Animal welfare index: an animal welfare evaluation of beef production farms in Ireland

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ABSTRACT
The study objective was to examine the animal welfare status of Irish beef production farms using an animal welfare index (AWI). Beef production farms (n = 105) including suckler calf-to-beef (n = 30), suckler calf/weaning/finishing (n = 63), dairy calf-to-beef (n = 12) were assessed during the winter housing period using the AWI. Fifty-one indicators were grouped into six categories: ‘locomotion’; six indicators, ‘social interactions’; eight indicators, ‘flooring’; four indicators, ‘environment’; nine indicators, ‘stockperson’; thirteen indicators and ‘husbandry management’ eleven indicators. Two indicators relating to the size of the farm and number of animals on the farm were also collected. The overall mean AWI percentage for the suckler calf-to-beef, suckler calf/weaning/finishing, dairy calf-to-beef farms were 70.3%, 71.9% and 66.6%, respectively. There was no difference (P > 0.05) in AWI between full-time and part-time farmers. This study demonstrated the application of the AWI for use in beef production systems.

1. Introduction
Issues relating to the welfare of farm animals are becoming increasingly important within the European Union (EU) (www.welfarequality.net). Improving animal welfare is an increasingly important aspect of livestock production systems predominantly due to increased consumer concern about the source of animal products. The assessment of animal welfare requires a multidimensional approach (Mason and Mendl 1993) and according to the European Food Safety Authority (EFSA 2009) should aim to determine the actual welfare of animals, including both their physical and mental state.

Indicators for the assessment of farm animal housing were proposed by several research teams and minimal requirements for animal welfare were implemented in the legislation of most European Union member states (EU directives) as reviewed by von Borrell and van den Weghe (1998). However, codes of practice for the welfare of farm animals are available (EU code of recommendation; Australian Animal Welfare Standards and Guidelines). The World Organisation for Animal Health (OIE) published the following definition: ‘Animal welfare means the physical and psychological condition of an animal in relation to the conditions in which it lives and dies. An animal experiences good welfare when the animal is healthy, comfortable, well-fed, safe, not suffering from unpleasant conditions such as pain, fear and distress, and able to express behaviors that are important to its physical and psychological condition’ (OIE 2019). In order to assess animal welfare on-farms in various production systems, different assessment methods have been developed in Europe (Johnsen et al. 2001; Welfare Quality® (WQ) 2009, 2012). These methods have taken into consideration the advantages and disadvantages of specific housing and management features for the welfare of farm animals. The idea of creating an index system for welfare assessment originates from a concept of Bartussek (1985), proposing a Tier-Gerechtheits-Index (TGI, translated as animal needs index) in the context of a state directive for intensive animal housing legislation in Austria. The concept was further developed leading to the TGI 35L/2000 (Bartussek 1999; Bartussek et al. 2000). The TGI 35L/2000 is a method that assesses the impact of the housing system on animal welfare of cattle, pigs and poultry mainly for organic production. The TGI 200 is another example of on-farm welfare assessment (Sundrum et al. 1994; Sundrum 1997). It is similar to the TGI 35L/2000 but goes beyond certification and can provide advice to farmers. More animal-based indicators were included and the maximum score possible is 200. Other methods utilize mainly animal-based indicators (Tarantola et al. 2020; Brsic et al. 2021), these methods are more accurate but not practical for on-farm assessment due to the length of time required to complete the inspection on the farm (Capdeville and Veissier 2010). The Welfare Quality Assessment Protocols define animal welfare status based on expert opinion (Welfare Quality Network 2009). They assess different aspects of animal welfare using twelve different criteria grouped into four principles (good feeding, good housing, good health and appropriate behaviour) and subsequently cumulates one
comprehensive overall score for on-farm animal welfare (Blockhuis 2008; Botreau et al. 2009; Blokhuis et al. 2010; Andreasen et al. 2013; Heath et al. 2014). The Welfare Quality Assessment cattle protocol (Welfare Quality Network 2009) is a validated tool which can establish the welfare status of cattle using many animal-based welfare measures (Andreasen et al. 2014; Wagner et al. 2021). Blokhuis et al. (2010) proposed that different indicators need to be included in efficient welfare assessment schemes, as all are important. The welfare quality assessment protocol is considered to be a good tool but has been criticized for being time-consuming, difficult to understand, the outcomes are considered to be incorrect (Andreasen et al. 2013, 2014; Grandin 2014) and low discrimination ability have been indicated (De Graaf et al. 2016). Additionally, de Graaf et al. (2018) proposed that the integration method of the welfare quality assessment protocol should be revised to ensure that the relative contribution of the various welfare measures to the integrated scores more accurately reflect their relevance for cattle welfare. Although it is suitable for use in research, many authors believe it needs to be simplified for commercial use or farmers will be reluctant to use it (Andreasen et al. 2013, 2014; Grandin 2014).

There is currently no data available on the status of animal welfare on different beef production farms in Ireland. A method derived from that of Mazurek et al. (2010) was modified and used to assess animal welfare at farm level. There are a wide range of beef production systems in use in Ireland with the two predominate systems today being the grass-based suckler calf-to-beef system and dairy calf-to-beef system. Cattle destined for beef production are categorized into three production stages: (1) Pre-weaning period, (2) Post-weaning (store period) and (3) Finishing phase. The objective of the present study was to assess the welfare status of Irish beef production farms using an animal welfare index (AWI).

2. Material and methods

2.1. Farm selection

The number of farms visited, included, suckler calf-to-beef ($n = 30$), suckler calf/weaning/finishing ($n = 63$), and dairy Calf-to-beef ($n = 12$) were assessed during the winter housing period using the animal welfare index (AWI) developed by Mazurek et al. (2010). The beef Specialist Advisor of the national agriculture research and extension organization (Teagasc) for each county, and Bord Bia (Irish Food Board) in Ireland were contacted to identify farms at random for the AWI assessment. The selected farmers were then contacted by the local Teagasc Adviser to arrange access to the farm for assessment. During the winter housing period (2012–2013) 105 farms were visited in Ireland and data for each indicator were collected for each farm.

2.2. On-farm evaluations

Beef production farms in Ireland were assessed once with housed cattle during the winter period. Two indicators of farm size were collected: (i) number of hectares, (ii) total number of animals in the herd (cows, calves, heifers, bulls, steers). In addition, the working status of the farmer (full-time or part-time; full-time implied that they required more than 0.75 labour units to operate; part-time implied that they required less than 0.75 labour unit to operate).

