen systems as is maintenance of fences/pens to prevent injury.

Lameness has been intensively studied and considered the largest welfare problem of housed dairy cattle causing chronic pain in a large proportion of herds (Broom 2004; Whay et al. 1997). Hyperalgesia (increased sensitivity to pain) occurs in chronically lame cows and may persist for a long period after resolution of the lesion (Whay et al. 1998). As mentioned above, lameness relates in part to housing design, flooring, whether animals are tethered and also social factors and genetics. Dairy cattle and bulls are often tethered on farms in Asia. Tethered beef animals may grow or increase weight rapidly and lack exercise. Tethered animals have different muscle development and more joint degeneration and limb pain, with obvious difficulties in standing and lying (Jury et al. 1998, de Vries et al. 1986). Poor hygiene, difficulties in stall cleaning and the inability to easily detect lameness (Leah et al. 2009) are all associated with tethering compound lameness.

Cattle at pasture can suffer from some stone bruising of hooves, but this can be less severe than wet, poorly maintained cubicle or wet straw pen systems (Broom 2004). Even if well-managed, the cubicle housing and feeding system can be expected to have a negative impact on the welfare of the cows in terms of leg and foot disorders and other injuries. Limited access to pasture and large group size are also associated with a higher incidence of injuries. Rutherford et al. (2008) found that the prevalence of hock damage was much greater in cows housed in cubicles compared with those housed in straw pens (46% vs. 25%). Dry, deep straw bedded pens with an abrasive area for normal hoof wear, result in low levels of lameness, and may be the best solution for housed, intensively fed cows (Broom 2004; AHAW Panel 2009).

A noted limitation of this Freedom is that prevention of pain, injury and disease should be the focus, not just provision of diagnosis and treatment. Disease monitoring, diagnosis and treatment of housed animals may be easier in intensively housed and fed systems but then infectious disease transmission is also easier. Larger herds may convey economies of scale and enable funds for more rapid veterinary diagnosis and treatment, though this may be limited in Vietnam unless private veterinarians are employed. Very large, intensively fed herds may conversely be more difficult to adequately monitor and treat. High stocking densities or herd numbers compound housing or management problems.
such as lameness, mastitis or metabolic disease. On balance cattle in intensively fed and penned systems have more lameness, mastitis and difficulty finding comfortable places to lie and rest, three main welfare problems inherent to the system and which present ongoing challenges in terms of prevention.

**Freedom from fear and distress – can conditions and treatment which avoid mental suffering be ensured?**

One of the major welfare issues in farm animals is stock handling (Animal Welfare Science Centre 2002), with poor stock handling likely to cause animals fear and distress. This has been demonstrated in cattle, where cattle were found to be more averse to being moved down a race where the handler used an electric goad or a raised voice than they were to slapping or tail twisting in that they took more time and required more force to move down the race (Pajor et al. 2000). Further studies have demonstrated improved handling facility designs and non-contact tools (flappers, rattles, flags). Grandin (1998) concluded that reducing handling stress improves both welfare and productivity.

Animals at pasture or semi-grazed systems may have larger flight zones and be more fearful of stockperson handling, though smallholder animals are usually conditioned to intensive handling at a young age, although not always in a positive manner. Housed animals are handled more frequently and usually have a significantly reduced flight zone and fear of humans. However if stock people are not trained or have a poor attitude, fear, avoidance behavior and production losses can be induced through poor stockmanship and handling.

In summary, pasture or semi-grazed systems can provide conditions and treatment which avoid significant mental suffering of cattle if well selected, trained and managed staff are employed. This becomes more challenging with larger, highly stocked intensive systems and strictly time-bound staff. Improved stock person attitude, knowledge and skills have been shown to deliver production benefits (Hemsworth et al. 2002).

**Freedom to perform normal behaviour – can sufficient space, proper facilities and company of the animal’s own kind be provided?**

This immediately begs the question “What is normal?” The usual approach in the past has been to study the behaviour of wild ancestors, the idea being to document behaviour in the absence of human interference. For cattle, the best that can be done is to study related wild bovines or cattle at pasture. Where this has been done, it has demonstrated that cattle spend 90 to 95% of their time engaged in four major behaviours, foraging, ruminating, resting and walking (Kilgour 2013; Kilgour et al. 2013). Where this has been used to compare the behaviour of cattle under intensive management, the same pattern emerges except that cattle at pasture spend more time foraging and walking and less time resting than cattle in the intensive systems (Table 1).

In addition, cattle at pasture show distinct diurnal rhythms, with majority of grazing during the day and lying down more at night. Cattle also lie down during the day, in bouts of about an hour. However, in pen or barn systems, this diurnal rhythm is less synchronized and distinct. Feeding and lying behavior is more interspersed during a 24 hour period. However, certain cues are important, such as delivery mechanism of feed. De Vries and von Keyserlingk (2005) have shown that feed delivery stimulates feeding behavior. Cows increased feeding by 82% during the first hour immediately following the delivery of fresh feed compared with a 26% decrease in feeding time after returning from the milking parlour.

