Risk assessment plan of animal welfare on red deer farms in the Netherlands

Master research thesis - risk assessment plan

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Cover photo: *Ruan Kok - Red deer yearlings on one of the visited farms in the Netherlands*

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1. Introduction

Farmed game in the Netherlands is relatively small compared to other farmed animals. In 2002 there were approximately 40-45 professional red deer (*Cervus elaphus*) farms (1), which shrunk to 25 farms in 2015 (2). Nowadays there are approximately nine commercial red deer farms for venison (3). Almost every red deer farm is a member of the Association for Dutch Deer Farmers (Vereniging van Nederlandse Hertenhouders), which was founded in 2001 and is affiliated with the Federation of European Deer Farmers Association.

In the Netherlands mostly red deer -and not fallow deer (*Dama dama*)- are farmed for venison, because they are easier to handle in captivity and produce more meat. The tendency to flee can be decreased by taming them, but the flight behaviour will not fully disappear. The Association for Dutch Deer Farmers aims to farm the red deer as naturally as possible (4). Red deer are seemingly calm, but one should always be on guard for their speed, agility, and unpredicted behaviour. It is important to approach them carefully, especially when they are in heat or with a newborn. Good farming practice and management is critical to reduce stress with red deer as much as possible.

Animal welfare is a subject of growing interest. Consumers consider animal welfare important, and nowadays veterinary students are educated more about the importance of animal welfare. Animal welfare is a state of an animal, when it can adequately -thus with normal behaviour- react to changes. If they can adapt, they can reach a state that they experience as positive (5). In the European Union the goal is to measure animal welfare for farmed animals. For that purpose, the Welfare Quality Assessment protocol is used. There are protocols for different animal species including cattle (6), but not (yet) for farmed game like red deer. Little to nothing is known or up to date about (the welfare of) red deer farmed in the Netherlands. Therefore this project was started with the goals to 1) determine the prevalence of factors potentially affecting or benefitting animal welfare with negative and/or positive consequences for farmed red deer in the Netherlands, and 2) to identify potential hazards for welfare on red deer farms. The main question of this research project is “What are the potential hazards of animal welfare on red deer farms in the Netherlands?”

In order to answer the main question, achieve these goals, to form a picture of how the farms work, and what the natural behaviour of red deer is, literature research was conducted as a first step. Based on that information a questionnaire was made to discuss with red deer farmers, in person or by filling in a survey. In addition, a welfare assessment checklist was made based upon the Welfare Quality Assessment for cattle. Of the nine commercial red deer farms known, four were visited to use this checklist as a tool to determine the potential hazards for animal welfare, and two other farms filled in the online survey based upon the same checklist. The information obtained was used to make a risk analysis.

What is animal welfare?

There are multiple ways to define animal welfare, but central in all definitions is the notion that there should be no (unnecessary) suffering for the animal (7,8), where suffering may be physical, mental or both. It is considered to be important for animals to have good physical health without pain, but also to have positive emotions such as contentment instead of negative ones like frustration or stress (7). The view on animal welfare has changed over time.

Initial ideas regarding animal welfare are based on the Brambell Committee, which was appointed by the British government in 1965. With professor Brambell as its chairperson, the committee was asked to investigate animal welfare in intensive livestock husbandry systems. This committee concluded that animals are sentient beings with behavioural needs, who can suffer physically and mentally. If these needs cannot be met it is likely to cause suffering (9,10). The committee recommended that animals should have at least the following five freedoms (10):

1. Freedom from hunger and thirst

An animal should have access to sufficient food and drink in order to prevent hunger and thirst. The feeding spots and watering points should be sufficient in number and properly distributed. The diet must be composed in such a way that it ensures good health (10).

2. Freedom from discomfort

Animals should be able to move without any kind of discomfort. The behaviour changes when animals suffer from thermal or physical discomfort. If a farmer knows the behaviour of his animals well, then it will stand out when an animal is in discomfort (10). Thermal and physical comfort depend on the availability of appropriate housing conditions in a way that animals are able to choose the right microenvironment when (climatic) circumstances change (11). If an animal is in discomfort, this means that it has an unpleasant feeling that generates a natural response of avoidance or reduction of the source of discomfort. Every physical or emotional occasion that gives an unpleasant feeling or sensation, can be a cause for discomfort. Pain can be a cause for discomfort, but not every discomfort is a result of pain (12). Thermal discomfort occurs when an animal is in an environment where the climate is uncomfortable. This can happen when there is a draught or if the temperature of the environment is below the lower critical temperature of the animals. One of the most important aspects of good physical comfort with livestock is the floor quality with bedding on it. Dry bedding results in physical and thermal comfort (11).

3. Freedom from pain, injury and disease

Based on the idea that there are relevant anatomical similarities between humans and other animals, scientists and ethicists use the analogy postulate. This postulate assumes that if animals have similar capacities in the experience of pain and suffering as humans, then we can assume that animals suffer from pain in the same way as human beings (10,13). It is important that a farmer sees his animals at least once a day to find out early if something is wrong with their animals. When a farmer notices that an animal is injured or in pain, it can be wise to seek the help of a veterinarian. A veterinarian can also help with the farming management by visiting every few weeks. Pain is defined as an “unpleasant sensory and emotional experience” that includes actual or potential tissue damage, and can -as mentioned earlier- cause discomfort.

4. Freedom from fear and distress

As with pain, it is assumed that animals can suffer from fear and distress like humans (10). For example, if there is competition for food or water between animals it can cause stress. In fact, when one of the five freedoms is not met the animal can suffer from distress. There are two forms of stress: acute and chronic

stress. Short term acute stress is critical for survival, whereas chronic stress can cause pathology and thereby increases the overall vulnerability. An acute stress response occurs as a response to a stressor. This response can benefit the animal when a fast fight-or-flight situation occurs. The acute stress response activates the sympathetic nervous system, and the release of catecholamines, epinephrine, and norepinephrine. With this response an animal is able to adapt to changing situations. If a (series of) stressor(s) persists, multiple stress responses are initiated and the animal becomes chronically stressed, which can lead to pathological conditions. In this case the stress response itself can generate problems (14). The animal will be more susceptible for diseases, which can result in less production and lead to a lesser quality of the meat.

5. Freedom to express normal behaviour

By providing sufficient space, proper facilities, and company of the animal's own kind this freedom can be met (15). When an animal requires these components in life, it is possible for them to express their normal behaviour they would also show living in the wild.

As an addition to these five freedoms a definition of animal welfare is provided in Saunders' comprehensive veterinary dictionary. Here, animal welfare is defined as the avoidance of abuse and exploitation of animals. It also states that the minimal requirements for housing must meet the Five Freedoms, and that it is important to continually keep an eye on the environment and care that humans give animals (8,16).

The OIE (World Organisation for Animal Health) describes animal welfare as complex and multi-faceted with scientific, ethical, economic, cultural, social, religious and political dimensions (17). According to the OIE, animal welfare refers to the degree to which an animal can cope with the conditions of its current situation. Good welfare is achieved when an animal is healthy, comfortable, well nourished, safe, able to express innate behaviour, and if it is not suffering from negativity like pain, fear, and distress. Proper disease prevention, treatment, shelter, management, nutrition, humane handling, and humane slaughter or killing are necessary to accomplish this state of wellbeing (18).