2.3. AWI indicators

The majority of the indicators listed in Mazurek et al. (2010) were unchanged, while scores for a new category ‘husbandry management’ were included. The definitions of the indicators used are summarized in Tables 1–6. The AWI grouped 51 indicators into six categories: locomotion (six indicators; space allowance, outdoor access, injurious protrusions, ease of locomotion, avoidance distance, grazing time (days per year)), social interactions (eight indicators; space allowance, housing – social groupings, proximity to other animals, calving method, weaning method, outdoor access, social grooming, grazing time (days per year)), flooring (four indicators; type of floor, animal cleanliness, type of yard flooring, housing duration), environment (nine indicators; natural light, artificial light, side openings, draughts, condensation, noise level, disinfection, alarms (fire), grazing time (days per year)), stockmanship (thirteen indicators; access to water facilities, number of animals per drinker, frequency of cleaning water facilities, feed quality, feed refusal quality, cleanliness of calving facilities, lameness, animal body condition score (BCS), tail clipping, experience, background, time spent with animals, interest) and husbandry management (eleven indicators; calving difficulty score, colostrum feeding relative to calf birth, choice of colostrum, cow and calf separation, housing duration, age of calves at weaning, pre-weaning - concentrates, disbudding age, disbudding with anaesthesia, castration age, castration with anaesthetic).

The rating score for each indicator within a category was assigned a value, outlined in Tables 1–6, and summed to give a category score (Mazurek et al. 2010). The six category scores were integrated to give an overall integrated AWI. The minimum score possible was −6 and the maximum score was 90.5 for the AWI (range of 96.5 AWI). Farms were rated with ranks. The same ranking scale was used as that used with the TGI35L/2000. The animal welfare was considered as ‘inadequate’ (IA) between 0 and 15% of the AWI maximum score, ‘adequate’ (A) from 16 to 30%, ‘satisfactory’ (S) from 31 to 50%, ‘good’ (G) from 51 to 60%, ‘very good’ (VG) from 61 to 75 and ‘excellent’ (E) above 75% (Bartussek et al., 2000).

2.4. Definitions of indicators and scores

In the ‘ locomotion’ category, the sub-indicators ‘slats’, indicators ‘injurious protrusions’, ‘outdoors access’ and ‘ease of locomotion’ were assessed (Table 1). The ‘lying down and rising’ indicator from the TGI 35L/2000 was modified and renamed to ‘ease of movement’ in the AWI. The TGI 35L/2000 assesses the ease of lying down/rising in the lying area whereas the AWI includes lying down, rising and ease of movements in the pen. The ‘outdoors exercise’ and ‘pasture/alpine pasture’ indicators from the TGI 35L/2000 were regrouped into the ‘grazing time indicator’ in the AWI (Table 1).
In the ‘social interactions’ category, the ‘calving method’, ‘weaning method’, ‘rest area’ and ‘outdoors access’ indicators were assessed. The ‘social structure of the herd’ and ‘integration of followers’ indicators from the TGI 35L/2000 were regrouped in the ‘age/group mixing’ indicator in the AWI. ‘Outdoors exercise’ and ‘pasture/alpine pasture’ indicators from the TGI35L/2000 were regrouped in the ‘grazing time’ indicator (Table 2).

In the ‘flooring’ category, indicators ‘resilience of floor’ from the TGI 35L/2000 was renamed ‘type of floor’ (Table 3). The ‘slipperiness of floor’ from the TGI 35L/2000 depends on the nature of the flooring and of its cleanliness; this indicator was not used in the AWI. ‘Cleanliness of lying area’ from the TGI 35L/2000 was modified in ‘yard cleanliness’ in the AWI. ‘Slipperiness of outdoors area’ was not used in the AWI; ‘type of floor in the yard’ was used instead. ‘Floor condition of exercise area’ from the TGI35L/2000 was modified as ‘yard cleanliness’ in the AWI, ‘pasture/alpine pasture’ from the TGI 35L/2000 was modified as ‘grassland’ in the AWI (Table 3).

In the ‘environment’ category, the ‘artificial light’ was included (Table 4). The ‘air quality and flow’ indicator from the TGI 35L/2000 was not used but replaced by ‘side openings’ and ‘condensation’ indicators. The ‘days outside per year’ and ‘hours outside per day’ indicators from the TGI 35L/2000 were modified and renamed ‘grazing time’ in the AWI (Table 4).

In the ‘stockmanship’ category, the indicators ‘experience’, ‘background’, ‘time spent with animals’ and ‘level of interest of the farmer’ were included (Table 5). The indicator ‘cleanliness of pens, feeding/drinking areas’ from the TGI 35L/2000 was modified to give 5 indicators, ‘access to water facilities’, ‘number of animals per drinker’, ‘Frequency of cleaning water facilities’, ‘Feed Quality’, ‘feed refusal quality’, and ‘cleanliness of cleaning facilities’. The parameter ‘technopathies’ was not in the AWI but was assessed by the ‘injurious protrusions’ indicator of the ‘locomotion’ category. The indicator ‘state of hooves’ in the TGI35L/2000 was not used and the indicator ‘lameness’ was used instead in the AWI. The indicator ‘animal health’ from the TGI 35L/2000 was renamed ‘diseases’.

A new category score called ‘welfare husbandry management’ included the following indicators: ‘calving difficulty score’, ‘colostrum feed within 2 h of birth’, ‘choice of colostrum’, ‘cows and calf separation’, ‘housing duration’, ‘age of calves at weaning’, ‘pre-weaning - concentrates’, ‘disbudding age’, ‘disbudding with anaesthesia’, ‘castration age’, and ‘castration with anaesthesia’ (Table 6).

When different conditions were observed for an indicator, the ‘worst’ 25% (Bartussek et al. 2000; Mazurek et al. 2010) were used for scoring. For example, if the flooring was dirtier in some areas than others, the dirtiest 25% was used for rating. When scoring the cleanliness of the animals, the 25% dirtiest were observed.

### 2.5. Locomotion (Table 1)

- **Space allowance**

The space allowance was calculated by dividing the total area available in an animal pen by the total Animal Weight Unit (AWU) (one AWU represents 500 kg of live body weight). The space allowance (m²/AWU) score was assigned to the pens with the smallest space allowance ratio in the herd. The size of the pens was measured using a measuring tape. The data on average weight of finished animals, the maximum number of animals in the herd during the year and the maximum number of animals in each pen were requested from the farmer, the first one to calculate the AWUs and the second one to calculate the space allowance where the density was the greatest (lowest m²/AWU) (Table 1).

