



Analysis of animal welfare risks from unloading until slaughter

Red meat livestock species

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WAGENINGEN UR

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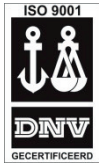
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Livestock Research Report 805

Table of contents

	Preface	7
1	Introduction	9
	1.1 Background	9
	1.2 Objectives	9
2	Material and methods	10
	2.1 Development of Table for Risk Analysis Animal Welfare	10
	2.2 Estimation of the magnitude	11
	2.3 Evaluation of consequences for food safety	12
3	Results	13
	3.1 Table for Risk Analysis Animal Welfare	13
	3.2 Magnitude of adverse effects	13
	3.2.1 Discomfort while walking	14
	3.2.2 Intoxication	14
	3.2.3 Cold stress	14
	3.2.4 Respiratory problems	14
	3.2.5 Insufficient foothold	14
	3.2.6 Wounds	15
	3.2.7 Desnutrition	15
	3.2.8 Frustration	15
	3.2.9 Aggression	15
	3.2.10 Fear (general)	16
	3.2.11 Fear of humans	16
	3.2.12 Bruises	16
	3.2.13 Fatigue	16
	3.2.14 Dehydration	17
	3.2.15 Heat stress	17
	3.2.16 (Continued) suffering	17
	3.2.17 Physical pain	17
	3.2.18 Ruptures	18
	3.2.19 Suffocation	18
	3.2.20 Fractures	18
	3.3 Possible consequences for food safety	18
	3.3.1 Risk related to food safety and animal welfare during the first phases of slaughtering (arrival - bleeding)	18
	3.3.2 Explanation of specific food safety consequences	19
4	Discussion and conclusion	21
	4.1 Methodology	21
	4.2 Results	21
	4.3 Conclusion	21
	Acknowledgements	22
	References	23
	Appendix 1 - info for experts	25
	Appendix 2 - Table	27

Preface

The time animals reside at the slaughterhouse is a critical phase for the welfare of the animals because they are exposed simultaneously to a variety of stressors that may result in high levels of fearfulness and pain, inducing psychological and physical stress, thus compromising their welfare. To assess animal welfare the different components of a risk assessment need to be established. In the current project, a table of hazards and adverse effects is developed for the red meat species: bulls, veal calves, cull cows, slaughter pigs, horses and lambs. Additionally, a magnitude (severity x duration) is assigned to each adverse effect. Furthermore, the possible risk for food safety for the adverse effects has been considered.

Dr. ir. Kathalijne Visser

1 Introduction

1.1 Background

The NVWA – BURO (Agency for Risk assessment and Research Programming) carries out risk analyses and risk profiling for all domains of food production, focusing on plant and animal health, animal welfare and food quality and safety. The overall aim of these analyses is to further improve the specific and risk based supervision by the NVWA of the food production process.

Incidents and lack of transparency in some parts of the food production chain caused discussions and commotion about animal welfare and food safety in both society as well as in Parliament. Examples like the 2013 meat adulteration scandal (foods advertised as containing beef were identified to contain undeclared or improperly declared horse meat and other undeclared meats such as pork), welfare and food safety issues regarding imported horse meat urged European authorities to find an EU wide solution.

The NVWA has asked WUR Livestock Research to list the main hazards and adverse effects to animal welfare of red meat species at small and medium abattoirs. The request concerned horses, pigs and cattle. As many more sheep lambs are slaughtered in The Netherlands compared to horses (in 2013 585,000 and 8,300 killings, respectively), it was proposed to include slaughter lambs as well.

1.2 Objectives

This study aims to:

1. provide the NVWA - BURO with a list of animal welfare hazards, their adverse effects from unloading to the time of sticking, for slaughter lambs, meat horses, slaughter pigs, veal calves (including rosé and white meat category), beef bulls and culled dairy cows at small and medium sized slaughter plants in the Netherlands.
2. value the adverse effects in terms of severance (magnitude) and rank the adverse effects per species into 8 categories (0=no adverse effect, 7=high degree of suffering/death).
3. identify which of the listed hazards can have a(n) (in)direct consequence for food safety when consuming the animals which suffered from the adverse effects

2 Material and methods

2.1 Development of Table for Risk Analysis Animal Welfare

In 2012 the European Food Safety Authority (EFSA) published their scientific opinion: Guidance on Risk Assessment for Animal Welfare (EFSA, 2012). The aim of this Guidance was to provide a harmonised methodology for the assessment of risks for farm animal welfare, together with suggestions about the assessment of benefits for animal welfare. The guidance is intended to be applicable to all types of factors that affect welfare (i.e. housing characteristics, transport conditions, stunning and killing conditions), all types of husbandry systems and all animal categories.

Risk assessment has three elements: 1) exposure assessment, 2) consequence characterisation and 3) risk characterisation.

- Ad 1) Exposure assessment should provide a qualitative or quantitative evaluation of the strength, duration, frequency and patterns of exposure for the factors relevant to the exposure scenario(s) developed during the problem formulation.
- Ad 2) Consequence characterisation involves assessing the magnitude (intensity and duration) of the negative and positive consequences for welfare and the probability of their occurrence at the individual level.
- Ad 3) Risk characterisation is the final step of risk assessment and is the qualitative or quantitative estimation of the probability of occurrence and magnitude of negative and positive welfare effects (known or potential) in a given population.

Uncertainty and variability in risk assessment, as well as all assumptions used in problem formulation and risk assessment, need to be clearly expressed. Quality of risk assessment includes the quality of the data input, the relevance of the assumptions and the quality of the final assessment in relation to uncertainty and variability.

In the EFSA reports different terminology is used interchangeable to describe identical steps in the risk assessment. For example factor and hazard identification are used interchangeable (EFSA, 2012). Whereas a factor is defined as 'any aspect of the environment of the animal in relation to housing and management, animal genetic selection, transport and slaughter, which may have the potential to impair or improve their welfare' an hazard is defined as 'a factor with the potential to cause *poor* welfare'.

Reviewing papers on animal welfare risk assessment, especially the papers published before 2012, use different levels of detail in describing for example hazards. Whereas in some studies a hazard is described on a relative abstract level ('driveway design', e.g. Algers, 2009) in other studies the hazards are defined in more detail, for example 'too narrow driveway' (e.g. Dalla Villa, 2009).

For the current project, given the available time, it was decided for the method to calculate the magnitude to use the EFSA opinion (EFSA, 2012), and for the hazards and adverse effects to focus primarily on, get inspiration out of, recent EFSA opinions and reports and results of ongoing research within the institute (Wageningen UR Livestock Research). The list of references at the end of this report shows which references have been used to develop a table for risk analysis.

The table for risk analysis includes hazards and adverse effects for the different phases in the process from unloading at the slaughterhouse until slaughter. It was assumed that the same (apart from a few exceptions) hazards and adverse effects were relevant for all animal species/categories in the project. In several steps a draft table was agreed between the NVWA and Wageningen UR Livestock Research that was sent to five internationally recognized animal welfare experts engaged in this study (see 2.2). These experts were appointed by NVWA.

Based on the feedback of the animal welfare experts and the need to provide a table with hazards and adverse effects that forms a basis for tables for the phases in animal housing (farm situation) and animal transport, the table was adjusted to fit this purpose. The following adjustments were made resulting in a final table, as presented in appendix 2.

- Context category (i.e. holding pens, management and handling) was adjusted to make comparisons with the phases at the farm and during transport in a later stage feasible.
- Hazards were further split in a 'hazard description' and a 'hazard specification'. In which the hazard description is a description of the hazard in general terminology that indicates the area of concern (i.e. design of sides/gates) and the hazard for animal welfare (i.e. inappropriate for the animal species). The hazard description is followed by a hazard specification in which the hazard is described more precisely in terms indicating how that hazard can increase the risk of poor welfare (i.e. too low).
- Based on discussions with the animal welfare experts some adverse effects were renamed, a few were omitted.

2.2 Estimation of the magnitude

Five internationally recognized animal welfare experts were invited by NVWA to participate in this study. The selection of the five experts was performed by the NVWA based on their Curriculum Vitae.

The experts were invited to respond on the hazards and adverse effects in the draft table. Suggestions were incorporated in the table and the semi-final table was send to the experts with the instruction to assign a magnitude for each combination of hazard and adverse effect. The magnitude was defined as the duration x severity of the combination. The magnitude was expressed on a linear scale from 0 (no effect) to 7 (maximum impact), approximately equating to the explanation as shown in table 1. Furthermore, the estimates should be limited to the duration that the animals are in the slaughterhouse and not take into account their entire lifetime (see also the info for experts, appendix 1). The experts were given a list with explanation of the adverse effects; precise definitions were not included. Experts scored the magnitude anonymously and independently.

Table 1.