Ohl and Van der Staay wrote a review in 2012 about a new dynamic concept of animal welfare. According to this review, welfare is achieved when animals can actively adjust to their environment and create an internal condition that they perceive as positive. During evolution animals optimised their ability to interact with and adapt to the environment they are in. In contrast to the perspective of the Five Freedoms they rather replace the 'freedom from' with 'freedom to react to', because it is debatable whether freedom from negative influences of stimuli alone ensures welfare. An animal has a natural reaction to negative emotions, which protects an individual from being harmed. Such negative emotional reactions should be seen as an indication of the animal's adaptive capacity to avoid negative welfare, and are part of the normal behaviour of animals. There are also situations in which an animal purposefully exposes itself to a stressful situation, for example when a red deer explores a new environment looking for food (19). Individuals are considered to be in a state of well-being when they are able to actively adapt to their living conditions and thereby achieve a state that they perceive as positive. The more an animal reaches its limits to adapt, the more the welfare of an animal becomes compromised.

The NVWA uses a tool to assess animal welfare on farms, which is called the Welfare Quality Assessment. There are assessments available for different species, including beef cattle and dairy cattle, but not for farmed red deer. The Welfare Quality resource is designed to enable farmers, advisors, researchers, policy and other groups to create strategies or policies about animal welfare problems. There are twelve criteria and four principles in Welfare Quality protocols. The principles are good feeding, good housing, good health, and appropriate behaviour. The twelve criteria are summarised in table 1.1 (20). The Welfare Quality Assessment for beef cattle is used as a basis for the checklist that was made for the red deer farms in this project.

Welfare principles	Welfare criteria	Measures
Good feeding	1. Absence of prolonged hunger	Body condition score
	2. Absence of prolonged thirst	Water provision, cleanliness of water points, number of animals using water points
Good housing	3. Comfort around resting	Time needed to lie down, cleanliness of the animals
	4. Thermal comfort	*No measures yet developed*
	5. Ease of movement (other than health or resting related issues)	Pen features according to live weight, access to outdoor loafing area or pasture
Good health	6. Absence of injuries (other than those due to disease or voluntary interventions)	Lameness, integument alterations
	7. Absence of disease (as well as neonatal and transport related mortality)	Coughing, nasal discharge, ocular discharge, hampered respiration, diarrhoea, bloated rumen, mortality
	8. Absence of pain induced by management procedures	Disbudding/dehorning, castration
Appropriate behaviour	9. Expression of social behaviours (balance between negative and positive aspects like aggression and social licking)	Agonistic behaviours, cohesive behaviours
	10. Expression of other behaviours (balance between negative and positive behaviours like stereotypies and exploration)	Access to pasture
	11. Good human-animal relationship (no or reduced	Avoidance distance

	fear of humans)	
	12. Positive emotional state (avoiding negative emotional states like anxiety, and promoting presumed positive ones like contentment)	Qualitative behaviour assessment

Table 1.1: Welfare principles and criteria - Welfare Quality assessment protocol

2. Materials and methods

Background information about the natural behaviour of red deer, red deer farms and animal welfare aspects about red deer was gathered through a literature search, using books, search engines like Google Scholar or Scopus, and information on game farms the NVWA had on record. Based on the information obtained and the existing Welfare Quality protocol for cattle, a checklist was made for the farms (see also appendix 7.1 and 7.2). This checklist contained animal welfare aspects that can be observed on the farm in the environment of the deer or can be narrated by the farmer. For this project, the red deer themselves were not examined -according to the guidelines based on the EFSA risk assessment- rather the welfare aspects of the environment of the red deer were examined, and the behaviour and impression of the red deer were observed. The pasture, stables, cradle or crush, manger, water trough, mud bath, trees, shrubs and possibly present shelter were inspected to get an impression of the environment of the animals. When looked at the behaviour, attention was paid to activity and approachability. With the observation of the red deer themselves, they were given a glance about their body condition score, coat condition, antler shedding, and possibly present injuries.

Four of the nine known farms were each visited once during the summer of 2020. On the farms I talked to the farmers about their management, working routines, feeding, handling, and housing during the different seasons. After and during the interview (see also appendix 7.2) I took a look around at the farm and the red deer. Due to the busy times in tourism and agriculture, the situation of COVID-19 or no response of the farmers, the other five farms -most of them with campings and agriculture business- were not able to welcome me. The farms that I was not able to visit were asked to fill in a survey (see also appendix 7.3) with questions that are comparable to the checklist and the ones examined on the four farms that were visited. Next to comparable questions that were asked on the visited farms, this survey also contained questions to get insight into how the farm is managed, how big it is, how many red deer there are, and how the animals are housed. Two of the five remaining farms filled in these questionnaires. Taken together, information was collected from six red deer farms in total.

The results of the four visited farms and two farms that filled in the survey, were compared and collected into tables to get a clear overview of these farms. A risk analysis was made thereafter with calculated risks and benefits, as explained in the next two headlines.

Exposure and consequences

Red deer are exposed to external factors which make up the *exposure scenario*, which represents their living conditions. The probability of exposure to such factors is dependent on the extent and occurence

of a factor. *Extent* means the (part of the) population that would be affected by the factor, which is scored by estimating the affected percentile of the population:

1. 1-25%
2. 26-50%
3. 51-75%
4. 76-100%

Occurrence means how often the population is exposed to the factor, which is scored by estimating the probability of occurrence:

1. Unlikely to occur
2. Occur with even probability
3. Very likely to occur
4. Almost certainly occur

These external factors can have different welfare *consequences*, which can be either positive (+) or negative (-) or even both. Nine factors are listed of the six farms in this project with their extent, occurrence, probability of occurrence, intensity, duration, and consequences (21).

Risks and benefits

Multiple aspects (such as extent and occurrence) should be considered to determine the risk and/or benefit of a factor. The *probability* of a consequence due to exposure should also be considered, as well as the magnitude of a consequence. The latter can be determined with the *intensity* of the *duration* of a consequence. Risks and benefits can therefore be calculated with the following formula (21):

Risk or benefit (associated to factor F)

=

probability of exposure to factor F within the considered scenario (= extent x occurrence)

x

probability of welfare consequences given exposure to factor F

x

magnitude of consequence (= intensity x duration consequence)

The same way as extent and occurrence was scored, probability, intensity and duration were classified and scored:

Probability means the estimated chance that a consequence of a factor will occur:

1. Unlikely (1-25%)
2. Probably (26-50%)
3. Likely (51-75%)
4. Certain (76-100%)

The *intensity* means the estimated intensity of a consequence of a factor:

1. Mild discomfort/benefit
2. Moderate discomfort/benefit
3. Severe discomfort or huge benefit

4. Non-recovery/extreme benefit

The *duration* is the estimated duration of a consequence of a factor:

1. Very short (minutes)
2. Short (hours - days)
3. Long (weeks - months)
4. Permanent

Using these scorings and the formula, the risk and/or benefit score was calculated for each factor and consequence, which indicates the importance of each factor. A high risk score corresponds with a high chance of negative impact on animal welfare, whereas a high benefit score corresponds with a high positive impact on animal welfare. The risks were given a red colour, and the benefits were given a green colour.

3. Results

What is the natural behaviour of red deer?