O’Connell et al. (1989) compared the behaviour patterns of dairy cows in confinement and at pasture. The cows were more restless indoors and this affected their lying behaviour, which in turn disrupted ruminating. Agonistic behaviour increased and benign interactions decreased during confinement. Wierenga et al. (1984) also found a much higher level of aggressive interactions in dairy cows in a cubicle system compared with a pasture system. Walczak et al. (2005) reported more frequent stereotypic behaviours in tethered compared to

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**Table 1. Proportion of scans in which animals were seen performing various behaviours at pasture, in a commercial feedlot, on a Japanese farm and in an experimental feedlot. Data were analysed by meta analysis. All animals were steers, so no reproductive behaviours are included.**

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Pasture</th>
<th>Commercial feedlot</th>
<th>Japanese farm</th>
<th>Experimental feedlot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lying sternally other</td>
<td>0.00</td>
<td>&lt;0.01</td>
<td>0.01*</td>
<td>0.01</td>
</tr>
<tr>
<td>Standing walking</td>
<td>0.14</td>
<td>0.05*</td>
<td>0.02**</td>
<td>0.04*</td>
</tr>
<tr>
<td>Standing other</td>
<td>0.07</td>
<td>0.05</td>
<td>0.09</td>
<td>0.07</td>
</tr>
<tr>
<td>Lying sternally resting/ruminating</td>
<td>0.15</td>
<td>0.27*</td>
<td>0.47*</td>
<td>0.41*</td>
</tr>
<tr>
<td>Resting/feeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Rum = 0.21)</td>
<td>Rest = 0.06</td>
<td>0.14)</td>
<td>(Rest = 0.14)</td>
<td>(Rest = 0.14)</td>
</tr>
<tr>
<td>Walking</td>
<td>0.07</td>
<td>0.25</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td>Ruminating</td>
<td>0.41*</td>
<td>(Rum = 0.37)</td>
<td>(Rum = 0.22)</td>
<td>(Rum = 0.28)</td>
</tr>
<tr>
<td>Standing resting/ruminating†</td>
<td>0.17</td>
<td>(Rum = 0.37)</td>
<td>(Rum = 0.22)</td>
<td>(Rum = 0.28)</td>
</tr>
<tr>
<td>Feeding</td>
<td>0.51</td>
<td>0.21*</td>
<td>0.15*</td>
<td>0.14*</td>
</tr>
<tr>
<td>Lying sternally resting/ruminating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Rum = 0.22)</td>
<td>Rest = 0.04</td>
<td>(Rum = 0.22)</td>
<td>(Rest = 0.03)</td>
<td>(Rest = 0.06)</td>
</tr>
<tr>
<td>Lying sternally other</td>
<td>0.00</td>
<td>&lt;0.01</td>
<td>0.01*</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*= significantly different from animals at pasture, P<0.05; ** = significantly different from animals at pasture, P<0.01; † At pasture, ruminating (Rum) and resting (Rest) could not be differentiated; 1Kilgour (2012); 2Kilgour et al. unpublished.
group housed cows concluding their general welfare was better in group housing.

Phillips and Schofield (1994) compared the behaviour of dairy cows in cubicles and a straw yard. They concluded that the welfare of the cows in the straw yard was improved because they were more comfortable, as indicated by longer lying times, and had greater opportunities to display normal behavioural changes at oestrus than the cows in cubicles. Similarly, Livshin et al. (2005) investigated cow comfort in different housing systems by monitoring lying behaviour and found that dairy cows housed in a barn without stalls lay on average for two hours longer daily than those housed in a barn with stalls.

Inability to perform basic normal behaviours such as turning around, lying comfortably, walking, licking or scratching all areas of the body is exacerbated by limited social interaction and spatial restriction. Tethered cattle develop a range of abnormal behaviours including tongue rolling, weaving and self-licking (Riese et al. 1977; Wierenga 1987). Ladewig (1984) reported that tethered social interaction and spatial restriction. Tethered cattle turning around, lying comfortably, walking, licking or...

...behaviour in many circumstances. Stable cattle groups in non-tethered group housing systems that provide preferred flooring, deep bedding and adequate space and ideally rubbing/scratching facilities as well as good access to food, ad lib water and good hygiene standards can achieve a reasonable balance of animal welfare. Access to daily exercise would be additionally beneficial, not only for improved welfare (displayed by normal social, grooming and investigative behaviour, reduced stereotypies, Krohn 1993) but also for reduced lameness. Housing systems have limitations in terms of size of cattle groups and good management that should also be considered.

**Limitation of the Five Freedoms**

The majority of welfare concerns associated with pasture or intensive feeding systems have been discussed in the context of the Five Freedoms. In addition, some key provisions or limitations are mentioned in general terms. Perhaps, the major limitation with the concept of the Five Freedoms, however, is that they are possibly too prescriptive and focus on freedom from negative welfare states. As pointed out above, if animals were totally free from hunger and thirst, they would be denied important aspects of their normal behavior. This prescriptive nature of the Five Freedoms has led Mellor and Reid (1994) to propose that these be thought of as the five domains of potential welfare compromise.

More recently, scientists and ethicists have proposed that providing freedom from or coping mechanisms for a negative welfare state may not be enough and that animals should be afforded positive affective states that contribute to a good Quality of Life (Yeats and Main 2008; McMillan 2005). For example, is freedom from pain and distress enough or should animals also be able to experience states of enjoyment and satisfaction that enable a life worth living, particularly for human benefit? However, this is attended by a range of challenges concerning measurement and arguments that Quality of Life may be a synonym for "animal welfare status" (Broom 2007; Mellor and Stafford 2009).

Whatever one’s point of view and future discussion that may evolve, the Five Freedoms are considered to at least a basic framework for the evaluation and study of animal welfare. They can contribute to identifying, resolving and preventing negative welfare states as well as defining good basic welfare for animals, though specifics are required. The Five Freedoms remain a good starting point for cattle in pasture or intensive feeding systems.

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