When animals had ad libitum access to feed, the animals were able to have their head outside the pen, when eating at the feed face, increasing the available area. In that case, the area represented by the length of the feeding space multiplied by 0.7 (extra space out of the pen when eating) was added to the available area (Bartussek et al. 2000). In the case of cubicles, half of the surface they represented was included as the movements of the animals are restricted in cubicles (Bartussek et al. 2000). In the case of slatted floor facilities the maximum score...
Table 2. Indicators in the AWI of the 'Social interactions' category and the definitions used for rating and their maximum individual score.

| Score | (a). Space allowance | (b). Housing – social groupings | (c). Proximity to other animals | (d). Calving method | (e). Weaning method | (f). Outdoor access | (g). Social grooming | (h). Grazing time (days per year) |
|-------|----------------------|-------------------------------|-------------------------------|-------------------|------------------|-----------------|----------------|-------------------------------|
| 3     | >7.5                 |                               |                               |                   |                  |                 |                 | >270                          |
| 2.5   | >6.5                 |                               |                               |                   |                  |                 |                 | >230                          |
| 2     | >5.5                 | Family herd                   |                               |                   |                  |                 |                 | >180                          |
| 1.5   | >4.5                 | Herd without bull             |                               |                   |                  |                 |                 |                               |
| 1     | >3                   | Same age                      | Separate pen                  | Visual contact    | Yes – all of the time | Yes |              | >120                         |
| 0.5   | <2                   | >0.8/0.5                      | No regroup                    | Visual contact    | Yes – partially  | Yes-partially   |              | >50                          |
| -0.5  | <2                   | >0.4/0.3                      | Regroup/age                   | Separate pen      | No               | No              |              |                               |
|       | <3                   |                               |                               | Visual contact    | Abrupt            |                 |              |                               |

| Score | (a). Type of floor | (b). Animal cleanliness | (c). Type of yard flooring | (d). Housing duration |
|-------|-------------------|------------------------|---------------------------|-----------------------|
| 5     | Very clean        |                        |                           |                       |
| 4     | Partially clean   |                        |                           |                       |
| 3     | Medium            |                        |                           | 2–4 months            |
| 2.5   | Straw             |                        | Straw >60 mm              |                       |
| 2     | Straw 30–60 mm    | Soiled                 | Straw 30–60 mm            | 4–6 months            |
| 1.5   | Woodchip/peat     | Woodchip/peat          |                           |                       |
| 1     | Mats              | Very soiled            | Mats                      | 6–8 months            |
| 0.5   | Softer slats      | Softer slats           | Concrete slats            | >10 months            |
| 0     | Concrete slats    | Concrete               |                           |                       |
| -0.5  | Concrete          |                        |                           |                       |

The definitions used for rating, and their maximum individual score for the flooring category. (a), and (c). Softer slats refers to slats that were softer than concrete (for example wooden slats). (b), and (d). Clean: no slurry/mud could be found in the pen (100–80 % for the straw or woodchip/slurry ratio); medium: not more than 3 spots of slurry/mud could be found in the pen for slatted floors (79–60 % for the straw or woodchip/slurry ratio) soiled; more than 3 spots of slurry could be found in the pen (59–40 % for the straw or woodchip/slurry ratio); very soiled: the pen was covered with slurry/mud (less than 40 % for the straw or woodchip/slurry ratio). (e) Score was assigned after checking the paddock size and frequency of new paddock with regard to the size of the herd, boundaries, conditions of alleys and gaps, number of topping per year and frequency of grass reseed and presence of shelters. The total 'Flooring' category score (column 1) equals to the sum of columns (a), (b), (c), and (d). access to the yard at anytime. In the present study, the maximum score assigned was 2; cows usually don’t have access to outside yards due to environmental considerations. The size of the outdoors yards (when present on–farm) was never larger than 5 m² and in the TGI 35L/2000, only yards of at least 5 m² are scored. For this reason, the maximum point that could be assigned in the AWI for the outdoors access indicator was 2. A score of 1 was assigned if the path to the outside yard hampered the animals exiting, if all the animals could not go outdoors at the same time or if they were not allowed access to the yard all of the time because it meant that the time spent outside by animal was lower compared with animals having full access. A score of zero was assigned if the animals did not have access to an outside yard (Table 1).

- Injurious protrusions

If no injurious protrusions were present the score was unchanged. A score of −0.5 was assigned to the indicator if injurious protrusions that were likely to injure the animals were found. Partitions, bars and other parts of the pen that could cause injuries to animals were also observed and recorded as part of the assessment for potential injurious protrusions. Particular attention was given to the nape of the neck, wither, coxal tuberosity, hair coat and joints for the presence of injuries.

- Ease of locomotion

A score of 1 was assigned if the shape of the pens allowed the animals to walk with no restriction in the pen and if they could stand up or lie down normally. If the shape hampered the animals in their locomotion (i.e. if an animal moving from one point of the pen to another had to stop moving because of another animal or because of a part of the pen) or lying down/standing up (low and repetitive head swinging, rocking back and forth etc.) a score of 0 was assigned. A

was 1 (according to the behavioural results of Hickey et al. 2003). In the case of loose housing or tether systems, the scores were not modified from the TGI 35L/2000 since it already covered these house types (Table 1).

- Outdoor yard access

This included yards that provided at least 3 m²/AWU. The maximum score of 2 was assigned if the animals had full access to the yard at anytime. In the present study, the maximum score assigned was 2; cows usually don’t have access to outside yards due to environmental considerations. The size of the outdoors yards (when present on–farm) was never larger than 5 m² and in the TGI 35L/2000, only yards of at least 5 m² are scored. For this reason, the maximum point that could be assigned in the AWI for the outdoors access indicator was 2. A score of 1 was assigned if the path to the outside yard hampered the animals exiting, if all the animals could not go outdoors at the same time or if they were not allowed access to the yard all of the time because it meant that the time spent outside by animal was lower compared with animals having full access. A score of zero was assigned if the animals did not have access to an outside yard (Table 1).
Table 4. Indicators in the AWI of the ‘Environment’ category, the definitions used for rating and their maximum individual score.

| Number | Natural light | Artificial light | Side openings | Draughts | Condensation | Noise level | Disinfection | Alarms (fire) | Grazing time (days per year) |
|--------|---------------|------------------|---------------|----------|--------------|-------------|--------------|--------------|-------------------------------|
| 3      |                |                  |               |          |              |             |              |              | >270                          |
| 2.5    |                |                  |               |          |              |             |              |              | >230                          |
| 2      | Open frontal  | Well lighted     | Yes           | None     | Good         | Yes         | Yes          | >180         | >120                          |
| 1.5    | Very light    | Very light       |               |          |              |             |              |              | >50                           |
| 1      | Light         | Light            |               |          |              |             |              |              |                               |
| 0.5    | Medium        | Medium           |               | Sometimes| Sometimes    | No noise    | Moderate     | Yes           |                               |
| 0      | Dark          | Dark             | No            | Often    | Ok           | Noisy       | No           | No            |                               |
| −0.5   | Very dark     | Very dark        |               | Always   | Bad          | Intense     |              |              |                               |

(a). Open fronted animal houses were considered as optimal conditions for light. The percentage of window area with light directed to the animals compared with the total surface floor was measured. Very dark: 0 % (no natural light), very light 15 %. (b). If no artificial light was present, the score assigned was −0.5. In case of neon or compact fluorescent lights (CFL’s), if less than one light per 5 m² was present the score assigned was 0. If 1–1.5 lights per 5 m² were present, the score assigned was 0.5; 1 was assigned if between 1.6 and 2 lights per m² were present and 1.5 was assigned if more than 2 lights per 5 m² were present. In case of halogen lights, 0 was assigned of there was less than one lamp per 15 m², 0.5 if there was between 1.6 and 2 lights per m² and 1.5 if there was more than 2 lights per m². (c). Represents the presence or absence of side openings. (d). Draughts were considered when air flow was greater than 0.2 m/s. (e). Air humidity was assessed subjectively with the forearms: if no humidity was felt the maximum score was assigned, if humidity could be clearly felt the minimum score was assigned. (f) Noise of the fans and ventilation systems were assessed subjectively, the maximum score was assigned if no ventilation system was present. If a ventilation system was present and the noise was irritating for the ear, the minimum score was assigned. The total environment score (column 1) equals to the sum of columns (a), (b), (c), (d), (e), (f), (g), (h), and (i).

score of −0.5 was assigned if the shape of the pens was restraining the animals’ movements to a critical point (animals that could not move much or that could not move at all) and they had extreme difficulties to stand up or lie down.