Seasons and weather

The natural environment of red deer in the wild is big enough for the herd with a varied structure. There should be trees like coniferous, deciduous and mixed forests for coverage combined with open spaces like a meadow. Most of the time the deer are in the meadows to eat, rest and ruminate. There should be sufficient variation in the vegetation with grass, herbs, shrubs, and trees. In addition to sufficient access to water, a mud bath is also important (22). In 2001 Gebert and Verheyden-Tixier wrote a review about the diet composition of wild red deer in Europe (23). They concluded that there were three types of diet based upon the environment of the red deer: moorland diet type, mixed-deciduous forest diet type, and mixed-coniferous forest diet type. One third of the diet in all habitats contains grass, the rest is composed of:

- *Calluna* (heather) and *Vaccinium* (blueberry) and coniferous browse in mixed-coniferous forests.
- Fruits, leaves of deciduous trees and shrubs, and twigs and bark in mixed-deciduous forests.
- *Calluna* (heather) and *Vaccinium* (blueberry) and forbs in moorland.

Every season is different in the life of a red deer. Spring is an intensive period of recovery from the winter period, and is at the same time a period for development of the unborn fetuses as well as the antlers of the stags. To support these developments, the deer migrate to places with a wide variation in protein foods. The fetuses begin to grow from just 200 grams in January, to six to nine kilograms when they are born in May or June after a gestation period of approximately 34 weeks (22,24,25). The first calves can come at the end of April and the last calves are born at the end of July, although on average most of them are born in May or June. Also during spring, the stags begin to grow their next antlers. From April until June is the spring shedding period in which the deer take mud baths more often to speed up the shedding (22,24,26).

The summer is the season of physical development. To support optimal growth, the herd moves to a place with varied feed that is high in protein and fibres. During summer, the calves grow 20 kilograms in just three months. At the end of August, they weigh around 25-30 kilograms. During these three months they drink milk from their mother, which gradually decreases during the summer and autumn and they

start eating grass (22,24). Most calves will be fully weaned when they are about nine or ten months old (27). The hinds are keen to ensure that the calves eat well, receive good protection and social development. By summer, the growth of the antlers is complete, and from the second half of July the stags start to shed the velvet of their antlers (22,24). As the summer is the season before the rut, the stags rest and eat a lot to build up reserves. Due to the high degree of feeding, the stags are the heaviest during summer. The deer take mud baths mostly in the morning and the evening for cooling and to combat parasites (22).

Halfway through August the stag herds fall apart, and the stags start to search for hinds for the rutting season in autumn. The rut starts at the beginning of September and lasts until the beginning of November. Most hinds are in heat in the last two weeks of September and the first week of October. It is still possible that calves keep drinking with their mothers during this time of year, and at the end of November they weigh around 45-50 kilograms. The stags lose a lot of weight due to their active behaviour in the rut season. They do not allow themselves to rest and eat, and they fight with other stags (22,24). From the rut until the winter the stags need to recover and replenish their reserves. To achieve this, they rest and eat a lot after the rutting season. Because of the autumn shedding the deer take mud baths during the day, which also helps against parasites, and to cool off. The deer again tend to migrate in autumn, to get to places with good food to create fat reserves (22).

During winter time the deer are mainly focused on rest and survival. Fetuses will hardly grow during this time of the year, and in February-March the stags throw off their antlers (22,24). The deer migrate to places with enough feed, i.e. places like low mountains or near a river. In the winter they eat high-fiber foods like dry grass, twigs, bark or hard fruits. If they do not find enough food, some deer may die from starvation (22).

When red deer move, they walk against the wind to easily smell danger ahead. On ground level they use scent and sound even more. They are most active in cool weather with low humidity. During prolonged hot and cold periods they are minimally active to save energy to keep themselves either cool or warm. Even if there is a warm wind in autumn or winter they are less active (22). To keep warm in the winter with less activity, red deer have an efficient winter coat. The winter coat the deer obtain after the autumn shedding has a double coat with coarse guard hairs overlying fine underhairs that are very similar to fine wool fibers from sheep. The winter guard hairs are twice as wide as the summer guard hairs, resulting in a greater insulation efficiency. The dense underhairs in the winter coat close to the skin contribute to insulation as well (28). In snow the deer are less active and only when the snowing stops they become active again. Rain does not have as much influence on their activity, except that deer are more often found in open terrain when it rains. When rain falls on leaves, it makes a lot of noise in the bushes and the deer are more found on the meadows (22). Even though they prefer to reside in open areas during rainfall, shelter is -next to resting and eating- the third important factor in a deer's life.

Daily routine

During the day, red deer are actively avoiding (potential) danger. When they are active they are grooming, have social interaction, move around and eat. At rest they ruminate (five to six hours a day), relax and sleep. About six to eight times a day they forage, which takes seven to ten hours a day. In areas with a lot of disturbance they only forage during dusk, twilight or in the dark (22).

There is a lot of food in the springtime and the deer have a higher metabolism than during the wintertime. This means that they need less time to eat and ruminate. In the course of the year the food becomes richer in fiber, scarcer and of lower quality. This is paralleled by a slowing down of their metabolism, and the deer rest more to save energy (22).

During the summer and after the rut the stags mainly eat, ruminate and rest. They have very little social interaction and movement. The reserves that they have built up during the summertime are needed in the rutting period where they eat and ruminate very little. After the rut they build up their reserves that they have used during the rutting period. Their day consists mainly of taking mud baths, having social interaction with hinds, and scaring or fighting with other stags (22).

Social life

Red deer are social animals that live in herds, which comprise females or males, respectively. The female herds are well organised according to a matriarchy, and most of the animals are related to each other. The male herds do not have any structure (1,24). Hinds that are about to calve separate themselves from the herds up to a week before calving. When they start calving the yearlings are rejected and start to wander. The stags go in search of hinds in the pre-rut. The non-dominant stags wander in the rutting time through the area with hinds (22).

The most dominant animals can be recognised in different ways. These animals demand the best feeding spots by not allowing the lower ranking animals to approach by hitting them with the front legs and sometimes even biting. The dominant deer determine where they walk and do not tolerate other animals directly next to or in front of them. They lead the way and the rest of the herd follows at an appropriate distance. The dominant deer in female herds are the strongest and most experienced hinds (22).

How are red deer kept on farms in the Netherlands?

In April 2020 thirteen farms that have red deer were known to the Netherlands Enterprise Agency (Rijksdienst Voor Ondernemend Nederland - RVO). The size of these farms varies substantially, from as little as twelve red deer to over two hundred animals. The farms have different purposes, which are not necessarily commercial red deer farming for meat. Some farms are petting zoos, care farms or private individuals that keep red deer for other reasons than venison. There are approximately nine commercial red deer farms that keep red deer for venison in the Netherlands (3). The results in this report are from six farms with red deer kept for venison, two of which also have a camping area.

Apart from the purpose, red deer farms keep their deer in different ways or with a different infrastructure. In general, there are stables, a couple of pastures, and a treatment area. The infrastructure is designed such that animals can be handled and treated in a calm and efficient way with as little stress as possible. In the treatment area there is a crush or cradle present which is respectively hydraulic or with a bottom floor that can come down. In this crush or cradle it is possible to give deer treatments like antiparasitics or remove the antlers (29,30). See also figures 3.1 and 3.2.