Explanation of the scale that was approximately used by the experts to quantify the magnitude of the adverse hazards. The scale was adapted from Dalla Villa et al., (2009) in which scale from 1-4 was expanded by the NVWA to a scale 0-7.

Magnitude scale	Explanation
0-1	Optimal health, physiological and ethological comfort
1-2	Minor changes from normality indicative of pain, malaise, fear or anxiety
2-3	Moderate changes from normality indicative of pain, malaise, fear or anxiety. Strong change in adrenal or behavioural reactions, such as motor responses and vocalisations)
3-4	Substantial changes from normality indicative of pain, malaise, fear or anxiety. Strong change in adrenal or behavioural reactions, such as motor responses and vocalisations)
4-5	Serious changes from normality indicative of pain, malaise, fear, anxiety or disease (reversal)
5-6	Extreme changes from normality indicative of pain, malaise, fear, anxiety, or disease, that could become life-threatening if they persist
6-7	Extreme changes from normality indicative of pain, malaise, fear, anxiety, or disease that result in death

To structure the decision process a Group Decision Room party was contracted. In the first step the experts were asked to assign magnitudes via a web-based tool (on-line round). In the second step, the results of the first step were discussed in a face-to-face meeting with all experts present. In the second step, scores assigned by different experts could be reconsidered after discussion and/or

¹ Als er een goede verklaring is voor een hogere sterfte en men kan aantonen dat er sprake is van overmacht, dan kan de staatssecretaris besluiten het bedrag te verhogen of te verlagen.

clarification had taken place. The advantages of the use of the Group Decision Room method is that individuals can participate anonymously, that there will be a strong focus on the content, many input in a short time frame, the possibility to work from different places around the world, and streamlining of the discussion.

The analysis of the magnitudes across experts, across animals species/categories and/or across different contexts were done using the median. It was preferred to use median over the mean (or average) to better tackle possible skewed data.

2.3 Evaluation of consequences for food safety

Two internationally recognized experts in food safety were invited to participate in the study. The selection of these two experts was proposed by the NVWA. Two meetings were scheduled to brainstorm and discuss possible consequences for food safety.

3 Results

3.1 Table for Risk Analysis Animal Welfare

Based on the literature search and the input of the expert meeting, a table for the risk analysis of animal welfare was developed. The table includes the columns 'context', 'hazard description', 'hazard specification', 'adverse effects', 'magnitude' and 'food safety'. See appendix 2.

3.2 Magnitude of adverse effects

The experts assigned magnitudes to the combinations of hazards and adverse effects for all phases in the slaughterhouse: unloading bay to lairage, holding pens, passageway to slaughter, race into stun area, during restraint, during stunning, and during slaughter. The magnitude is the product of severity and duration of the adverse effect. For relative short durations, such as in the slaughterhouse, the magnitude score will be close to the score for severity. In the current project it is therefore assumed that the appointed magnitude scale by the experts is close to a score for severity of the same hazards in the slaughterhouse.

Table 2 shows the median magnitude for the different adverse effects. In appendix 2, the magnitudes for the different combinations of context-hazard-adverse effects are presented. In the paragraphs below, the main results of the expert meeting with animal welfare experts are described per adverse effect.

Table 2

Adverse effects and their magnitude (median of 5 experts, different hazards, context, and across animal species/categories) for the phase of unloading till slaughter. Adverse effects are arranged from smallest magnitude (1) to highest magnitude (7).

Adverse effects	Magnitude (median)
Discomfort while walking	1
Intoxication	1
Cold stress	2
Respiratory problems	2
Insufficient foothold	3
Wounds	3
Desnutrition	3
Frustration	3
Aggression	3
Fear (general)	3
Fear of humans	3
Bruises	4
Fatigue	4
Dehydration	5
Heat stress	5
(continued) Suffering	5
Physical pain from management procedures	5
Ruptures	6
Suffocation	6
Fractures	7

3.2.1 Discomfort while walking

Discomfort while walking was explained as 'movement is hampered due to e.g. too rough, uneven or damaged flooring'. At the expert meeting it was discussed whether this was in fact an adverse effect. Since there was no unanimous conclusion to delete it as an adverse effect it was kept in the analysis.

- The overall magnitude that was given to this adverse effect was **1**.
- There were small differences for the different animal species/categories: calves (2), cows (1), bulls (2), pigs (2), horses (1), lambs (1).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed slightly: unloading (2), holding pens (1).

3.2.2 Intoxication

Intoxication was explained as 'ingestion of toxic substance'.

- The overall magnitude that was given to this adverse effect was **1**.
- There were small differences for the different animal species/categories: calves (1), cows (1), bulls (2), pigs (2), horses (1), lambs (2).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed slightly: unloading (1), holding pens (2), passage to slaughter (1).

3.2.3 Cold stress

Cold stress was explained as 'animals have difficulty to maintain body temperature, but may be able to cope'.

- The overall magnitude that was given to this adverse effect was **2**.
- There were small differences for the different animal species/categories: calves (3), cows (2), bulls (3), pigs (2), horses (2), lambs (2).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed slightly: unloading (2), holding pens (3), passage to slaughter (2).

3.2.4 Respiratory problems

Respiratory problems was not provided as an adverse effect at the beginning, but was distinguished from intoxication during the expert meeting.

- The overall magnitude that was given to this adverse effect was **2**.
- There were small differences for the different animal species/categories: calves (1), cows (2), bulls (2), pigs (2), horses (2), lambs (2).
- Only one phase in the process from unloading to slaughter was considered, i.e. holding pens. Across animal species/categories the magnitude for this phase was similar to the overall magnitude: holding pens (2).

3.2.5 Insufficient foothold

Insufficient foothold was explained as 'animals have difficulty to maintain balance and may slip or fall'. At the expert meeting it was discussed that not poor foothold was the problem, but 'losing control'.

- The overall magnitude that was given to this adverse effect was **3**.
- There were small differences for the different animal species/categories: calves (3), cows (3), bulls (4), pigs (3), horses (4), lambs (3).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed slightly: unloading (3), holding pens (4), passage to slaughter (4), race to stun area (3), during restraint (4).

3.2.6 Wounds

Wounds or scratches were explained as 'damage of the integument'. At the expert meeting it was discussed that the severity of the wounds has a major influence on the magnitude, and that the likelihood of sharp objects possibly influenced the magnitude score.

- The overall magnitude that was given to this adverse effect was **3**.
- There were no differences for the different animal species/categories: calves (3), cows (3), bulls (3), pigs (3), horses (3), lambs (3).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter showed no differences: unloading (3), holding pens (3), passage to slaughter (3), race to stun area (3), during restraint (3).

3.2.7 Desnutrition

Desnutrition was explained as 'disturbed metabolism (impaired health, reduced disease resistance, increased cold stress sensitivity), i.e. more than just frustrated appetite for feeding'. At the expert meeting it was discussed that the magnitude is largely dependent on the duration and the context.

- The overall magnitude that was given to this adverse effect was **3**. It is notably that there was a large variation between the experts. The lowest magnitude given by one of the experts was 1 and the highest magnitude given was a 6.
- There were differences for the different animal species/categories: calves (4), cows (3), bulls (4), pigs (3), horses (4), lambs (2).
- Only one phase in the process from unloading to slaughter was considered, i.e. holding pens. Across animal species/categories the magnitude for this phase was similar to the overall magnitude: holding pens (3).

3.2.8 Frustration

At the expert meeting it was suggested that frustration should be defined as 'obstruction of a motivation to ...'.

For the on-line round where the experts reported their estimates of the magnitudes of adverse effects of specified hazards seven different categories of frustration were distinguished: frustration, frustration (appetence for drinking), frustration (appetence for feeding), frustration (appetence for lying down or grooming), frustration (isolation), frustration (not able to go where wanted) and frustration (not able to perform behaviour). The final conclusion at the expert meeting was that all could be combined, and that the magnitude is merely dependent on the context. The above suggestion was taken into account when analysing the results below.

- The overall magnitude that was given to this adverse effect was **3**.
- There were small differences for the different animal species/categories: calves (3), cows (3), bulls (3), pigs (3), horses (4), lambs (3).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed slightly: holding pens (3), during restraint (2).

3.2.9 Aggression

Aggression was explained as 'social stress due to e.g. mixing or lack of space'. It was discussed that aggression was a multifactorial adverse effect; that is was a negative emotional state and that it needs to be considered differently for the animal species.

- The overall magnitude that was given to this adverse effect was **3**. It is notably that there was a large variation between the experts. The lowest magnitude given by one of the experts was 0 and the highest magnitude given was a 7.
- There were differences for the different animal species/categories: calves (3), cows (3), bulls (4), pigs (4), horses (4), lambs (2).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed: holding pens (4), race to stun area (2), during slaughter (5).