- Grazing time per year

The indicator ‘pasture/alpine pasture’ from the TGI 35L/2000 was not applicable in the conditions of the study because there was no alpine/mountain landscapes in Ireland. The indicator was renamed ‘grazing time per year’ and the same scoring system as in the TGI 35L/2000 was used. A minimum score of 1 was assigned if the animals stayed more than 50 days per year at grass. A maximum score of 3 was assigned if the animals stayed more than 270 days at grass per year (Table 1).

2.6. Social interactions (Table 2)

This category represents the level of social interactions using resourced-based indicators.

- Space allowance

The same indicators were used as was outlined for the ‘locomotion’ category.

- Age of the animals / groups mixing

This indicator was scored using the same scoring system as in the TGI 35L/2000. Family herds consisted of suckler cows with male and female calves, heifers and steers born in the herd and/or bulls in the same pen or if the bulls were in an adjacent separated pen. This reflects the natural herd structure (Bartussek et al. 2000; Wharton 1957). A score of 1 was assigned if the bulls were housed in separate pens and could not be seen by the other animals (or if the farmer was using artificial insemination and there was no bull on-farm) and/or the animals were grouped regarding their age, thus animals of the same age in a pen, with no regrouping. A score of 0 was assigned if minimal regrouping occurred during the year or if between 10 and 50% of buying-in occurred during the year. If frequent mixing and/or a significant gap in the age (of animals that were not from the same family were issued from different sources) of the cattle of one same pen occurred and if more than 50% of animals were bought each year then the score was −0.5.

- Rest area

Cubicles allow animals to rest in a private space and avoid negative interactions with more dominant animals (Bartussek et al. 2000). The presence of cubicles, straw resting areas or yard used for rest (if the yard flooring was concrete the score was 0) was scored 0.5; their absence was scored 0.

- Weaning method

In nature, calves get independence gradually by drinking less and less milk from the dam and by foraging more and more. A score of 1 was assigned if the weaning process was gradual and calves had visual contact with the dams during weaning because it reflects the natural behaviour of the animals. A score of 0 was assigned if no visual contact was possible. If the cows had to calve in the pen amongst other animals, a score of −0.5 was assigned.

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2.7. Flooring (Table 3)

- Type of floor, cleanliness of floor

The score assigned to the floor type is shown in Table 3. If several types of flooring were present in the pen, the worst
### Table 5. Indicators in the AWI of the 'Stockpersonship' category, the definitions used for rating and their maximum individual score.

| Score | (a). Access to water facilities | (b). Number of animals per drinker | (c). Frequency of cleaning water facilities | (d). Feed quality | (e). Feed refusal quality | (f). Cleanliness of calving facilities | (g). Lameness | (h). Animal body condition score (BCS) | (i). Tail clipping | (j). Experience | (k). Background | (l). Time spent with animals | (m). Interest |
|-------|---------------------------------|-----------------------------------|------------------------------------------|-----------------|--------------------------|-------------------------------------|---------------|-------------------------------|-----------------|-----------------|-----------------|-----------------|----------------|
| 2     | Very good                       | Good                              | Adequate space                           | Daily           | Excellent                 | Good                                 | Good          | Very good                     | Average         | Great           | Family          | Frequent on a daily basis | High interest |
| 1     | Good                            | Adequate space                    | Daily                                    | Excellent       | Good                      | Good                                 | Good          | Average                       | Yes             | Family          | Average interest | High interest |
| 0.5   | Medium                          | Good                              | Adequate space                           | <5 %            | Medium                    | Poor                                 | 5–10 %        | No                            | Other Infrequent| Average interest | Low interest    | Infrequent       |
| 0     | Poor                            | Partially restricted              | Medium                                   | Medium          | Poor                      | 5–10 %                               | No            | No                            | Older than 9 months of age | Yes             | Older than 6 months of age | Yes             |
| −0.5  | Very restricted                 | Infrequent                        | Poor                                     | Poor            | >10 %                     | Little                               | No            | No                            | Older than 6 months of age | Yes             | Older than 6 months of age | Yes             |

(a), (b), and (c). The troughs were considered clean when the water was clear, no algae could be seen in the water and no mud/slurry was present on them. Troughs were considered medium when the water was clear but small amount of algae could be found and/or few spots of mud/slurry of less than 2 cm in diameter were present on them. They were considered insufficient if the water started to be blurred but it was still possible to see through it, if the amount of algae was preponderant and if many spots of less than 2 cm in diameter of mud/slurry were present on them. They were considered soiled if the water was blurred and it was not possible to see through it, if algae colonized the troughs and if mud/slurry covered the troughs or many spots of more than 2 cm of diameter were found. (e) Clean animals were covered with less than 10% of slurry/mud, medium between 11 and 20% and soiled over 20%. (g) The list of diseases and symptoms consisted of: mild diseases (scours, worms, parasites) and severe diseases (bovine viral diarrhoea (BVD), bovine respiratory disease (BRD), Johne's disease, tuberculosis, leptospirosis and black leg). A maximum score of 1 was assigned if no disease was reported. A score of 0.5 was assigned if up to 2 mild diseases or symptoms were reported. A score of 0 was assigned if the presence of one or two severe diseases or more than two mild diseases were reported. (i) This indicator is subjective and the interest of the farmer was assessed using a questionnaire and face-to-face interview. The total Stockpersonship score (column 1) equals to the sum of columns: (a), (b), (c), (d), (e), (f), (g), (h), (i), (j), (k), (l), and (m).