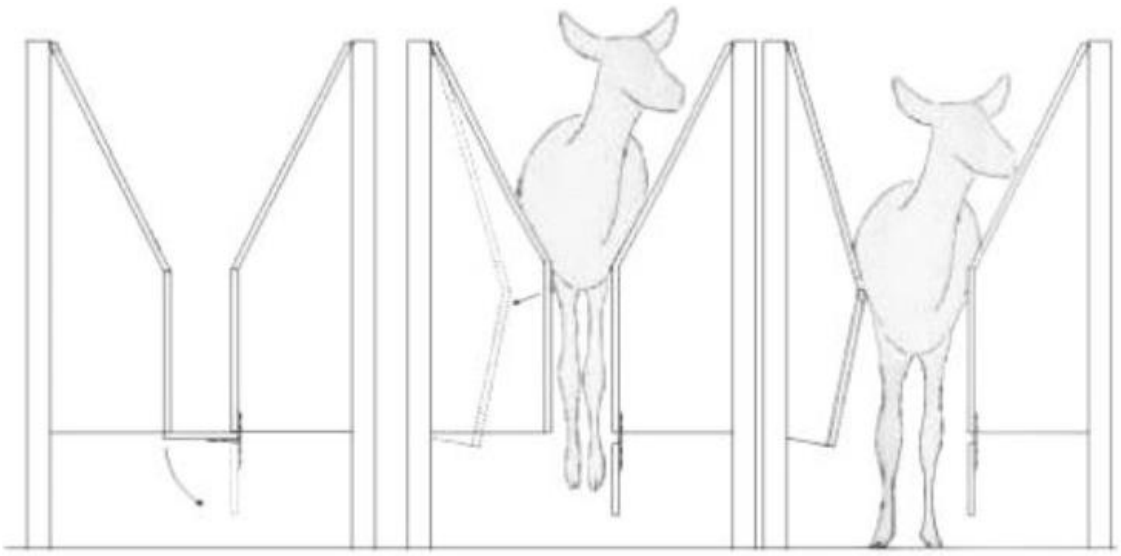

Figure 3.1: cradle with removable floor (30)

Figure 3.2: hydraulic crush (31)

Two of the four farms that were visited had a cradle with a dropdown floor that they both use once a year to remove the antlers of the yearlings -male yearlings are also called spikers- and give a deworming treatment to the calves when they are weaned and put inside the stables for the winter period. The stags on these two farms cannot be put inside these cradles, because they are too big and strong. Their antlers are removed on the meadow or inside the stables with sedation given by a

veterinarian. The hinds on these same two farms do not go in these cradles, because they do not have antlers that have to be removed or get a deworming treatment. Adult deer get immune and do not have to get a deworming treatment (32).

The other two of these four farms had a hydraulic crush, where they remove the antlers of the yearlings and the stags once a year. A hydraulic crush can be adapted to the size of a deer, and is therefore suitable for the stags as well. The sidewalls of this crush can be adjusted in height and closeness to the deer, in a way that the animals are really tight. One of the two farms that were not visited but completed the online survey, also had a hydraulic crush, but the other one did not have a cradle or crush at all. The farm with the hydraulic crush uses this to remove the antlers of the spikers. The other farm does not remove antlers at all.

Veterinarians rarely need to visit a red deer farm, mostly for sedation of the stags to remove the antlers or when there are calamities -which rarely occur. If a deer is wounded, this mostly heals on its own and they are not separated from the herd. The average death rates of the hinds, stags, yearlings, and calves is on all farms 0-5%. See also table 3.1 below for an overview.

	Farm 1 - visited	Farm 2 - visited	Farm 3 - visited	Farm 4 - visited	Farm 5 - survey	Farm 6 - survey
Crush or cradle	Cradle	Cradle	Hydraulic crush	Hydraulic crush	Hydraulic crush	No
Antlers removal stags	With sedation	With sedation	In crush - without sedation	In crush - without sedation	No	No
Antlers removal spikers	In cradle - without sedation	In cradle - without sedation	In crush - without sedation	In crush - without sedation	In crush - without sedation	No
Visit veterinarian	Every half year, sedation, calamities	Sedation, calamities	Calamities	Calamities	Calamities	Calamities

Table 3.1: cradle or crush on farms

On the farms there are one or more herds with hinds for breeding purposes, and -most of the time- as many stags as there are herds. On the farms where the stags and hinds live separately, the stags join the hinds during the rutting season. When the calves are born in May - June the calves stay with the hinds until the start of the rut when they are weaned and housed inside the stables during the winter. These calves go to slaughter the next year in autumn when they are around 18 months old; a few calves can be kept on the farm for breeding (29,30). All of these six farms keep the hinds more than ten years on the farm. The stags are kept five to ten years or more than ten years, which depends mostly on the quality of the stags. See also table 3.2 for an overview. These six farms all have the yearlings slaughtered at the slaughterhouse in the autumn when they are about 18-20 months old, and all farms have them transported without sedation. It is often thought that it is necessary to sedate red deer for transport, but the opposite is true. When the red deer are inside a building and there is a light inside the truck, they can be relatively easy to load in the truck. During transport the deer must be able to respond to their surroundings which should help them in their self-preservation. It has happened that a sedated deer lost

an eye during transport due to the friction on the floor. When red deer have enough space, it is easy to transport them. During transport they often lay down, which is the reason that the spikers should have their antlers sawn off to prevent injuries during transport. If there is not enough space, they cannot get up again because the other animals are blocking this and could hurt the laying deer (29).

	Farm 1 - visited	Farm 2 - visited	Farm 3 - visited	Farm 4 - visited	Farm 5 - survey	Farm 6 - survey
Number of herds	2	1	2	3	1	2
Number of stags	3	2	2	3	1	1
Average years stags stay on the farm	>10	>10	>10	>10	5-10	>10
Number of hinds	>50	45-50	45-50	>50	20-25	35-40
Average years hinds stay on the farm	>10	>10	>10	>10	>10	>10
Total number of red deer	>100	>100	>100	>100	40-50	90-100

Table 3.2: red deer composition on the farms

Unlike most farmed cattle, red deer are fertilised naturally. Handling red deer can cause a lot of distress and is unnecessary, because the pregnancy rate is almost 100% on most farms. During the rutting season in autumn the stags live together with the hinds, with one stag per herd to prevent fighting between the stags. When the hinds have to calve it is important that they can isolate or hide themselves from the rest of the herd. This can be managed on a farm by having a pasture that is big enough with hiding places like bushes, high grass or a shelter. The moment of weaning of the calves is not the same for every farm. On most farms the calves are weaned before the rut, because it is safer for the farmer to select the calves and put them inside the stable without an aggressive stag walking in the herd. It is also possible to wean them during or after the rut, or the natural way without separating the calf from the herd. When the calves are kept with the hinds during the rutting season, the calves can still drink milk and the hind can be distracted. The calves stay inside until March or April. See also table 3.3 for an overview.