3.2.10 Fear (general)

For the on-line round where the experts reported their estimates of the magnitudes of adverse effects of specified hazards six different categories of fear were distinguished: fear (general), fear due to bad or unfamiliar smell, fear due to noise, fear due to poor control, fear due to visual factors and fear of humans. The final conclusion at the expert meeting was that fear of humans should be distinguished from other types of fear. All other types of fear should be combined. The magnitude of fear is merely dependent on the context. The above suggestion was taken into account when analysing the results below.

- The overall magnitude that was given to this adverse effect was **3**.
- There were no differences for the different animal species/categories: calves (3), cows (3), bulls (3), pigs (3), horses (3), lambs (3).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter increased: unloading (3), holding pens (3), passage to slaughter (3), race to stun area (3), during restraint (3), during stunning (5), during slaughter (6).

3.2.11 Fear of humans

For the on-line round where the experts reported their estimates of the magnitudes of adverse effects of specified hazards six different categories of fear were distinguished: fear (general), fear due to bad or unfamiliar smell, fear due to noise, fear due to poor control, fear due to visual factors and fear of humans. The final conclusion at the expert meeting was that fear of humans should be distinguished from other types of fear. All other types of fear should be combined. The magnitude of fear is merely dependent on the context. The above suggestion was taken into account when analysing the results below.

- The overall magnitude that was given to this adverse effect was **3**.
- There were small differences for the different animal species/categories: calves (3), cows (2), bulls (3), pigs (3), horses (3), lambs (2).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed: unloading (3), holding pens (2), passage to slaughter (3), race to stun area (3), during restraint (4).

3.2.12 Bruises

Bruises were explained as 'tissue damage that cannot be seen before slaughter'.

- The overall magnitude that was given to this adverse effect was **4**.
- There were no differences for the different animal species/categories: calves (4), cows (4), bulls (4), pigs (4), horses (4), lambs (4).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed slightly: unloading (4), holding pens (3), passage to slaughter (4), race to stun area (4), during restraint (3).

3.2.13 Fatigue

At first, fatigue was explained as 'when it is very severe this can be described as exhaustion'. At the expert meeting fatigue was distinguished from exhaustion as being a gradual process from fatigue to exhaustion. When scoring the magnitudes the experts interpreted fatigue not as exhaustion.

- The overall magnitude that was given to this adverse effect was **4**. It is notably that there was a large variation between the experts. The lowest magnitude given by one of the experts was 0 and the highest magnitude given was a 7.
- There were small differences for the different animal species/categories: calves (4), cows (4), bulls (4), pigs (4), horses (4), lambs (3).
- Only one phase in the process from unloading to slaughter was considered, i.e. holding pens. Across animal species/categories the magnitude for this phase was similar to the overall magnitude: holding pens (3).

3.2.14 Dehydration

Dehydration was explained as 'disturbed thermoregulation, impaired health, i.e. more severe than frustrated appetite for drinking'.

- The overall magnitude that was given to this adverse effect was **5**. It is notably that there was a large variation between the experts. The lowest magnitude given by one of the experts was 1 and the highest magnitude given was a 7.
- There were small differences for the different animal species/categories: calves (5), cows (5), bulls (5), pigs (4), horses (5), lambs (4).
- Only one phase in the process from unloading to slaughter was considered, i.e. holding pens. Across animal species/categories the magnitude for this phase was similar to the overall magnitude: holding pens (5).

3.2.15 Heat stress

Heat stress was explained as 'animals have difficulty to maintain body temperature, but may be able to cope'. In the on-line round it appeared that experts scored differently for different animal species/categories; and between a large variation between experts. After discussion at the expert meeting, heat stress was more precisely characterised as any individual showing signs of heat stress (i.e. depending on the animal species: panting, increased respiration rate, sweating). Experts reconsidered their scores for magnitudes.

- The overall magnitude that was given to this adverse effect was **5**.
- There were small differences for the different animal species/categories: calves (5), cows (6), bulls (5), pigs (6), horses (5), lambs (5).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter showed no differences: unloading (5), holding pens (5), passage to slaughter (5).

3.2.16 (Continued) suffering

Continued suffering was explained as 'used to describe what happens if animals arrive at the slaughterhouse in poor state and are not treated adequately'. At the expert meeting it was discussed that strictly taken, continued suffering cannot be regarded as an adverse effect. Continued suffering is a combination of different adverse effects like fear, frustration, pain etc. However, several experts felt it was not right to delete continued suffering from the list, it was suggested to change the term to 'suffering'.

- The overall magnitude that was given to this adverse effect was **5**. It is notably that there was a large variation between the experts. The lowest magnitude given by one of the experts was 1 and the highest magnitude given was a 7.
- There were small differences for the different animal species/categories: calves (5), cows (5), bulls (5), pigs (5), horses (6), lambs (4).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed slightly: holding pens (5), during stunning (6).

3.2.17 Physical pain

Physical pain from management procedures was explained as 'activities causing pain not covered by other adverse effects (e.g. pain due to injuries in intrinsic to its adverse effects).

- The overall magnitude that was given to this adverse effect was **5**.
- There were small differences for the different animal species/categories: calves (5), cows (5), bulls (5), pigs (4), horses (5), lambs (5).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter differed: unloading (4), holding pens (5), passage to slaughter (4), race to stun area (4), during restraint (6), during stunning (5), during slaughter (6).

3.2.18 Ruptures

Ruptures were explained as 'damage of tendon'.

- The overall magnitude that was given to this adverse effect was **6**.
- There were no differences for the different animal species/categories: calves (6), cows (6), bulls (6), pigs (6), horses (6), lambs (6).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter showed no differences: unloading (6), holding pens (6), passage to slaughter (6), race to stun area (6).

3.2.19 Suffocation

Suffocation was explained as 'used to describe what happens if animals get blood in their lungs or otherwise cannot breath'. At the expert meeting it was added by one of the experts that suffocation is the physical obstruction or separation of the upper respiratory tract from atmospheric air. After a short discussion, experts reconsidered their scores for magnitudes. These have been incorporated in the analysis.

- The overall magnitude that was given to this adverse effect was **6**.
- There were no differences for the different animal species/categories: calves (6), cows (6), bulls (6), pigs (6), horses (6), lambs (6).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter showed no differences: holding pens (6), during stunning (6), during slaughter (6).

3.2.20 Fractures

Fractures were explained as 'broken bones'. At the expert meeting it was discussed that the magnitude of the duration of the adverse effect could have a major influence on the magnitude.

- The overall magnitude that was given to this adverse effect was **7**.
- There were small differences for the different animal species/categories: calves (7), cows (7), bulls (7), pigs (6), horses (7), lambs (6).
- Across animal species/categories, the magnitudes for the phases in the process from unloading to slaughter showed no differences: unloading (7), holding pens (7), passage to slaughter (7), race to stun area (7).

3.3 Possible consequences for food safety

3.3.1 Risk related to food safety and animal welfare during the first phases of slaughtering (arrival - bleeding)

Food safety of animal products is an important subject and must be seen in the "farm to fork" chain. Farm management, animal living conditions on primary farms, transporting animals, slaughtering animals and processing of animal products all have e.g. influence on food safety levels. Food safety hazards in the primary phase can be diminished even to a negligible level during processing at the end of the chain e.g. by pasteurization.

Transporting animals from the primary farm to a slaughterhouse is in this project considered for all animal species in the same way. Animals are transported in groups, animals are carrier of microbial food safety pathogens, animals can have contact with other animals and the environment during transport. Of course, the number of animals transported can vary considerably: horses being transported with only a few at a time and pigs being transported in large numbers. If a food pathogen negative animal is transported in a food pathogen negative environment, welfare problems will have no influence on food safety but can have affect food quality.

Welfare consequences (see table 3) during transport and slaughtering phase are very variable. For food safety, the consequences of stress, contact with animals, contact with environment, open wounds

and skin contamination are considered the main risk factors. Wounds are seen as opening of the skin barrier. Fractures, ruptures and bruises are in this risk reflection considered as closed; so no opening of skin. Contact of animals with the environment or with other animals can be seen as infection/contamination moments and stress can influence shedding by and (trans) location of pathogens in the animal. When an animal is infected with a food pathogen it is dependent of the food pathogen what will happen. The food pathogen can enumerate in numbers in the animal and in this way increase the risk for food safety and infection of other animals but it is also possible that the animal just stays infected or even becomes negative again. So, time is a risk influencing factor.

Inhalation or ingestion of pathogens is considered in this project as a possible infection route of an animal. But in the slaughterhouse, due to time needed for the animal to become infectious itself, this route is not considered as a route in which an animal can infect another animal

Table 3

Description of possible consequences for food safety for animals being transported, handled, and housed at slaughter plants.