### Table 6. Indicators in the AWI of the 'Husbandry management' category, the definitions used for rating and their maximum individual score.

| Score | (a). Calving difficulty score | (b). Colostrum feed within 2 h of birth | (c). Choice of colostrum | (d). Cow and calf separation | (e). Housing duration | (f). Age of calves at weaning - concentrates | (g). Pre-weaning age | (h). Disbudding age | (i). Disbudding with anaesthesia | (j). Castration age | (k). Castration with anaesthetic |
|-------|------------------------------|--------------------------------------|-------------------------|--------------------------|-------------------|-------------------------------------|------------------------|-----------------|--------------------------------|-----------------|-----------------------------|
| 3     | Very easy                    | Yes                                  | Natural                 | After 11–20 days         | 6–8 months        | Older than 9 months old             | Yes                    | Younger than 2 weeks old         | Yes             | Younger than 6 months of age | Yes             |
| 2     | Easy                         | Yes                                  | Natural                 | After 4–10 days          | 6–8 months        | Between 6 and 9 months old          | Yes                    | Younger than 2 weeks old         | Yes             | Younger than 6 months of age | Yes             |
| 1.5   | Medium                       | Yes                                  | Stomach tube            | After 1–3 days           | 8–10 months       | Older than 6 months                 | Yes                    | Younger than 2 weeks old         | Yes             | Younger than 6 months of age | Yes             |
| 1     | Medium                       | Yes                                  | Nipple bottle           | After 4–10 days          | 6–8 months        | Older than 6 months                 | Yes                    | Younger than 2 weeks old         | Yes             | Younger than 6 months of age | Yes             |
| 0.5   | Medium                       | Yes                                  | Nipple bottle           | After 4–10 days          | 6–8 months        | Older than 6 months                 | Yes                    | Younger than 2 weeks old         | Yes             | Younger than 6 months of age | Yes             |
| 0     | Very difficult               | No                                   | Stomach tube            | After 1–3 days           | 8–10 months       | Older than 6 months                 | No                     | Older than 6 weeks               | No              | Older than 9 months of age    | No              |
| −0.5  | Very difficult               | No                                   | Stomach tube            | After 1–3 days           | 8–10 months       | Older than 6 months                 | No                     | Older than 6 weeks               | No              | Older than 9 months of age    | No              |

The total 'welfare husbandry management score' (column 1) equals to the sum of columns: (a), (b), (c), (d), (e), (f), (g), (h), (i), (j), (k), (l), and (m).
one was used for scoring and the dirtiest 25% of the area was used to score the cleanliness of the floor.

2.8. Outside yard; type of yard floor and yard floor cleanliness

The same parameters as those used to score the type of floor were also used to score this indicator.

2.9. Environment (Table 4)

- Natural light
  Open fronted housing represented buildings with an area of at least 0.45 m²/AWU to unrestricted access to open air. The minimum height of these openings had to be 1 m. Open fronted area represented the best light conditions for the animals (Bartussek et al. 2000). If the building was not open fronted, the assessment of the natural light indicator that was directed at the animals was performed using the percentage of window area relative to the floor area was measured (0% was considered as very dark; no natural light; 15% and more as very light), the position of the open areas with access to direct daylight, on walls and/or roof and the cleanliness of the windows had to be taken into account to score the natural light.
  - Artificial light
    The number of lights and their strength relative to the floor area of the building were used to assess the artificial light indicator. If no artificial light was present, the score assigned was −0.5. In the case of neon lights or CFLs if less than one light per 5 m² was present the score assigned was 0. If 1–1.5 lights per 5 m² were present the score was 0.5; 1 was assigned if between 1.6 and 2 lights per 5 m² were present and 1.5 was assigned if more than 2 lights per 5 m² were present. In case of halogen lights, 0 was assigned if there was less than one light per 15 m², 0.5 if there was between 1 and 1.5 lights per 15 m², 1 if there was between 1.6 and 2 lights per 15 m² and 1.5 if there was more than 2 lights per 15 m². This was based on an average of 50 W for neon and CFL and 500 W for halogen lights but it was not possible to know the exact light intensity received by the animals. It was not possible to measure the light intensity with technical equipment.
  - Side openings
    Side openings contribute to a good airflow and thus air renewal in the buildings. The presence of side openings on the walls of the housing facilities was scored as 0.5, the absence of the latter was score 0.
  - Draughts
    Areas that were likely to have draughts (along the walls adjacent to doors, gates and openings) were examined using the AWI (Bartussek et al. 2000). Draughts were considered when air flow was greater than 0.2 m/s (Table 4) using an anemometer. If no draughts could be found and the building’s structure was designed to reduce them, a maximum score of 1 was assigned. The minimum score of −0.5 was assigned if draughts could be found in only one part of the building and if the shape of the building allowed frequent draughts.
  - Noise levels
    The building was checked for presence of fans/ventilation system to assess the noise levels. A score of 1 was assigned if the noise levels on-farm were very low, for example if there was natural ventilation and no mechanical ventilation. The minimum score of −0.5 was applied in the case of a very noisy environment (ventilation made by fans that start to be irritating for the human ear, that is to say around 70 dB). It was not possible to measure the intensity of noise with technical equipment.
  - Condensation
    This parameter was assessed subjectively because no technical equipment was available to measure the hygrometry of the housing. A maximum score of 0.5 was assigned if no condensation or humidity was felt on the naked forearms of the assessors or if the building was open fronted. A score of 0 was assigned if a sensation of humidity could be slightly felt on the forearm of the assessors (light feeling of air humidity). A score of −0.5 was assigned if the humidity was clearly felt (strong feeling of air humidity) on the forearm of the assessors and if wetness or condensation droplets were noticed on the wall and/or roof.

2.10. Stockpersonship (Table 5)

These indicators reflect how the stockperson manages the housing environment.
  - Cleanliness of water troughs/outdoor troughs
    The troughs were considered clean when the water was clear, no algae could be seen in the water and no mud/slurry was present on them. Troughs were considered slightly dirty when the water was clear but a small amount of algae could be found and/or few spots of mud/slurry of less than 2 cm in diameter were present on them. They were considered insufficient if the water started to be blurred but it was still possible to see through it, if the amount of algae was abundant and if many spots of less than 2 cm of diameter of mud/slurry were present on them. They were considered soiled if the water was blurred and it was not possible to see through it, if algae colonized the troughs and if mud/slurry covered the troughs or many spots of more than 2 cm of diameter were found.
  - Feed space cleanliness
    Clean feeding spaces were assigned the maximum score. If the presence of old feed slurry/mud was found at the feeding place then the maximum score could not be assigned, depending of the amount of old feed/slurry/mud different scores were assigned ranging from 0.5 to −0.5. The score was assigned after the two assessors discussed the cleanliness of the feed space.
  - Condition of the facilities
    The maximum score was assigned when the equipment (chute, race, catching gate and pen bars.) was recent (less than 5 years) and safe. The minimum score was assigned if critical defects could be found and that could be dangerous for the stockperson and/or cattle or if no handling system was present on-farm.
  - Cleanliness of animals
    Animals were assessed on both sides of the body, and were considered clean if they were covered with less than 10% of slurry/mud, medium between 11 and 20% and soiled over 20%.
  - Lameness
A distracter objective was given to the farmer. They were told that the aim of the study was to evaluate the efficiency of vaccines, antibiotics and anthelmintics and were asked for what diseases they were vaccinating against, which anthelmintics they were using, what antibiotics they were using for the treatment of diseases. If they were dosing animals and if they noticed the diseases or symptoms after the treatments in the last year. The presence of lameness in cows was reported by the farmer. A maximum score of 0.5 was assigned if less than 5% of cows were lame; a score of 0 if between 5 and 9% of cows were lame and −0.5 if 10% or more of cows were lame.