	Farm 1 - visited	Farm 2 - visited	Farm 3 - visited	Farm 4 - visited	Farm 5 - survey	Farm 6 - survey
Average number of hinds	>50	45-50	45-50	>50	20-25	35-40
Average number of	>50	40-50	40-50	>50	10-20	20-30

calves						
Moment of weaning	Before rut	Before rut	During rut	Before rut	Naturally	After rut
Herd composition outside rut	Stags, hinds, and yearlings separated	Stags, hinds, and yearlings separated	Stags, hinds, and yearlings separated	Stags, hinds, and yearlings separated	Stags, hinds, and yearlings all together	Stags and hinds together, yearlings apart

Table 3.3: average number of calves born each year and their moment of weaning

To meet as many requirements for the environment of the red deer year-round as possible, a deer farm should at least contain a couple of features listed next. Outside should be a pasture which is big enough for the deer to spend most of the day eating, resting, and ruminating with fencing around the pasture. There are no guidelines or rules how much space a farmed red deer in the Netherlands should have, but it is recommended in literature to have around 20-22 red deer per hectare (1). In general, the farms from this project have pastures of at least one hectare for each herd. The pasture should have coverage and shadow possibilities like trees, bushes or a shelter. When the deer are shedding they take mud baths (seen in figure 3.3) to get rid of loose hair. Mud baths are also used to cool down or to fight parasites. In the summertime, the stags and spikers should be able to shed their antlers on trees, bushes or tree trunks. In figure 3.4 a spiker is in the middle of shedding his antlers. In this photo one can see clearly that the velvet is a living part with blood vessels.

Figure 3.3: hind taking a mud bath – Panthera Smit
Figure 3.4: spiker shedding his antlers – Ruan Kok

The stables all have a temperature that is comparable with or a few degrees higher than outside, where they are always kept on straw bedding. Inside it is recommended that the calves should have at least 1.5-2m^2 and hinds at least 3-4m^2 (29,30). Around March or April the deer are going outside again. None of the six farms have a climate computer or fans, because the red deer are only inside the stables

as calves between weaning in the autumn and the beginning of springtime (on all four farms visited) or all the red deer are inside during the winter period (on two farms after the rut until the beginning of spring). One farm had a year-round possibility for the deer to choose between being outside or inside. No fans are needed in winter due to the low temperatures, and no climate computer is needed because red deer can adjust to the winter temperatures with their thick coat. The stables on all visited farms are similar to the ones where cattle are kept (some stables are actually old dairy farms). For these reasons, the presence of climate computers and/or fans were not taken into account when the farms were compared to each other. The housing conditions that are provided on the six examined farms are given in table 3.4 below.

	Farm 1 - visited	Farm 2 - visited	Farm 3 - visited	Farm 4 - visited	Farm 5 - survey	Farm 6 - survey
m^2/red deer outside	>100	>100	>100	>100	>100	>100
m^2 /red deer inside	5-10	0-5	5-10	0-5	Unknown	5-10
Mud bath	Yes	Yes	Yes	No	Yes	Yes
Antler shedding	Trees, bushes, trunks	Trees, bushes, trunks	Trees	Trees, bushes	Trunks	Trunks
Coverage or shadow	Yes	Yes	Yes	Yes	Yes	Yes

Table 3.4: environment on the farms

As mentioned earlier, the hinds and stags stay on the farms for many years. This means that replacement is only needed every couple of years. The hinds can be replaced by young hinds born in the same herd or purchased from another farm. The stags can also be replaced by male calves born on the farm, but are mostly purchased or switched with the stags from another red deer farm. The reason new stags (or hinds) are purchased is to get better fertility rates and/or a new genetic pool which can result in more or better quality venison. However, it is possible that the former or the new stag is (suddenly) more aggressive than expected and for that reason slaughtered or sold. When purchased animals arrive at the farm, on none of these six farms are they kept in quarantine. There is a possibility that these purchased animals (almost exclusively stags) contain new parasites. Most of the farms allow visitors which is safe considering zoonotic diseases. Comparable to other ruminants one should consider Q-fever, chlamydiosis, leptospirosis, campylobacteriosis, salmonellosis, cryptosporidiosis, listeriosis, yersinia disease, and giardiasis. These zoonoses can be picked up through direct contact with feces, urine, placental tissues or birth fluids of red deer, which is unlikely to occur when people visit. Red deer are also susceptible for diseases like foot and mouth disease, but commonly these kinds of diseases do not occur in the Netherlands thanks to government control programs. An overview of the results is listed below in table 3.5.

	Farm 1 - visited	Farm 2 - visited	Farm 3 - visited	Farm 4 - visited	Farm 5 - survey	Farm 6 - survey
Purchase of animals	Yes	Yes	Yes	Yes	No	Yes
Which animals are purchased	Stags	Stags and hinds	Stags	Stags	-	Stags
Always the same source	No	No	No	No	-	No
Visitors	No	Yes	Yes	No	Yes	Yes

Table 3.5: purchasing and visitors

During the farm visits not one red deer stood out with a very low or very high body condition score (BCS). See also appendix 7.4 for the BCS chart that was used as a basis. In general, all animals looked as expected for the time of the year (summer). In fact, some stags could be considered to be (slightly) too fat, but that was expected in these months before the start of the rutting season and thus not marked as a very high BCS. The farms were asked what the basic ration was in winter and summer, and if some animals were given more than just the basic ration. The answers to these questions were arranged by season, gender, and farmed purpose.

- The basic rations on these six farms in the summer were composed of one or more of the following options: grass, leaves, concentrate, hay, herbs, sticks, bark, acorns, corn silage, fodder beet, crushed wheat, vegetables, and bread.
- In the winter the basic rations were composed of one or more of the following: grass, grass silage, straw, concentrate, lick stone, fodder beet, hay, herbs, leaves, sticks, acorns, crushed wheat, corn silage, vegetables, and bread.
- On four out of six farms the pregnant hinds do not get anything more than the basic ration, but the other farms give one or more extra of the following feed: grass silage, chopped grain, crushed barley, herbs, acorns, and lick stones.
- The lactating hinds were not given anything extra than the basic ration on two out of six farms, but the other farms gave them one or more of the following: concentrate, corn silage, crushed barley, lick stone, and hay.
- On half of the farms the stags were given no extra feeding, if given extra feeding on the other farms then this contained one or more of the following: minerals, grass silage, and fodder beet.
- On five of the six farms the yearlings were given extra feeding next to the basic ration: concentrate, crushed wheat, corn silage, grass silage, fodder beet, acorns, and lick stones.

The red deer on these farms were being fed once or twice per day, and had unlimited access to grass per day. Most farms have one feeding moment per day and red deer do not eat their roughage all at once. The number of red deer per feeding and water place outside as well as inside were also considered. The results are shown in table 3.6 below.

	Farm 1 - visited	Farm 2 - visited	Farm 3 - visited	Farm 4 - visited	Farm 5 - survey	Farm 6 - survey
Number of feeding moments	1	2	1	1	Unlimited	2
Outside						
Number of red deer per feeding place	1-10	1-10	1-10	1-10	40-50	1-10
Number of red deer per water place	1-10	40-50	40-50	40-50	40-50	30-40
Inside						
Number of red deer per feeding place	1-10	1-10	1-10	1-10	10-20	30-40
Number of red deer per water place	30-40	10-20	20-30	40-50	1-10	20-30

Table 3.6: number of feeding moments, feeding places, and water places outside as well as inside

Risk and benefit scores

A calculation of the risks and benefits of each farm was made based on nine factors for each farm. The calculations are summarised separately for each farm in the tables 3.7 - 3.12 below. These factors were chosen because they refer specifically to farming red deer compared to other farmed animals, or are basic factors for good welfare. The scores of the consequences were calculated using the formula given in *Materials and methods - Risks and benefits*. The positive consequences (and their score) are coloured green, and the negative consequences (and their score) are coloured red. The score of the factor was calculated by adding up all the scores of the consequences of that factor. When a factor had positive and negative consequences, then the score factor was marked either red or green, depending on whether the biggest portion was negative or positive.