Possible consequences for food safety	
1	Negligible
2	Increased permeability of intestines enabling already present gut pathogens to cross the barrier
3	Oral infection of a negative animal with food pathogen from another animal (directly or through the environment)
4	Oral infection of a negative animal with food pathogen from another animal (directly or through environment) and the enumeration of food pathogens
5	Opening of skin barrier in addition to and/or as a result of a wound infection
6	Opening of skin barrier in addition to and/or as a result of sepsis with (human) pathogens
7	Translocation of food pathogens within already infected animal to gut system
8	Translocation of food pathogens within already infected animal to gut system and enumeration of pathogens
9	Infection of oropharynx with food pathogens with possible infection of gut system
10	Contamination of the skin with food pathogens from surroundings (from animal itself, other animals or environment)

3.3.2 Explanation of specific food safety consequences

During stress situations for animals tight junctions in gut epithelium can open so pathogens can translocate from the gut into different tissues of the animal. As a result, food pathogens can circulate through the animal, possibly leading to contaminated meat during slaughter. It also has been shown that during stress situations animals can start shedding pathogens or increase the number of pathogens shed. This will mainly lead to contamination of the skin, of the infected animal but also animals in close proximity, possibly leading to contaminated meat during slaughter. Stress can also influence translocation within the animal of food pathogens e.g. from the tonsils to the gut system. As a consequence, risk levels of a specific pathogen can change. Risks for food safety of a specific animal depending on the animals being infected or contaminated with pathogens. So every circumstance in which negative animals become infected or contaminated is seen as a food safety risk. Therefore, any contact moment is seen as a situation with food safety consequences.

The skin is an important barrier for pathogens to enter the body. Therefore, wounds can be a port d'entrée for food pathogens in an animal. This at first can only be a wound infection but in time can develop to a sepsis and transport of pathogens through the animal. Possible consequences for food safety can be arranged in different scenarios, see table 4.

Table 4

Description of possible scenarios and their consequences for food safety specific for animals being transported and the phase at the slaughter plant. Scenarios are used in the table in the appendix 2.

Scenario	Animal situation / welfare risk	Possible consequences food safety
A	Stress	2, 7, 8
B	A + Contact with other animal(s)	2, 3, 7, 8, 9, 10
C	B + Animal wounded & contact with other animal(s)	2, 3, 5, 6, 7, 8, 9, 10
D	B + Contact with other animal(s) & longer duration	2, 3, 4, 7, 8, 9, 10
E	D + Animal wounded, contact with other animal(s) & longer duration	2, 3, 4, 5, 6, 7, 8, 9, 10
F	A + Animal wounded & alone	2, 5, 6, 7, 8

The above mentioned scenarios for the possible consequences for food safety are included in table 5 (appendix 2).

4 Discussion and conclusion

4.1 Methodology

- Based on the EFSA publications and some additional related reports it was feasible to develop a table with hazards and adverse effects. However, the references used show a large variety in methodologies, descriptions and definitions to set up a risk analysis. Based on common sense and the attempt to enable harmonization with other phases in the chain (such as farm and transport), the table as shown in appendix 2, was developed. It must be emphasised though, that the current table should be subject to small improvements during further studies.
- The animal welfare experts invited by NVWA were all very well qualified to contribute to the project. Nevertheless, interpretation of the relevance and estimation of the magnitudes of the adverse effects showed large differences between experts for some of the adverse effects.
- The panel of animal welfare experts gave an estimate for over 1500 entries (combination of context, hazard, adverse effect, and animal species/categories). To improve the used method it was recommended by some panel members to focus on adverse effects in combination with the context (since the context can have a major influence on for example duration and hence on the magnitude).
- The experts on animal welfare and the food safety experts recommended for further studies to start with precise definitions of the adverse effects and the context. In their opinion this would improve the consensus for several magnitudes.

4.2 Results

- The possible consequences for food safety can be affected greatly by other factors not included in the current project. Obviously, the phases after slaughtering and the phases before arriving at the slaughter plant.

4.3 Conclusion

It is possible to develop a table with hazards, adverse effects and magnitudes (severity x duration) that can be used to perform a risk analysis in the slaughter plant (from unloading till slaughter) based on recent EFSA publications and expert opinions on veal calves, culled cows, bulls, slaughter pigs, meat horses and slaughter lambs. Furthermore, it is also feasible to add possible consequences (scenario's) for food safety in relation to adverse effects from arriving at the slaughter plant, with the help of expert opinions.

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References

- Algers, B., H. Anil, H. J. Blokhuis, K. Fuchs, J. Hultgren, B. Lambooj, T. Nunes, P. Paulsen, and F. Smulders. 2009. Project to develop Animal Welfare Risk Assessment Guidelines on Stunning and Killing, SLU, Uppsala.
- Dalla Villa, P., M. Marahrens, A. Velarde, A. Di Nardo, N. Kleinschmidt, C. Fuentes Alvarez, A. Truar, E. Di Fede, J. L. Otero, and C. Müller-Graf. 2009. Project to develop Animal Welfare Risk Assessment Guidelines on Transport.
- EC(EuropeanCommission). 2005. Council Regulation (EC) No. 1/2005 on the Protection of Animals During Transport and Related Operations and Amending Directives 64/432/ EEC and 93/119/EC and Regulation (EC) No. 1255/97.
- EC(EuropeanCommission). 2009. Council Regulation (EC) No. 1099/2009 on the protection of animals at the time of killing.
- EFSA. 2011. Scientific Opinion Concerning the Welfare of Animals during Transport. 9(1):1966: 125.
- EFSA. 2012. Scientific Opinion: Guidance on Risk Assessment for Animal Welfare. 10(1):2513: 30.
- EFSA. 2013a. Guidance on the assessment criteria for studies evaluating the effectiveness of stunning interventions regarding animal protection at the time of killing. 11(12):3486: 41.
- EFSA. 2013b. Sample size calculation tool for monitoring stunning at slaughter. 2013:EN-541: 18.
- EFSA. 2013c. Scientific Opinion on monitoring procedures at slaughterhouses for bovines. 11(12):3460: 65.
- EFSA. 2013d. Scientific Opinion on monitoring procedures at slaughterhouses for pigs1. 11(12):3523: 62.
- EFSA. 2013e. Scientific Opinion on monitoring procedures at slaughterhouses for sheep and goats. 11(12):3522: 65.
- ESCO. 2008. Prepared by the EFSA Scientific Cooperation Working Group on Fostering Harmonised Risk Assessment Approaches in Member States.
- Gerritzen, M., J. Westra, H. Reimert, V. Hindle, and J. Van de Werf. 2011. Welzijn varkens op de slachterij. Rapport 541. 541, Wageningen UR Livestock Research, Lelystad.
- Grandin, T. 2003. Transferring results of behavioral research to industry to improve animal welfare on the farm, ranch and the slaughter plant. 81: 215-228.
- Grandin, T. 2010. Auditing animal welfare at slaughter plants. Meat Sci. 86: 56-65.
- Marahrens, M., N. Kleinschmidt, A. Di Nardo, A. Velarde, C. Fuentes, A. Truar, J. L. Otero, E. Di Fede, and P. D. Villa. 2011. Risk assessment in animal welfare - Especially referring to animal transport. 102: 157-163.
- O'Connor, A., R. Dzikamunhenga, J. Sargeant, J. Glanville, and H. Wood. 2013. Preparatory work for future development of four scientific opinions on monitoring procedures at slaughterhouses.
- Visser, E.K., Ouweltjes, W., Neijenhuis, F., Lourens, A., Van der Werf, J.T.N., Gunnink, H., Hindle, V.A., Verkaik, J.C., Binnendijk, G. P., Gerritzen, M. A. 2014. Jaarrapportage onderzoek Animal Welfare Check Points 2013. Lelystad, Wageningen UR (University & Research centre) Livestock Research, Livestock Research Report 753, 90 blz.
- Von Holleben, K., M. Von Wenzlawowicz, N. Gregory, H. Anil, A. Velarde, P. Rodriguez, B. Cenci Goga, B. Catanese, and B. Lambooj. 2010. Report on good and adverse practices - Animal welfare concerns in relation to slaughter practices from the viewpoint of veterinary sciences, Schwarzenbek, Schwarzenbek, Germany.

Appendix 1- info for experts

Explanation of the task

Herewith you receive further information regarding the expected contribution to determination of magnitudes of adverse effects on animal welfare in slaughterhouses. It is important to know that we are specifically interested in hazards and their adverse effects in small and medium size slaughterhouses, although to our knowledge the hazards do not differ for those of large slaughterhouses.