- Background

Stockpersons with an agricultural background (family farming) were assigned a score of 1 while those with no agricultural background received a score of 0.

- Interest of the stockperson

The interest of the farmer was evaluated using five questions. The farmers were asked ‘How much time do you spend with the animals?’ ‘Would you spend more time if you could?’ ‘How do you consider farming nowadays?’ ‘What training did you receive?’ ‘Were you happy with the training?’ This parameter was very subjective as it was possible that the farmers could have been dishonest and it was also relative to the operators. The scores were 1 if the answers were going toward a good interest, 0.5 if the interest seemed to be average −0.5 if the interest seemed to be low.

### 2.11. Husbandry management category

The definitions used for rating and their maximum individual score are presented in Table 6 for; calving difficulty score, colostrum feed within 2 h of birth, choice of colostrum, cow and calf separation, housing duration, age of calves at weaning, preweaning - concentrates, disbudding age, disbudding with anaesthesia, castration age and castration with anaesthetic

For each category, the indicators were evaluated and the farm was scored. The score for each indicator within a category was summated to give a category score. The category scores were then summated to give an AWI. The minimum score possible was −6 and the maximum score was 90.5, with a range of 96.5 points. The raw score was transformed into a relative score.

### 2.12. Statistical analysis

Statistical analyses were carried out with the programme SAS® 9.4 (SAS Institute Inc., Cary, NC, USA). The AWI and the category scores were tested for normality using a Shapiro–Wilk test (SAS 9.4). Mann–Whitney tests were performed to determine the differences in individual indicator scores (not continuous variable) and Spearman’s rank correlation coefficients (Rs) were performed to identify the correlations of the number of animals and the interest of the farmers with the other indicators of the AWI.

### 3. Results

#### 3.1. Farms status

The mean size of the farms and mean number of animals per farm were; 99 ha and 191 animals for the suckler calf-to-beef farms; 74.8 ha and 148 animals for the suckler calf-to-weaning/store-to-finish; and 105.8 ha and 272 animals for the dairy calf-to-beef farms. The total number of cattle per individual enterprise are presented in Table 7. Eighty-one % of the interviewed farmers were full-time (FT) and 19% were part-time (PT) (Table 8).

In Ireland, the predominant (86.0%) floor type used in beef housing systems is concrete slatted floors (CS). Within farms using CS, 55% use CS alone, 13% CS covered with rubber matting (RM), 15% CS combined with a straw-bedded area, 3.0% CS combined with cubicles. The remainder (14.0%) of farms use straw-bedding alone (10.0%), and cubicles with RM (4.0%).

The suckler calf-to-beef farms had Limousin × (40.3%), Simmental × (14.5%) and Charolais × (25.8%) cow breeds, respectively. Of these farms, 25%, 42% and 15% used Limousin, Charolais and Aberdeen Angus sire breeds, respectively. The suckler calf/weaning/finishing farms had Limousin × (39.3%), Simmental × (20.2%) and Charolais × (21.3%) cow breeds. Limousin (34.9%) and Charolais (41.9%) were the main sire breeds used. On the dairy calf-to-beef farms, 66.7% and 33.3% used Holstein and Holstein × Friesian cow breeds with 25%, 33% and 25% using Holstein, Aberdeen Angus and Holstein × Friesian sire breeds, respectively. The cow culling rate in the Irish beef production systems was 5-10%.

#### 3.2. Category scores and integrated AWI cores

##### 3.2.1. Locomotor category

There was no difference (P > 0.05) in the scores for density, loose housing, tether system, outdoor access, injurious protrusions, shape of pen, avoidance or grazing time across the three systems or between full-time and part-time farmers (Table 8).

##### 3.2.2. Social interaction category

There was no difference (P > 0.05) in the scores for social (density slats, loose housing, tether system, number of animals per group, proximity, outdoor access, calving method, weaning procedure, social licking and grazing)

### Table 7. The total land area (ha) and number of animals/farm. Values are expressed as mean (± s.d.).

| Beef production system | Land owned (ha) | Land rented (ha) | Total land area (ha) | Total number of Animals |
|------------------------|----------------|-----------------|----------------------|-------------------------|
| Suckler calf-to-beef (n = 28) (FT) | 84.6 ± 78.75 | 16.7 ± 23.75 | 101.3 ± 80.35 | 196 ± 64.95 |
| Suckler calf-to-beef (n = 2) (PT) | 43.5 ± 24.75 | 17.0 ± 24.04 | 60.5 ± 0.71 | 121 ± 0.00 |
| Suckler calf/weaning/finishing (n = 45) (FT) | 63.9 ± 35.03 | 16.4 ± 33.48 | 80.5 ± 44.60 | 162 ± 123.30 |
| Suckler calf/weaning/finishing (n = 18) (PT) | 50.6 ± 45.83 | 10.7 ± 15.84 | 61.2 ± 49.96 | 135 ± 92.38 |
| Dairy calf-to-beef (n = 12) (FT) | 72.8 ± 54.41 | 33.0 ± 28.08 | 105.8 ± 68.58 | 272 ± 115.57 |
across the three production systems or between full-time and part-time farmers (Table 8).

### 3.2.3. Flooring category

There was no difference ($P > 0.05$) in scores for animal cleanliness, type of yard, housing duration between full-time and part-time farmers (Table 8).

### 3.2.4. Environment category

There was a difference ($P < 0.05$) in artificial light and creep facilities between FT and PT. There was no difference ($P > 0.05$) in scores for natural light, side-openings, draughts, condensation, noise level, disinfection, alarms, grazing time, lights-on, crush side-openings, weaning facilities, housing facilities, across the three production systems or between full-time and part-time farmers (Table 8).

### 3.2.5. Stockpersonship category

The time spent score was more frequent ($P < 0.05$) on a daily basis for full-time compared to part-time farmers. There was no difference ($P > 0.05$) for access to water facilities, number of animals per drinker, frequency of cleaning water facilities, feed quality, feed refusal quality, cleanliness of calving facilities, lameness, animal body condition score, clipping of hair on tails, stockperson experience, background, and interest across the three production systems or between full-time and part-time farmers (Table 8).

### 3.2.6. Husbandry management category

The calving difficulty score and castration age score were different between full-time and part-time farmers. There was no difference ($P > 0.05$) between full-time and part-time farmers for housing duration, colostrum feeding practices, colostrum method, cow calf separation, disbudding, disbudding age, castration age, weaning age, pre-weaning concentrate feeding, weaning procedure (Table 8).

### 3.2.7. Integrated AWI scores

There was no difference in overall AWI across the three Irish beef production systems and no difference ($P > 0.05$) in the integrated AWI between FT and PT farmers (Table 9).