Risk factor	Consequence(s)	Extent	Occurrence	Probability	Intensity	Duration	Score consequence(s)	Score factor
Antler removal	Sedation	1	4	4	2	2	64	448
	Handling	1	4	4	2	1	32	
	Less injuries	2	4	4	3	3	288	
	Safe transportation	2	4	4	4	2	256	
Antler shedding	**Less discomfort**	**1**	**4**	**4**	**3**	**3**	**144**	**144**
Social housing/grouping with conspecifics	Social enrichment	4	4	4	2	4	512	416
	Stressful social interactions	4	2	3	2	2	96	
Weaning	**Stress**	**2**	**4**	**4**	**2**	**3**	**192**	**204**
	Improvement condition hinds	**2**	**3**	**3**	**2**	**3**	**108**	
	Less stress with hinds during rut	**2**	**4**	**4**	**3**	**3**	**288**	
Mudbath	Expel parasites	4	3	3	3	2	216	504
	Grooming	4	4	3	3	2	288	
Food type	**Health**	**4**	**4**	**4**	**4**	**4**	**1024**	**1024**
Ad lib water access	Health	4	4	4	4	4	1024	1024
Size of pasture	**Room to avoid conspecifics**	**4**	**4**	**4**	**3**	**3**	**576**	**1344**
	Room for grazing	**4**	**4**	**4**	**4**	**3**	**768**	
Handling in cradle/crush	Stress	3	4	4	2	1	96	48
	Handling	3	4	4	1	1	48	
	Safe examination/treatment	3	4	4	2	1	96	

Table 3.7: risk and benefit scores farm 1 (visited)

Risk factor	Consequence(s)	Extent	Occurrence	Probability	Intensity	Duration	Score consequence(s)	Score factor
Antler removal	Sedation	1	4	4	2	2	64	448
	Handling	1	4	4	2	1	32	
	Less injuries	2	4	4	3	3	288	
	Safe transportation	2	4	4	4	2	256	
Antler shedding	**Less discomfort**	**1**	**4**	**4**	**3**	**3**	**144**	**144**
Social housing/grouping with conspecifics	Social enrichment	4	4	4	2	4	512	416
	Stressful social interactions	4	2	3	2	2	96	
Weaning	**Stress**	**2**	**4**	**4**	**2**	**3**	**192**	**204**
	Improvement condition hinds	**2**	**3**	**3**	**2**	**3**	**108**	
	Less stress with hinds during rut	**2**	**4**	**4**	**3**	**3**	**288**	
Mudbath	Expel parasites	4	3	3	3	2	216	504
	Grooming	4	4	3	3	2	288	
Food type	**Health**	**4**	**4**	**4**	**4**	**4**	**1024**	**1024**
Ad lib water access	Health	4	4	4	4	4	1024	1024
Size of pasture	**Room to avoid conspecifics**	**4**	**4**	**4**	**3**	**4**	**768**	**1792**
	Room for grazing	**4**	**4**	**4**	**4**	**4**	**1024**	
Handling in cradle/crush	Stress	3	4	4	2	1	96	48
	Handling	3	4	4	1	1	48	
	Safe examination/treatment	3	4	4	2	1	96	

Table 3.8: risk and benefit scores farm 2 (visited)

Risk factor	Consequence(s)	Extent	Occurrence	Probability	Intensity	Duration	Score consequence(s)	Score factor
Antler removal	Sedation	1	1	1	2	2	4	524
	Handling	1	4	4	1	1	16	
	Less injuries	2	4	4	3	3	288	
	Safe transportation	2	4	4	4	2	256	
Antler shedding	**Less discomfort**	**1**	**4**	**4**	**3**	**3**	**144**	**144**
Social housing/grouping with conspecifics	Social enrichment	4	4	4	2	4	512	416
	Stressful social interactions	4	2	3	2	2	96	
Weaning	**Stress**	**2**	**4**	**4**	**2**	**3**	**192**	**204**
	Improvement condition hinds	**2**	**3**	**3**	**2**	**3**	**108**	
	Less stress with hinds during rut	**2**	**4**	**4**	**3**	**3**	**288**	
Mudbath	Expel parasites	4	3	3	3	2	216	504
	Grooming	4	4	3	3	2	288	
Food type	**Health**	**4**	**4**	**4**	**4**	**4**	**1024**	**1024**
Ad lib water access	Health	4	4	4	4	4	1024	1024
Size of pasture	**Room to avoid conspecifics**	**4**	**4**	**4**	**3**	**3**	**576**	**1344**
	Room for grazing	**4**	**4**	**4**	**4**	**3**	**768**	
Handling in cradle/crush	Stress	3	4	4	1	1	48	0
	Handling	3	4	4	1	1	48	
	Safe examination/treatment	3	4	4	2	1	96	

Table 3.9: risk and benefit scores farm 3 (visited)

Risk factor	Consequence(s)	Extent	Occurrence	Probability	Intensity	Duration	Score consequence(s)	Score factor
Antler removal	Sedation	1	1	1	2	2	4	524
	Handling	1	4	4	1	1	16	
	Less injuries	2	4	4	3	3	288	
	Safe transportation	2	4	4	4	2	256	
Antler shedding	**Less discomfort**	**1**	**4**	**4**	**3**	**3**	**144**	**144**
Social housing/grouping with conspecifics	Social enrichment	4	4	4	2	4	512	416
	Stressful social interactions	4	2	3	2	2	96	
Weaning	**Stress**	**2**	**4**	**4**	**2**	**3**	**192**	**204**
	Improvement condition hinds	**2**	**3**	**3**	**2**	**3**	**108**	
	Less stress with hinds during rut	**2**	**4**	**4**	**3**	**3**	**288**	
Mudbath	Expel parasites	4	1	1	3	2	24	48
	Grooming	4	1	1	3	2	24	
Food type	**Health**	**4**	**4**	**4**	**4**	**4**	**1024**	**1024**
Ad lib water access	Health	4	4	4	4	4	1024	1024
Size of pasture	**Room to avoid conspecifics**	**4**	**4**	**4**	**3**	**4**	**768**	**1792**
	Room for grazing	**4**	**4**	**4**	**4**	**4**	**1024**	
Handling in cradle/crush	Stress	3	4	4	1	1	48	0
	Handling	3	4	4	1	1	48	
	Safe examination/treatment	3	4	4	2	1	96	

Table 3.10: risk and benefit scores farm 4 (visited)