We have done the following preparatory work:

- We have set up a list of possible **animal welfare hazards** which is mainly based on the technical report submitted to EFSA in 2009 on stunning and killing and its annex. Compared to the descriptions in this annex we have reformulated some hazards if we assumed this could clarify the link with the adverse effects, and also to harmonise between species (we think that the hazards are very similar for all species, although the magnitudes of the effects may differ). To our judgement e.g. insufficient monitoring of unloading or insufficient training of handlers are not exact descriptions of welfare hazards, but possible causes of hazards such as inadequate intervention at unloading and bad animal handling respectively. Therefore these inadequacies are not included in the list of hazards. A hazard regarding unfit animals on arrival is added, since this is explicitly mentioned in Regulation 1099/2009. Several hazards appear in more than one phase (e.g. slippery floors, air too hot). Although the report on stunning and killing gives separate hazards for the different stunning methods that are applied, we have clustered these since we primarily are interested in estimates for the adverse effects of suboptimal or poor stunning devices/methods (where it may be effective but painful or fearful), insufficiently effective stunning (i.e. animals may still be or return to consciousness) etc., regardless of the method used.
- Our purpose is to obtain estimates of magnitudes for single adverse effects (if possible). We have noticed however that **adverse effects** had not always been described in detail and the description in EFSA publications was not always consistent. Moreover, magnitudes were often not specified for separate effects. Therefore we have reformulated the adverse effects. For this, we first listed the adverse effects in the case welfare criteria are not fulfilled. Phenomena such as reluctance to move, slipping or panting are not included in the list of adverse effects since these are animal based parameters that indicate problems such as fear, poor foothold or heat stress. Next, we linked the adverse effects to the hazards, which we based on reports submitted to EFSA if possible. The result is a rather long list of combinations of hazards and adverse effects, in which the same adverse effect may have been caused by different hazards. Where descriptions of adverse effects are the same (e.g. "fear"), we are not always certain if in fact the hazard is relevant to judge the magnitude (e.g. will "fear due to humans" result in a different magnitude than "fear due to limited vision", "fear due to loud noise" or "fear due to being restrained during slaughter without stunning"). Therefore we present in the first consultation the combinations of hazards and adverse effects under different circumstances: from arrival at the slaughterhouse until slaughter.

What do we ask you to do:

1. Check the list of hazards: is any hazard potentially endangering the needs of the animals missing? Do you agree with the clustering of different stunning methods? If not please comment.
2. Judge whether the list of adverse effects as linked to the hazards is OK, if not add your comments, for example you may consider descriptions of adverse effects too general to estimate their magnitude.

-
3. Give your estimates of the magnitudes of the adverse effects according to the EFSA-method published in 2012 ¹(accounting for severity and duration of the effect) and expressed on a linear scale from 0 (no effect) to 7 (=maximum impact). The estimates should be limited to the duration that the animals are in the slaughterhouse and not take into account their entire lifetime. When estimating the magnitudes please keep in mind that these refer to animals arriving at a slaughterhouse in conditions normal for their categories, and that environmental circumstances presumably have not been extreme nor were transport circumstances.

We contract a third party to structure the decision process, from whom you will receive further instructions to complete a questionnaire as step 1 in the decision making. This replaces a first physical meeting, and will presumably cost you considerable time. The results of this round will be used to prepare the meeting at Schiphol airport on August 19th 2014. The current planning for that meeting is to start at 10 o'clock and finish around 17 o'clock (with a lunch and breaks in between).

¹ <http://www.efsa.europa.eu/en/efsajournal/pub/2513.htm>

Appendix 2 - Table

Table 5

Table presenting the estimated magnitudes (severity x duration) for animal welfare and their possible consequences for food safety for veal calves (CALVES), culled cows (COWS), bulls (BULLS), slaughter pigs (PIGS), meat horses (HORSES), and slaughter lambs (LAMBS) for the combinations: context (situation/place) - hazards (description and specification) - adverse effects. For the qualitative assessment of food safety consequences no differences were expected between animal species/categories. Numbering refers to the excel table associated with the results of this table.