### 3.3. Correlations

On the suckler calf-to-beef farms, the social ($R_S = 0.47, P < 0.01$), environment ($R_S = 0.67, P < 0.0001$), stockperson ($R_S = 0.50, P < 0.001$) and animal husbandry ($R_S = 0.48, P < 0.01$) categories were significantly correlated with the integrated AWI. On the suckler calf/weaning finishing farms the social ($R_S = 0.630, P < 0.0001$), environment ($R_S = 0.55, P < 0.001$), stockperson ($R_S = 0.51, P < 0.001$) and animal husbandry ($R_S = 0.32, P < 0.05$) category scores were significantly correlated with the integrated AWI score. On the dairy calf-to-beef farms the environment ($R_S = 0.65, P = 0.03$) and stockperson ($R_S = 0.68, P = 0.02$) category scores were significantly correlated with the integrated AWI.

### 4. Discussion

To our knowledge, this is the first study applying the AWI protocol to the different types of beef producing farms in Ireland. In agreement with the findings of Bartussek (1999) and Mazurek et al. (2010), it was possible to define an on-farm welfare assessment score using the AWI. Over two-thirds of farms visited (82%) were managed by full-time farmers and 19% by part-time farmers. By full-time farmers, it is implied that they require more than 0.75 labour units to operate (Connolly et al. 2005).

The overall mean percentage of the AWI for the suckler calf-to-beef, suckler calf/weaning/finishing, dairy calf-to-beef farms were rated as very good. If the overall AWI score is below 15% welfare is considered as not suitable or not sufficient; between 16 and 30% as scarcely suitable or sufficient; 31–50% as

### Table 8. The mean category scores and integrated AWI scores for part-time (PT) and full-time (FT) farmers. The values are expressed as mean (± s.d.).

| Beef production system | Locomotion | Social | Flooring | Environment | Stockperson | Husbandry management | Integrated AWI | P values |
|------------------------|------------|--------|----------|-------------|-------------|----------------------|---------------|----------|
| Suckler calf-to-beef (n = 28) (FT) | 63.0 ± 5.60 | 76.5 ± 5.33 | 59.6 ± 5.78 | 61.8 ± 7.36 | 74.9 ± 8.72 | 52.8 ± 7.92 | 70.3 ± 3.27 | NS |
| Suckler calf-to-beef (n = 2) (PT) | 64.3 ± 0.00 | 80.6 ± 0.00 | 57.7 ± 0.00 | 61.3 ± 1.77 | 66.1 ± 7.58 | 53.6 ± 0.00 | 69.6 ± 0.78 | NS |
| Dairy calf-to-beef (n = 12) (FT) | 64.6 ± 3.87 | 69.9 ± 4.83 | 57.1 ± 3.96 | 56.0 ± 9.01 | 78.3 ± 4.43 | 39.3 ± 16.90 | 66.6 ± 3.95 | NS |
| Suckler calf/weaning/finishing (n = 45) (FT) | 64.9 ± 4.26 | 73.3 ± 8.52 | 58.5 ± 5.49 | 59.8 ± 9.59 | 73.4 ± 8.73 | 53.3 ± 7.29 | 72.3 ± 2.30 | NS |
| Suckler calf/weaning/finishing (n = 18) (PT) | 63.1 ± 4.42 | 72.0 ± 9.19 | 58.5 ± 2.49 | 58.6 ± 8.41 | 71.2 ± 8.70 | 54.2 ± 5.49 | 71.2 ± 1.59 | NS |

NS = not significant

### Table 9. The mean category scores and integrated AWI score for the suckler calf-to-beef (n = 30), suckler calf to weaning/store (n = 63), and dairy calf-to-beef (n = 12) systems. The values are expressed as mean (± s.d.).

| Beef production system | Locomotion | Social | Flooring | Environment | Stockperson | Husbandry management | Integrated AWI |
|------------------------|------------|--------|----------|-------------|-------------|----------------------|---------------|
| Suckler calf-to-beef (n = 30) | 63.1 ± 5.41 | 76.7 ± 5.32 | 59.5 ± 5.60 | 61.7 ± 7.10 | 74.3 ± 8.80 | 52.9 ± 7.63 | 70.3 ± 3.61 |
| Suckler calf/weaning/finishing (n = 63) | 64.5 ± 4.35 | 73.1 ± 8.64 | 58.6 ± 4.81 | 59.6 ± 9.16 | 72.8 ± 8.77 | 53.6 ± 6.74 | 71.9 ± 2.15 |
| Dairy calf-to-beef (n = 12) | 64.6 ± 3.86 | 69.9 ± 4.84 | 57.1 ± 3.96 | 56.0 ± 9.01 | 78.3 ± 4.41 | 39.3 ± 16.91 | 66.6 ± 3.94 |

*Within a column, means having different superscript letters indicating significant differences ($P < 0.05$).
somewhat suitable or satisfactory; between 51 and 60% as fairly suitable or good; between 61 and 70% as suitable or very good and more than 70% as very suitable or excellent. The present findings are in agreement with the study by Mazurek et al. (2010) who reported an overall AWI in the range of 66.7% to 71.9% for 196 beef suckler farms (suckler calf/weaning/finishing). When well-managed, both pasture-fed and continuously housed systems bring welfare benefits. Grazing may offer many opportunities to express normal behaviours and access to abundant diverse pasture, which promotes ruminal and overall health. Continuous housing may enable close monitoring of food and water intake and high biosecurity. However, even when well-managed, each system also has potential weaknesses. For example, grazing brings increased biosecurity risks from faecal contamination of pasture. Continuous housing may inhibit normal behaviour and within restricted indoor environments there is an increased risk of bullying by dominant animals. The question is if the system is suitable. Does it provide what an animal needs?

Much research on farm animal welfare has mainly addressed welfare issues that are considered common in intensive systems, whereas, welfare of animals in more extensive systems has received much less attention (Grandin and Manteca 2020). In Ireland, due to seasonality in growth and supply of grass, grass-based beef production systems usually comprise of a grazing season and an indoor winter period annually (Drennan and McGee 2009). Within such systems, spring-born suckler-bred ‘weanling’ cattle, that previously spent a 7-to-8 month grazing season sucking their dam, are generally housed indoors for a 4-to-5 month period, and offered a relatively low energy diet to support moderate live-weight gain (‘backgrounding’ phase) and avail of compensatory growth during the subsequent grazing season (McGee et al. 2014). Similarly, older animals may be finished indoors over 4-to-5 months on a relatively high-energy diet following a second grazing season (Drennan and McGee 2009) or at other times.

Dairy calves, in contrast to beef calves, are commonly separated from their dam a few hours after birth to allow the collection of milk from their dams. In grass-based dairy-beef steer production systems (e.g. McGee et al. 2005; Keane and Drennan 2009; Murphy et al. 2007, 2018), spring-born calves are typically offered milk replacer plus concentrates over an indoor rearing period of 8 weeks, turned out to pasture in May, and housed at the end of the grazing season (October).

During the ‘first’ winter indoor (‘store’ feeding period, animals consume a restricted-energy diet based on grass silage and supplementary concentrates, followed by a ‘second’ grazing season (March-October/November) exploiting compensatory growth (Ashfield et al. 2014). During the ‘second’ indoor winter period steers are offered grass silage and concentrates, and some animals are finished at 24-months of age. The remaining animals are finished during the third grazing period.