Risk factor	Consequence(s)	Extent	Occurrence	Probability	Intensity	Duration	Score consequence(s)	Score factor
Antler removal	Sedation	1	1	1	2	2	4	668
	Handling	1	4	4	1	1	16	
	Less injuries	4	3	4	3	3	432	
	Safe transportation	2	4	4	4	2	256	
Antler shedding	**Less discomfort**	**1**	**4**	**4**	**3**	**3**	**144**	**144**
Social housing/grouping with conspecifics	Social enrichment	4	4	4	2	4	512	368
	Stressful social interactions	4	3	3	2	2	144	
Weaning	**Stress**	**2**	**4**	**4**	**2**	**3**	**192**	**204**
	Improvement condition hinds	**2**	**3**	**3**	**2**	**3**	**108**	
	Less stress with hinds during rut	**2**	**4**	**4**	**3**	**3**	**288**	
Mudbath	Expel parasites	4	3	3	3	2	216	504
	Grooming	4	4	3	3	2	288	
Food type	**Health**	**4**	**4**	**4**	**4**	**4**	**1024**	**1024**
Ad lib water access	Health	4	4	4	4	4	1024	1024
Size of pasture	**Room to avoid conspecifics**	**4**	**4**	**4**	**3**	**4**	**768**	**1792**
	Room for grazing	**4**	**4**	**4**	**4**	**4**	**1024**	
Handling in cradle/crush	Stress	3	4	4	1	1	48	0
	Handling	3	4	4	1	1	48	
	Safe examination/treatment	3	4	4	2	1	96	

Table 3.11: risk and benefit scores farm 5 (survey)

Risk factor	Consequence(s)	Extent	Occurrence	Probability	Intensity	Duration	Score consequence(s)	Score factor
Antler removal	Sedation	1	1	1	2	2	4	25
	Handling	1	1	1	1	1	1	
	Less injuries	2	1	1	3	3	18	
	Safe transportation	2	1	1	3	2	12	
Antler shedding	**Less discomfort**	**1**	**4**	**4**	**3**	**3**	**144**	**144**
Social housing/grouping with conspecifics	Social enrichment	4	4	4	2	4	512	368
	Stressful social interactions	4	3	3	2	2	144	
Weaning	**Stress**	**2**	**4**	**4**	**2**	**3**	**192**	**204**
	Improvement condition hinds	**2**	**3**	**3**	**2**	**3**	**108**	
	Less stress with hinds during rut	**2**	**4**	**4**	**3**	**3**	**288**	
Mudbath	Expel parasites	4	3	3	3	2	216	504
	Grooming	4	4	3	3	2	288	
Food type	**Health**	**4**	**4**	**4**	**4**	**4**	**1024**	**1024**
Ad lib water access	Health	4	4	4	4	4	1024	1024
Size of pasture	**Room to avoid conspecifics**	**4**	**4**	**4**	**3**	**4**	**768**	**1792**
	Room for grazing	**4**	**4**	**4**	**4**	**4**	**1024**	
Handling in cradle/crush	Stress	1	1	1	1	1	1	0
	Handling	1	1	1	1	1	1	
	Safe examination/treatment	1	1	1	2	1	2	

Table 3.12: risk and benefit scores farm 6 (survey)

Factors of importance

For the evaluation of the risks and benefits on these farms, two factors are highlighted here: the highest scoring risk and benefit factors. It should be noted that eight out of the nine factors considered were scored as benefits and just one factor was scored as a risk, but only on the farms with a cradle. The farms with a hydraulic crush and the farm without a cradle or a crush do not have calculated risks. On all six

farms the outcome of the factors as risk or benefit were comparable, with the handling in a cradle or crush as an exception, but the height of the scores was different across farms. For all six farms the same factor had the same highest benefit and the two farms with a risk had the same risk; these factors will be discussed in more detail below.

The *highest benefit score* was the size of the pasture. On all six farms the pastures -mostly grassland- were at least one hectare in size, but were sometimes even more greater on the bigger farms. When there are for example fifty red deer on one hectare, there is 200 m^2 for each deer, which is a very big space for one animal even though it is more crowded than literature (1) suggests. This means there is always sufficient room for grazing and avoiding conspecifics. This is really important in the spring when the hinds give birth to the calves. In the wild a hind will seclude herself when she is about to give birth, and in the first week of the calf's life it is able to hide while the hind searches for food. This way the hinds and the calves are able to adapt to their environment on farms and exhibit natural behaviour. With a good size of the pasture the deer have enough grass to eat, sufficient room to lay down, and are also able to flee when they are suddenly startled. That a low density of the population is beneficial for animal welfare corresponds to a field study from the Italian Alps. In a study in 2011/2012 in the Italian Alps 174 red deer were culled in the hunting season and their Hair Cortisol Concentration (HCC) was measured. This study showed that the red deer from a high density area had higher cortisol concentrations. This confirmed their hypothesis that areas with a high density of the population and harsher environmental conditions results in higher cortisol levels, reflecting more stress (33). All visited farms had pastures without red deer and were able to maintain a rotating system with the pastures to allow the grass time to recover.

The *highest risk score* was the handling in the cradle or crush. The exposure of this factor is actually quite low, because the hinds for instance do not go into the cradle or crush, unless they might be having trouble with parasites, particularly on farms where the calves do not get standard treatment when they are being weaned. On two farms, when the calves are weaned they go into the cradle or crush for a treatment against parasites. Before going to the slaughterhouse, the spikers go into the cradle or crush to have their antlers sawn off. The farms with a hydraulic crush that have the antlers sawn off of the stags as well, put the stags into the crush once a year for this purpose. To put red deer in a cradle or crush is not easy. The animals must be herded to the treatment area where the cradle or crush is located. At the farms that were visited, the last meters before the cradle or crush consisted of a (darkened) labyrinth of paths, guiding the animals to walk towards the cradle or crush. When they are inside the cradle or crush they are clamped to prevent escaping or moving when they get a treatment or the antlers are sawn off. The time needed to give the calves an antiparasitic treatment in the cradle or crush is really short. The sawing off of the antlers takes more time than the antiparasitic treatment, but not longer than approximately three minutes. Because the velvet -which is the living and therefore sensitive part of the antlers- is already gone, the sawing can be done without any analgesia. Even though they do not have pain with these procedures, they can still get stressed with the handling in the cradle or crush because they are not used to it and red deer are not domesticated animals.

Priority ranking

Overall, when considering the calculated risks and benefits for these red deer farms, there is one risk and the rest of the factors were calculated as benefits. A priority ranking table (table 3.13 below) was made

for the six farms, based on the highest and lowest calculated scores. In this table, number 1 represents the risk or benefit with the lowest score which has the highest priority to give more attention, and the one with the highest number (in these cases 8 instead of 9 because of a shared position) that has the lowest priority. The lowest priority means that this factor was calculated as the best one on this farm, with little to no room and need for improvement. The prioritisation was largely comparable for all six farms, with similar priorities on position 1, 7 (twice), and 8.

	Farm 1 - visited	Farm 2 - visited	Farm 3 - visited	Farm 4 - visited	Farm 5 - survey	Farm 6 - survey
Antler removal	5	5	6	6	6	2
Antler shedding	2	2	2	3	2	3
Social housing / grouping with conspecifics	4	4	4	5	4	5
Weaning	3	3	3	4	3	4
Mud bath	6	6	5	2	5	6
Food type	7	7	7	7	7	7
Ad lib water access	7	7	7	7	7	7
Size of pasture	8	8	8	8	8	8
Handling in cradle / crush	1	1	1	1	1	1

Table 3.13: priority ranking table of all six farms

4. Discussion

For this research project I studied the daily life and needs of red deer with the variations in the different seasons to get familiar with the needs of red deer. These results were used to determine the state of checkpoints on four visited red deer farms that needed observation for the evaluation of the welfare of the animals. A positive impression had been obtained of the welfare of the red deer on these four farms. The other five known red deer farms in the Netherlands were asked to fill in a survey, which two of the five farms completed.