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
7	Unloading bay to lairage	Inadequate layout	too steep, too high steps	insufficient foothold	3	2	3	3	4	3	B
8	Unloading bay to lairage	Inadequate layout	too steep, too high steps	bruises	3	4	3	3	4	3	B
9	Unloading bay to lairage	Inadequate layout	too steep, too high steps	wounds	3	3	3	2	2	2	C
10	Unloading bay to lairage	Inadequate layout	too steep, too high steps	fractures	7	7	7	7	7	6	B
11	Unloading bay to lairage	Inadequate layout	too steep, too high steps	ruptures	5	6	6	5	6	5	B
12	Unloading bay to lairage	Inadequate layout	too steep, too high steps	fear	2	2	2	3	3	2	B
14	Unloading bay to lairage	Inadequate layout	too narrow or too wide	bruises	4	5	5	3	4	3	B
15	Unloading bay to lairage	Inadequate layout	blocking zones (lighting, noises, smell)	fear	3	3	3	3	4	3	B
16	Unloading bay to lairage	Inadequate layout	sharp curves and dead ends	fear	3	3	3	3	3	3	B
17	Unloading bay to lairage	Inappropriate flooring	too slippery	insufficient foothold	2	4	3	4	3	3	B
18	Unloading bay to lairage	Inappropriate flooring	too slippery	bruises	4	4	4	2	4	3	B
19	Unloading bay to lairage	Inappropriate flooring	too slippery	wounds	4	3	3	3	4	3	C
20	Unloading bay to lairage	Inappropriate flooring	too slippery	fractures	7	7	7	7	7	6	B
21	Unloading bay to lairage	Inappropriate flooring	too slippery	ruptures	5	6	6	6	6	5	B
22	Unloading bay to lairage	Inappropriate flooring	too slippery	fear	2	3	2	2	3	3	B
23	Unloading bay to lairage	Inappropriate flooring	gaps, potholes, sharp protrusions, missing battens, inappropriate dimensions or distance battens	insufficient foothold	2	3	3	2	3	3	B
24	Unloading bay to lairage	Inappropriate flooring	gaps, potholes, sharp protrusions, missing battens, inappropriate dimensions or distance battens	discomfort while walking	2	2	2	2	2	1	B
25	Unloading bay to lairage	Inappropriate flooring	gaps, potholes, sharp protrusions, missing battens, inappropriate dimensions or	bruises	3	3	3	4	4	4	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
			distance battens								
26	Unloading bay to lairage	Inappropriate flooring	gaps, potholes, sharp protrusions, missing battens, inappropriate dimensions or distance battens	wounds	3	4	3	4	4	3	C
27	Unloading bay to lairage	Inappropriate flooring	gaps, potholes, sharp protrusions, missing battens, inappropriate dimensions or distance battens	fractures	7	7	7	6	7	6	B
28	Unloading bay to lairage	Inappropriate flooring	gaps, potholes, sharp protrusions, missing battens, inappropriate dimensions or distance battens	ruptures	6	5	6	6	5	5	B
29	Unloading bay to lairage	Inappropriate flooring	gaps, potholes, sharp protrusions, missing battens, inappropriate dimensions or distance battens	fear	3	3	2	3	2	2	B
30	Unloading bay to lairage	Inappropriate flooring	uneven flooring	discomfort while walking	2	1	1	1	1	1	B
31	Unloading bay to lairage	Inappropriate flooring	uneven flooring	bruises	2	4	2	3	4	4	B
32	Unloading bay to lairage	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	bruises	4	5	6	3	4	3	B
33	Unloading bay to lairage	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	wounds	4	4	5	3	4	3	C
34	Unloading bay to lairage	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	fractures	6	7	7	7	7	7	B
35	Unloading bay to lairage	Inappropriate design sides and gates	partially open or short/low sides/gates	fear	2	2	3	3	3	3	B
37	Unloading bay to lairage	Inappropriate climate	unhealthy air quality (dust, exhaust gases, noxious gases)	intoxication	1	1	1	1	1	2	B
38	Unloading bay to lairage	Inappropriate climate	draught	fear	3	2	3	3	3	3	B
39	Unloading bay to lairage	Inappropriate climate	air too cold	cold stress	3	2	3	2	2	1	B
40	Unloading bay to lairage	Inappropriate climate	air too hot	heat stress	5	6	5	6	5	5	B
41	Unloading bay to lairage	Inappropriate climate	air too humid	heat stress	5	6	5	6	5	5	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
42	Unloading bay to lairage	Inappropriate management and handling	rough operation of gates (noise)	fear	3	3	3	3	3	3	B
43	Unloading bay to lairage	Inappropriate management and handling	high speed throughput	fear	3	3	3	2	3	3	B
44	Unloading bay to lairage	Inappropriate management and handling	handlers shouting	fear of humans	2	2	3	3	5	4	B
45	Unloading bay to lairage	Inappropriate management and handling	handlers hitting, striking, kicking	wounds	2	5	2	3	3	2	C
46	Unloading bay to lairage	Inappropriate management and handling	handlers hitting, striking, kicking	physical pain from management procedures	4	4	4	4	4	3	B
47	Unloading bay to lairage	Inappropriate management and handling	handlers hitting, striking, kicking	fear of humans	3	2	3	3	3	2	B
48	Unloading bay to lairage	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	physical pain from management procedures	4	4	5	4	5	4	B
49	Unloading bay to lairage	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	fear of humans	3	2	3	2	3	2	B
50	Holding pen	Inadequate layout	too small ground surface per animals (for lying, standing up, turning, drinking, eating)	desnutrition	4	3	3	3	3	2	B
51	Holding pen	Inadequate layout	too small ground surface per animals (for lying, standing up, turning, drinking, eating)	dehydration	5	6	5	4	5	6	B
52	Holding pen	Inadequate layout	too small ground surface per animals (for lying, standing up, turning, drinking, eating)	fatigue	4	4	4	3	4	3	B
53	Holding pen	Inadequate layout	too small ground surface per animals (for lying, standing up, turning, drinking, eating)	heat stress	5	6	5	6	5	5	B
54	Holding pen	Inadequate layout	too small ground surface per animals (for lying, standing up, turning, drinking, eating)	aggression	3	4	4	4	4	2	B
55	Holding pen	Inadequate layout	too small ground surface per animals (for lying, standing up, turning, drinking, eating)	frustration	3	3	3	3	4	3	B
56	Holding pen	Inadequate layout	too large groups	aggression	2	3	4	4	3	2	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
57	Holding pen	Inadequate layout	too large groups	bruises	5	5	5	5	5	5	B
58	Holding pen	Inadequate layout	too large groups	fatigue	4	4	3	4	4	3	B
59	Holding pen	Inadequate layout	blocking zones (lighting, noises, smell)	fear	3	2	3	3	3	2	B
60	Holding pen	Inadequate drinking facilities	no water, inadequate flow rate, insufficient number of water points, poor water quality	dehydration	4	6	5	5	6	5	B
61	Holding pen	Inadequate drinking facilities	no water, inadequate flow rate, insufficient number of water points, poor water quality	frustration	5	5	5	5	6	5	B
62	Holding pen	Inadequate drinking facilities	lack of emergency provisions for water supply	dehydration	5	5	5	4	5	4	B
63	Holding pen	Inadequate feeding facilities	no feeding, unfamiliar feedstuff, insufficient places to eat	desnutrition	4	6	4	4	5	4	B
64	Holding pen	Inadequate feeding facilities	no feeding, unfamiliar feedstuff, insufficient places to eat	dehydration	4	5	5	4	5	4	B
65	Holding pen	Inadequate feeding facilities	no feeding, unfamiliar feedstuff, insufficient places to eat	fatigue	4	4	4	4	4	3	B
66	Holding pen	Inadequate feeding facilities	no feeding, unfamiliar feedstuff, insufficient places to eat	heat stress	5	6	5	6	5	5	B
67	Holding pen	Inadequate feeding facilities	no feeding, unfamiliar feedstuff, insufficient places to eat	aggression	3	3	4	5	4	3	B
68	Holding pen	Inadequate feeding facilities	no feeding, unfamiliar feedstuff, insufficient places to eat	frustration	4	3	4	4	4	4	B
69	Holding pen	Inappropriate flooring	too slippery	insufficient foothold	4	5	4	5	4	3	B
70	Holding pen	Inappropriate flooring	too slippery	bruises	3	3	3	3	3	3	B
71	Holding pen	Inappropriate flooring	too slippery	wounds	2	2	2	2	2	2	C
72	Holding pen	Inappropriate flooring	too slippery	fractures	7	7	7	7	7	6	B
73	Holding pen	Inappropriate flooring	too slippery	ruptures	6	6	6	6	6	6	B
74	Holding pen	Inappropriate flooring	too slippery	fear	3	3	3	3	4	3	B
75	Holding pen	Inappropriate flooring	gaps, too high steps, potholes, sharp protrusions	insufficient foothold	3	3	3	3	4	3	B
76	Holding pen	Inappropriate flooring	gaps, too high steps, potholes, sharp protrusions	discomfort while walking	2	1	2	2	1	1	B
77	Holding pen	Inappropriate	gaps, too high steps, potholes, sharp	bruises	3	3	2	3	3	3	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
		flooring	protrusions								
78	Holding pen	Inappropriate flooring	gaps, too high steps, potholes, sharp protrusions	wounds	2	2	2	2	2	2	C
79	Holding pen	Inappropriate flooring	gaps, too high steps, potholes, sharp protrusions	fractures	7	7	7	7	7	7	B
80	Holding pen	Inappropriate flooring	gaps, too high steps, potholes, sharp protrusions	ruptures	6	6	6	6	6	6	B
81	Holding pen	Inappropriate flooring	gaps, too high steps, potholes, sharp protrusions	fear	2	2	2	3	2	2	B
82	Holding pen	Inappropriate flooring	uneven flooring	discomfort while walking	1	1	1	1	1	1	B
83	Holding pen	Inappropriate flooring	uneven flooring	bruises	3	3	2	3	3	3	B
84	Holding pen	Inappropriate flooring	inadequate for lying (not comfortable, too wet, too cold, too dirty)	fatigue	3	3	3	3	3	2	B
85	Holding pen	Inappropriate flooring	dirty lying area	infectious diseases	2	3	2	2	2	2	B
86	Holding pen	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	bruises	3	4	3	4	4	4	B
87	Holding pen	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	wounds	3	3	3	3	3	3	C
88	Holding pen	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	fractures	7	7	7	7	7	7	B
89	Holding pen	Inappropriate design sides and gates	partially open or short/low sides/gates	bruises	4	3	5	2	3	2	B
90	Holding pen	Inappropriate design sides and gates	partially open or short/low sides/gates	wounds	3	2	3	3	3	2	C
91	Holding pen	Inappropriate design sides and gates	partially open or short/low sides/gates	fractures	3	3	3	3	3	2	B
93	Holding pen	Inappropriate climate	unhealthy air quality (dust, noxious gases)	respiratory problems	1	2	2	2	2	2	B
95	Holding pen	Inappropriate climate	lack of shade, protection from the sun	heat stress	5	6	5	6	5	5	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
96	Holding pen	Inappropriate climate	lack of protection against wind and precipitation	cold stress	3	2	3	3	2	2	B
97	Holding pen	Inappropriate climate	air too cold	cold stress	3	3	3	3	2	2	B
98	Holding pen	Inappropriate climate	air too hot	heat stress	5	6	5	6	5	5	B
99	Holding pen	Inappropriate climate	air too humid	heat stress	5	6	5	6	5	5	B
100	Holding pen	Inappropriate climate	lack of emergency provisions for ventilation	heat stress	5	6	5	6	5	5	B
101	Holding pen	Inappropriate climate	lack of emergency provisions for ventilation	intoxication	2	2	2	2	2	2	B
102	Holding pen	Inappropriate management and handling	handlers shouting	fear of humans	2	2	2	2	3	2	B
103	Holding pen	Inappropriate management and handling	handlers hitting, striking, kicking	wounds	3	3	3	3	3	3	C
104	Holding pen	Inappropriate management and handling	handlers hitting, striking, kicking	physical pain from management procedures	5	5	5	5	5	5	B
105	Holding pen	Inappropriate management and handling	handlers hitting, striking, kicking	fear of humans	2	2	2	2	3	3	B
106	Holding pen	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	physical pain from management procedures	5	4	5	5	5	5	B
107	Holding pen	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	fear of humans	2	2	2	3	2	2	B
108	Holding pen	Inappropriate management and handling	mixing animals (familiar/unfamiliar; horned/dehorned; tied/untied; mature/immature; different farms, gender, ages, species, temperaments, size)	aggression	3	4	4	4	4	2	B
109	Holding pen	Inappropriate management and handling	separating animals familiar with each other	frustration	3	3	3	3	3	3	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
110	Holding pen	Inappropriate management and handling	inappropriate milking management lactating animals (no facilities, poor timing, poor skills)	physical pain from management procedures	6	5	5	5	5	5	B
111	Holding pen	Inappropriate management and handling	incorrect tethering (too short, too long)	desnutrition	3	3	4	2	4	2	B
112	Holding pen	Inappropriate management and handling	incorrect tethering (too short, too long)	dehydration	5	5	6	3	6	3	B
113	Holding pen	Inappropriate management and handling	incorrect tethering (too short, too long)	frustration	3	3	3	2	3	2	B
114	Holding pen	Inappropriate management and handling	incorrect tethering (too short, too long)	fatigue	4	4	4	5	4	3	B
115	Holding pen	Inappropriate management and handling	incorrect tethering (too short, too long)	wounds	4	4	4	3	3	3	C
116	Holding pen	Inappropriate management and handling	incorrect tethering (too short, too long, strangulation)	suffocation	6	6	6	6	6	6	B
117	Holding pen	Inappropriate management and handling	insufficient monitoring and intervention of animals	continued suffering	5	5	5	5	6	3	B
118	Passage to slaughter	Inadequate layout	blocking zones (lighting, noises, smell)	fear	3	3	3	3	3	3	B
119	Passage to slaughter	Inadequate layout	too narrow or too wide	fear	3	2	3	3	3	3	B
120	Passage to slaughter	Inadequate layout	too narrow or too wide	bruises	4	3	4	4	4	4	B
121	Passage to slaughter	Inadequate layout	sharp curves and dead ends	fear	3	3	3	3	3	3	B
122	Passage to slaughter	Inadequate layout	too steep, too high steps	insufficient foothold	3	3	4	3	4	4	B
123	Passage to slaughter	Inadequate layout	too steep, too high steps	bruises	3	3	3	3	3	3	B
124	Passage to slaughter	Inadequate layout	too steep, too high steps	wounds	3	3	3	3	3	3	C
125	Passage to slaughter	Inadequate layout	too steep, too high steps	fractures	7	7	7	6	7	6	B
126	Passage to slaughter	Inadequate layout	too steep, too high steps	ruptures	6	6	6	6	6	6	B
127	Passage to slaughter	Inadequate layout	too steep, too high steps	fear	2	2	2	2	3	2	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
128	Passage to slaughter	Inappropriate flooring	too slippery	insufficient foothold	3	4	5	2	4	3	B
129	Passage to slaughter	Inappropriate flooring	too slippery	bruises	4	5	5	4	4	4	B
130	Passage to slaughter	Inappropriate flooring	too slippery	wounds	4	4	4	3	3	3	C
131	Passage to slaughter	Inappropriate flooring	too slippery	fractures	7	7	7	6	7	6	B
132	Passage to slaughter	Inappropriate flooring	too slippery	ruptures	6	6	6	6	6	6	B
133	Passage to slaughter	Inappropriate flooring	too slippery	fear	2	2	2	3	3	2	B
134	Passage to slaughter	Inappropriate flooring	gaps, potholes, sharp protrusions	insufficient foothold	4	3	4	3	4	3	B
136	Passage to slaughter	Inappropriate flooring	gaps, potholes, sharp protrusions	bruises	3	5	4	3	3	4	B
137	Passage to slaughter	Inappropriate flooring	gaps, potholes, sharp protrusions	wounds	3	4	3	3	3	3	C
138	Passage to slaughter	Inappropriate flooring	gaps, potholes, sharp protrusions	fractures	7	7	7	6	7	6	B
139	Passage to slaughter	Inappropriate flooring	gaps, potholes, sharp protrusions	ruptures	6	6	6	6	5	5	B
140	Passage to slaughter	Inappropriate flooring	gaps, potholes, sharp protrusions	fear	2	2	2	3	3	2	B
142	Passage to slaughter	Inappropriate flooring	uneven flooring	bruises	3	3	3	3	4	2	B
143	Passage to slaughter	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	bruises	4	5	5	5	5	4	B
144	Passage to slaughter	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	wounds	3	4	3	3	3	3	C
145	Passage to slaughter	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	fractures	7	7	7	5	7	5	B
146	Passage to slaughter	Inappropriate design sides and gates	partially open or short/low sides/gates	fear	3	2	3	3	3	3	B
147	Passage to slaughter	Inappropriate climate	unhealthy air quality (noxious gases)	intoxication	1	1	2	2	1	1	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
148	Passage to slaughter	Inappropriate climate	draught	fear	3	3	3	3	3	3	B
149	Passage to slaughter	Inappropriate climate	air too cold	cold stress	1	2	2	2	2	2	B
150	Passage to slaughter	Inappropriate climate	air too hot	heat stress	5	6	5	6	5	5	B
151	Passage to slaughter	Inappropriate climate	air too humid	heat stress	5	6	5	6	5	5	B
152	Passage to slaughter	Inappropriate management and handling	rough operation of gates (noise)	fear	3	3	3	3	3	3	B
153	Passage to slaughter	Inappropriate management and handling	handlers shouting	fear of humans	3	2	3	3	3	2	B
154	Passage to slaughter	Inappropriate management and handling	handlers hitting, striking, kicking	wounds	3	3	3	3	3	3	C
155	Passage to slaughter	Inappropriate management and handling	handlers hitting, striking, kicking	physical pain from management procedures	4	4	4	4	4	4	B
156	Passage to slaughter	Inappropriate management and handling	handlers hitting, striking, kicking	fear of humans	3	2	3	3	3	3	B
157	Passage to slaughter	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	physical pain from management procedures	4	4	4	4	5	4	B
158	Passage to slaughter	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	fear of humans	3	2	3	3	3	3	B
159	Passage to slaughter	Inappropriate management and handling	uncontrolled automatic driving system or inadequately handled manual system	bruises	4	4	4	4	4	4	B
160	Passage to slaughter	Inappropriate management and handling	sharp protrusions or edges in sides/gates	fractures	7	7	7	6	7	6	B
161	Passage to slaughter	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	physical pain from management	5	4	5	5	5	5	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
				procedures							
162	Race to stun area	Inadequate layout	blocking zones (lighting, noises, smell)	fear	3	3	3	3	3	3	B
163	Race to stun area	Inadequate layout	too narrow or too wide	fear	3	3	3	3	3	3	B
164	Race to stun area	Inadequate layout	too narrow or too wide	bruises	4	4	4	4	4	4	B
165	Race to stun area	Inadequate layout	sharp curves and dead ends	fear	3	3	3	3	3	3	B
166	Race to stun area	Inadequate layout	too steep, too high steps	insufficient foothold	4	3	4	3	4	2	B
167	Race to stun area	Inadequate layout	too steep, too high steps	bruises	4	4	4	4	4	4	B
168	Race to stun area	Inadequate layout	too steep, too high steps	wounds	3	3	3	3	3	3	C
169	Race to stun area	Inadequate layout	too steep, too high steps	fractures	7	7	7	6	7	6	B
170	Race to stun area	Inadequate layout	too steep, too high steps	ruptures	6	6	6	6	6	6	B
171	Race to stun area	Inadequate layout	too steep, too high steps	fear	2	2	2	3	2	2	B
172	Race to stun area	Inappropriate flooring	too slippery	insufficient foothold	3	3	4	3	4	3	B
173	Race to stun area	Inappropriate flooring	too slippery	bruises	4	4	4	4	4	4	B
174	Race to stun area	Inappropriate flooring	too slippery	fear	2	2	2	2	3	2	B
175	Race to stun area	Inappropriate flooring	gaps, potholes, sharp protrusions	insufficient foothold	3	3	4	3	4	3	B
177	Race to stun area	Inappropriate flooring	gaps, potholes, sharp protrusions	bruises	4	4	4	4	4	4	B
178	Race to stun area	Inappropriate flooring	gaps, potholes, sharp protrusions	wounds	3	3	3	3	3	3	C
179	Race to stun area	Inappropriate flooring	gaps, potholes, sharp protrusions	fractures	7	7	7	6	6	5	B
180	Race to stun area	Inappropriate flooring	gaps, potholes, sharp protrusions	ruptures	5	5	5	5	5	5	B
181	Race to stun area	Inappropriate flooring	gaps, potholes, sharp protrusions	fear	2	2	2	3	3	2	B
183	Race to stun area	Inappropriate flooring	uneven flooring	bruises	3	4	3	3	3	2	B
184	Race to stun area	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	bruises	3	5	3	4	5	5	B