Most of the farm welfare assessment methods that have been developed to date are directed at intensive systems. The methods are resource-based, some animal-based or a combination (Johnsen et al. 2001; de Vries et al. 2013; Kirchner et al. 2014; Kaurivi et al. 2020). Animal welfare audits (e.g. Cook 2018) and private standards have been designed to improve animal health and welfare (Main et al. 2001, 2014; Metz et al. 2015; Lundmark et al. 2018). More et al. (2021) highlighted the potential value of private standards and associated quality assurance programmes to improve dairy cow welfare. Indeed, evaluation of resource provision is considered one of the best ways of assessing positive welfare at present, in the absence of validated and practical animal-based measures (Rowe and Mullan 2022). Animal-based indicators are more likely to be a better assessment of animal welfare than resource-based indicators (Johnsen et al. 2001; Keeling and Bock 2007), since they are easy to evaluate on-farm (for example, the flight test, docility test, handling test) and are not demanding in time and labour from the farmer. Animal-based indicators are easy to assess under controlled experimental conditions and give a good idea of animals’ perception but are not always practical for on-farm assessment (Johnsen et al. 2001).

A limitation of the present study was that more focus was on the resource-based measures and this was mainly due to the limited time available to do the welfare assessment. Consequently, several animal-based measures had to be replaced by resource-based ones, losing information about some aspects of welfare while mainly assessing only conditions predisposing for welfare issues.

In the present study, using the overall integrated score allowed compensation for poor conditions in one category, by better scores in another one, for example a lower score in the ‘locomotion’ category could be compensated by a better score in the ‘environment’ category. However, a check of the minimal requirements was performed before scoring a farm. Minimum requirements were checked by the individual operator carrying out the assessments and included the feeding (animals need to be fed every day and in sufficient quantity), drinking (animals need constant water supply) and a minimum space allowance described in the EU scientific report about the welfare of cattle kept for beef production (SCHAHW 2001). If one of the minimal requirements was not achieved then the AWI was considered as ‘inadequate’ and indicators were not assigned a score.

The AWI indicators used in the present study were in the original TGI 35L/2000 (Bartussek et al. 2000), some of these indicators were modified and new indicators were also used on farms. Some indicators from the TGI 35L/2000 were not used, for example, the levels of CO₂ and NH₃ in the animal housing. It is reported in the literature that the background of the farmer is important in the detection of welfare problems (Lensink, Raussi, et al. 2001; Lensink, Veissier, et al. 2001), therefore the indicator ‘background’ was included in the AWI assessments. The importance of the ‘interest of the farmer’ in the management of animal well-being is well documented (Hemsworth 2003), thus the ‘level of interest’ indicator was included in the AWI.

In the present study, the ‘locomotion’ category score was reduced this may be because locomotion was limited during housing as most of the housing types did not have access to an outside yard during winter and cattle were housed on concrete slatted floors. However, under Irish Environmental regulations, outdoor yards are discouraged for environmental protection reasons. This explains why most farms do not
have access to outdoor yards. However, this is counterbalanced by the fact that the animals remain a longer time at grass throughout the year (Drennan and McGee 2008, 2009). The ‘flooring’ category score was lower because most of the farmers use concrete slatted floor sheds rather than loose housing. Fully slatted systems for finishing and growing cattle usually have high stocking rates, which are necessary to ensure that faecal material is trodden through the concrete slats. All animals were able to lie down at the same time and feed access was typically good (Keane et al. 2018).

The number of diseases and the level of lameness should be taken into account for an accurate assessment of the animals’ welfare. Health and lameness levels were reported by the farmers, assessing these indicators directly by the assessor would demand substantially more time. In the present study, lameness detection was reported by the farmers, however, the perception of lameness by the farmer is an underestimation of the real value (Wells et al. 1993; Whay et al. 2002; Whay 2019). A more recent study by Browne et al. (2022), reported that fifty-seven percent of farmers were not familiar with lameness scoring. It is possible therefore that the level of welfare reported in the present study could be overestimated because of this. This is a drawback of the method, which leads to a higher score than the farm would get with a locomotion scoring. It is possible therefore that the level of welfare reported in the present study could be overestimated because of this. This is a drawback of the method, which leads to a higher score than the farm would get with a locomotion scoring made by an independent assessor. Consequently, the 25% worst animals should be identified on-farm and used to rate the indicator of lameness if it is not possible to inspect all the animals by an independent assessor. Two inspections should be done: when the animals are at grass, and when they are housed.

The ‘social’ and ‘stockpersonship’ category had the highest scores placing these categories as ‘Excellent’ for both full-time and part-time farmers. In the present study, new indicators regarding calving conditions and weaning methods were included. The ‘stockpersonship’ category included the new indicators, the ‘interest of the farmer’ and ‘background of the farmer’ since they have an impact on animal welfare (Lensink, Veissier et al. 2001; Hemsworth 2003). The importance of the ‘interest of the farmer’ in the management of animals is well documented (Hemsworth 2003). The present study confirmed the importance of the farmer by his level of interest. There was a strong positive correlation between ‘the interest of the farmer’ and the AWI. The ‘interest of the farmer’ however, was not correlated with the number of animals and this is in agreement with Hemsworth (2003) or with the land area (Mazurek et al. 2010). If a farmer is interested but has wrong beliefs, this can have an impact on his animals (Lensink et al. 2003). It would be of interest to analyse and understand the human animal relationship (HAR) in order to include relevant indicators that would be accurate and quick to assess. The ‘interest of the farmer’ used in the AWI is a subjective indicator that could be replaced by a test assessing the quality of the human animal relationship such as the avoidance test proposed by Windschnurer et al. (2009). The underlying assumption of the avoidance test being that animals that are fearful of the human handler will keep the greatest distance. In the present study, it was not possible to observe the farmer while working with animals for reasons of timing, however, this is an indicator that could be included in future welfare assessments.

5. Conclusion

This study demonstrated the very good welfare standard of the three Irish beef production systems and confirmed the importance of the farmer by his level of interest which was highly correlated with the ‘stockpersonship’ category score. A strong positive correlation was also found between the interest of the farmer and the AWI. More generally, a greater level of interest was linked with less lameness (reported by the farmer), a better cleanliness of the equipment, floor and of the animals, less diseases (reported by the farmer), better ‘environment’ category score and better ‘artificial lights’ score due to better buildings, a better ‘locomotion’ category score, better weaning methods and better ‘social interactions’ category scores.

The present method was easily applicable on-farm. The evaluation of the different indicators allowed the inspection to last 30 min at housing. Health and lameness levels were reported by the farmers, assessing these indicators directly by the assessor would demand substantially more time. The welfare, health and management of farm animals are important factors that need to be considered in order to maintain optimal animal welfare and increase consumer acceptance of animal production in the near future.

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