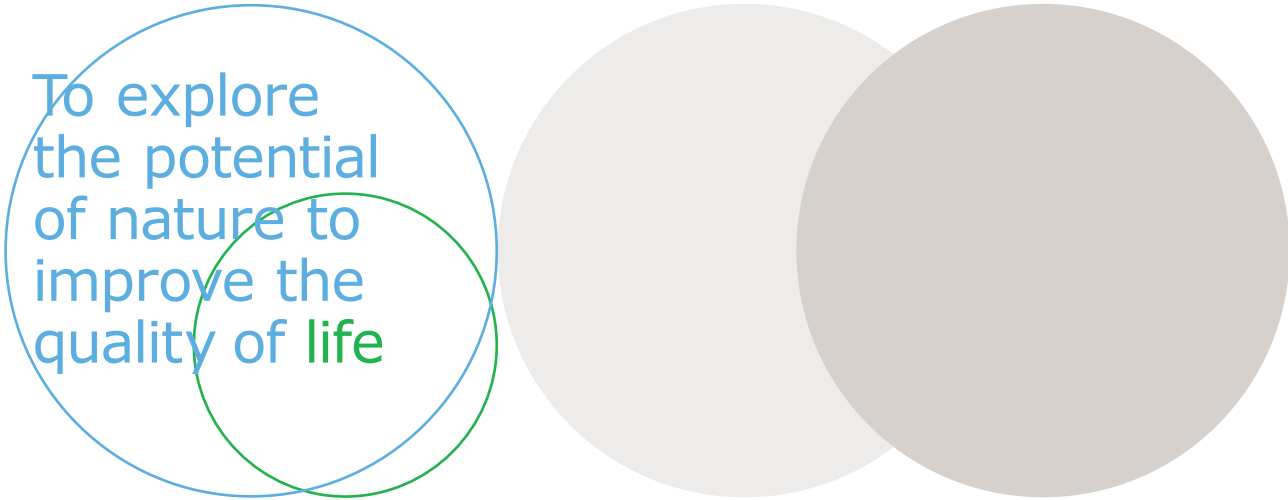
NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
185	Race to stun area	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	wounds	3	3	3	3	3	3	C
186	Race to stun area	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	fractures	7	7	7	6	7	6	B
187	Race to stun area	Inappropriate design sides and gates	partially open or short/low sides/gates	fear	4	3	3	3	3	3	B
188	Race to stun area	Inappropriate climate	draught	fear	4	3	3	4	3	3	B
189	Race to stun area	Inappropriate management and handling	rough operation of gates (noise)	fear	3	3	3	3	3	3	B
190	Race to stun area	Inappropriate management and handling	high speed throughput	fear	3	3	4	4	4	4	B
191	Race to stun area	Inappropriate management and handling	handlers shouting	fear of humans	2	2	2	3	3	3	B
192	Race to stun area	Inappropriate management and handling	handlers hitting, striking, kicking	wounds	3	3	3	3	3	3	C
193	Race to stun area	Inappropriate management and handling	handlers hitting, striking, kicking	physical pain from management procedures	4	4	4	4	4	4	B
194	Race to stun area	Inappropriate management and handling	handlers hitting, striking, kicking	fear of humans	3	2	3	3	2	3	B
195	Race to stun area	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	physical pain from management procedures	4	4	4	4	4	4	B
196	Race to stun area	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	fear of humans	3	2	2	3	2	2	B
197	Race to stun area	Inappropriate management and handling	faulty operation of non return gates	bruises	4	4	4	4	4	3	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
198	Race to stun area	Inappropriate management and handling	sharp protrusions or edges in sides/gates	fractures	7	7	7	6	7	6	B
199	Race to stun area	Inappropriate management and handling	inappropriate use of devices (e.g. electric shocks adult cows and pigs), inappropriate positioning in relation to the animal	physical pain from management procedures	4	4	4	4	4	4	B
200	Race to stun area	Inappropriate management and handling	mixing animals (familiar/unfamiliar; horned/dehorned; tied/untied; mature/immature; different farms, gender, ages, species, temperaments, size)	aggression	2	2	2	3	2	1	B
201	During restraint	Inadequate layout	blocking zones (lighting, noises, smell)	fear	3	3	3	3	3	3	B
202	During restraint	Inadequate layout	too narrow/wide/long/short	insufficient foothold	3	4	4	4	5	4	B
203	During restraint	Inadequate layout	too narrow/wide/long/short	bruises	3	5	4	5	5	5	B
204	During restraint	Inadequate layout	too narrow/wide/long/short	fear	3	3	3	4	3	3	B
205	During restraint	Inadequate layout	too narrow/wide/long/short	physical pain from management procedures	5	5	5	5	5	5	B
206	During restraint	Inadequate layout	improper restraint device & method to position animal	physical pain from management procedures	6	6	6	6	6	6	B
207	During restraint	Inadequate layout	poor operation of restrainer	physical pain from management procedures	5	6	6	6	5	6	B
208	During restraint	Inappropriate flooring	too slippery	insufficient foothold	3	3	5	3	4	3	B
209	During restraint	Inappropriate flooring	too slippery	fear	3	3	2	3	3	2	B
210	During restraint	Inappropriate design sides and gates	sharp protrusions or edges in sides/gates	wounds	3	3	3	3	3	3	C
211	During restraint	Inappropriate design sides and gates	gaps, potholes, sharp protrusions	fear	3	3	2	4	3	2	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
212	During restraint	Inappropriate design sides and gates	uneven flooring	bruises	3	3	3	3	3	3	B
213	During restraint	Inappropriate management and handling	delayed interval before stunning or cutting	frustration	2	3	2	2	3	2	B
214	During restraint	Inappropriate management and handling	delayed interval before stunning or cutting	fear	3	2	3	4	3	3	B
215	During restraint	Inappropriate management and handling	handlers shouting	fear of humans	2	2	2	3	3	2	B
216	During restraint	Inappropriate management and handling	handlers hitting, striking, kicking	physical pain from management procedures	5	6	6	5	5	5	B
217	During restraint	Inappropriate management and handling	handlers hitting, striking, kicking	fear of humans	5	5	5	5	5	5	B
218	During stunning for slaughter (all stunning)	Inadequate layout	improper stunning device & method	physical pain from management procedures	2	3	3	3	3	3	B
219	During stunning for slaughter (all stunning)	Inadequate layout	improper stunning device & method	fear	6	5	6	5	6	5	B
220	During stunning for slaughter (all stunning)	Inadequate layout	improper stunning device & method	continued suffering	6	6	6	6	6	6	B
221	During stunning for slaughter (all stunning)	Inappropriate management and handling	insufficiently effective stunning	physical pain from management procedures	6	5	6	5	5	5	B
222	During stunning for slaughter (all stunning)	Inappropriate management and handling	insufficiently effective stunning	fear	5	5	5	5	5	5	B
223	During stunning for slaughter (all stunning)	Inappropriate management and handling	no back-up in case of failure of 1st attempt	physical pain from management procedures	6	6	6	6	6	6	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
224	During stunning for slaughter (all stunning)	Inappropriate management and handling	insufficiently effective stunning (no back-up)	fear	6	6	6	6	6	6	B
225	During stunning for slaughter (all stunning)	Inappropriate management and handling	too long interval between stunning and bleeding/killing	physical pain from management procedures	6	5	6	5	5	5	B
226	During stunning for slaughter (all stunning)	Inappropriate management and handling	insufficiently effective stunning (delay between stunning and bleeding)	fear	5	5	5	5	5	5	B
227	During stunning for slaughter (all stunning)	Inappropriate management and handling	incorrect tethering (too short, too long, strangulation)	suffocation	6	6	6	6	6	6	B
228	During stunning for slaughter (all stunning)	Inappropriate management and handling	poor exsanguination	physical pain from management procedures	5	5	5	5	5	5	B
229	During stunning for slaughter (all stunning)	Inappropriate management and handling	uncomfortable position during restraint (degree of rotation)	fear	5	5	5	5	5	5	B
230	During stunning for slaughter (all stunning)	Inappropriate management and handling	start of dressing before animal is dead	physical pain from management procedures	6	6	6	6	6	6	B
231	During slaughter without stunning	Inadequate layout	uncomfortable position during restraint (degree of rotation)	physical pain from management procedures	6	6	6		6	6	B
232	During slaughter without stunning	Inadequate layout	uncomfortable position during restraint (degree of rotation)	aggression	5	5	5		6	5	B
233	During slaughter without stunning	Inadequate layout	uncomfortable position during restraint (degree of rotation)	fear	6	6	6		6	6	B
234	During slaughter without stunning	Inadequate layout	improper restraint of body and or head	physical pain from management procedures	7	6	7		7	6	B
235	During slaughter without stunning	Inadequate layout	uncomfortable position during restraint (degree of rotation)	fear	6	6	6		7	6	B

NUMBER	CONTEXT	HAZARD DESCRIPTION	HAZARD SPECIFICATION	ADVERSE EFFECTS	CALVES	COWS	BULLS	PIGS	HORSES	LAMBS	FOOD SAFETY
236	During slaughter without stunning	Inappropriate management and handling	improper operation of cutting procedure	physical pain from management procedures	7	7	7		6	7	B
237	During slaughter without stunning	Inappropriate management and handling	aspiration of blood into the lungs while the animal is still conscious	suffocation	6	6	6	6	6	6	B
238	During slaughter without stunning	Inappropriate management and handling	uncomfortable position during restraint (degree of rotation)	fear	7	6	7		7	6	B
239	During slaughter without stunning	Inappropriate management and handling	too long interval between cutting and unconsciousness	physical pain from management procedures	6	7	6		7	7	B
240	During slaughter without stunning	Inappropriate management and handling	uncomfortable position during restraint (degree of rotation)	fear	7	7	7		7	7	B
241	During slaughter without stunning	Inappropriate management and handling	removal from restrained position while conscious	physical pain from management procedures	7	6	7		7	6	B
242	During slaughter without stunning	Inappropriate management and handling	uncomfortable position during restraint (degree of rotation)	fear	6	7	6		7	7	B
243	During slaughter without stunning	Inappropriate management and handling	start of dressing before animal is dead	physical pain from management procedures	7	7	7		7	7	B



To explore
the potential
of nature to
improve the
quality of life

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Livestock Research Report 805

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