The two farms that filled in the survey were not visited and there is no definite vision of the management and precise routines of the season work on these farms. Opposite answers were given to some questions. To clarify this, there has been mail traffic between the writer and the farms, but this can not guarantee that the interpretation of the writer is 100% correct for these two farms. For future research it is better -if a visit to the farm is not possible- to put control questions in the survey that should generate the same answer, but the question is formulated differently. The difficulty in surveys is always the fact that you are never certain that questions have been correctly interpreted and answered (34),

something that is a smaller risk with interviews in person. For example, farm 5 answered in the survey that the basic ration -grass during the summer, and grass and corn silage during the winter- was given ad lib (see table 3.6), but it is likely to assume that the corn silage was given once or more a day and it took the deer the entire day to eat. Another example that stood out: spikers that go to the slaughterhouse are supposed to get their antlers sawn off, but farm 6 said in the survey that they do not have a cradle or crush and do not saw the antlers off (see table 3.1). However, their animals do go on transport to the slaughterhouse. Based on the survey alone it is now uncertain if these animals are transported with their antlers still on, but this seems highly unlikely. For future research it would be better to put a control question in the survey like: 'Are the spikers transported to the slaughterhouse with their antlers still on?' Two of the four visited farms mentioned during the visit that it was mandatory to transport deer without antlers. Looking at the laws and regulations in the Netherlands, European regulation nr. 1/2005 demands that it is forbidden to transport animals in a way that they can get hurt in any way (35). If they are transported with antlers, then it is important that the deer are transported in individual pens to prevent injuries with other deer (36). Considering all this, one can assume that the red deer of farm 6 also get transported without antlers. Therefore the results of the two farms that finished the online survey, turned out to be a limitation of this research. For these reasons the results of the four visited farms are more trustworthy and can be better interpreted. Nonetheless, the risk analysis revealed a consistent picture across the farms which is visible in table 3.13 about the priorities on the different farms. Four of the nine factors had the same priority ranking on all farms, and the other factors were closely the same. This shows that the results of farm 5 and 6 did not confuse this research.

Another inconsistency -this time about all six farms- was the room inside the stables. Based on the results in table 3.4, the red deer seem to have too little space inside the stables. However, the deer are mostly outside except for the calves. On one farm the deer had the possibility to choose between being inside or outside year-round. Therefore the space inside can give a distorted picture. In reality, all the deer on these six farms had sufficient room to express natural behaviour, and to obtain adequate food, without conflict.

This research took place mostly during the summer months, but farming red deer is seasonal work. Every season of the year the management and the animals will be different (26,37). For future research it is important to visit the farms during every different season to be able to evaluate animal welfare better, and one can observe the management and animals instead of getting the results via live interview or online survey.

5. Conclusion

When I visited the four farms for this project, my impression of the farms, the animals, and the management was quite positive compared to other farmed animals for food. After comparing the results with routines and requirements that red deer have in the wild, and calculating the risks and benefits, this impression was confirmed. Little to no potential risks were detected for the animal welfare of farmed red deer for venison in the Netherlands. This may be due to the fact that red deer do not need any assistance with insemination, calving, weaning, and do not get sick often. As a consequence, there is little to no interference needed from the farmer. This allows the red deer to live undisturbed with very little stress.

Moreover, there are a lot of welfare benefits, with the size of the pasture standing out as the highest benefit. On all the farms the red deer had sufficient space which is important for good animal welfare, and is in line with the literature (33). The only calculated risk was the handling in a cradle or crush, which was evident on the farms with a cradle instead of a hydraulic crush. These cradles were almost exclusively used for antiparasitic treatment and removal of antlers of the spikers, and may therefore outweigh the risks of the handling in the longer term. However, it remains important to herd and handle the deer with as little stress as possible. Taken together, based on the current analyses, the housing and management of red deer in the Netherlands is well organised and farmed red deer have sufficient space and opportunities to display their natural behaviour, and reach a positive welfare state.

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7. Appendix

Appendix 7.1 - Checklist farm visit

Behaviour/observations

- Eating
- Resting
- Social interactions
- Approachability
    - <50 cm
    - 50-100 cm
    - >100 cm
- Body condition score (BCS)
    - Sufficient (3 or higher)
    - Poor (1 or 2)
- Lameness
- Lesions
- Coughing
- Diarrhoea

Environment

- Outside
    - Water points
    - Feeding places
    - Size of pasture
    - Number of animals per pasture
    - Shelter
    - Mud bath
- Inside
    - Water points
    - Feedings places
    - Size of pen
    - Number of animals per pen
    - Ground coverage
- Treatment area
    - Labyrinth paths
    - Cradle or crush

Appendix 7.2 - Interview farmer

Management

- How many people work on the farm?
- How many years of experience with red deer does the farmer have?
- Which people work with the red deer?
- How many years are red deer farmed on this farm?

Animals

- Are there any other commercially kept animals on this farm?
    - If so, is there a possibility that these species can have physical contact?
- Are there any companion animals kept on this farm?
    - If so, is there a possibility that these species can have physical contact?
- How many herds are on this farm?
- How many red deer are on this farm?
- How are the red deer grouped outside the rutting time?
- How many hinds are on this farm for breeding purposes?
- How many years do the hinds stay on this farm on average?
- How many stags are on this farm for breeding purposes?
- How many years do the stags stay on this farm on average?
- At what age do the animals for slaughter go to slaughter?
- Where are the animals slaughtered?
- If the animals go to the slaughterhouse alive, do they get sedation for transport?

Hygiene and biosecurity

- Are there red deer bought?
    - If so, which group of deer?
- Are the bought deer always from the same source?
- Are bought deer kept in quarantine?
- How often are red deer bought?
- Do bought deer get more attention?
- How many days a year do the deer have access to the pasture?
- How many hours a day are the red deer outside?
- How many days are the deer kept inside?
- Are visitors allowed on this farm?
    - If they are, are they allowed to touch the deer?

Reproduction

- How does the fertilisation of the hinds take place?
- How many calves are yearly born on this farm on average?
- How many female calves are yearly kept for breeding purposes?
- How many male calves are yearly kept for breeding purposes?
- How many calves are yearly kept for slaughter?
- Are hinds housed separately during farrowing?
- When are the calves weaned?
- How does the calf get milk?

- Do the calves get more attention?

Water and feeding

- What does the basic ration consist of in the summer months?
- What does the basic ration consist of in the winter months?
- What extra food do the pregnant hinds get?
- What extra food do the lactating hinds get?
- What extra food do the stags get?
- What extra food do the slaughter animals get?
- How is the food offered?
- How many red deer are there per feeding place outside?
- How many red deer are there per feeding place inside?
- How is the water offered?
- How many red deer are there per drinking place outside?
- How many red deer are there per drinking place inside?

Climate

- Is there a climate computer present and in use inside the stables?
- What temperature is maintained inside the stables?
- Are there options to help the stags shed their antlers?
- What does the ground cover consist of inside the stables?
- How many m^2 per red deer do the animals have at their disposal outside?
- How many m^2 per red deer do the animals have at their disposal inside?

Health

- Is there a cradle or crush present?
- Do the red deer get antiparasitic treatment?
    - If so, which animals get this treatment?
- Are interventions like antler removal performed?
    - If so, how are the antlers of the stags removed?
    - And how are the antlers of the spikers removed?
- Is there a regular veterinarian for this farm?
- How often does the veterinarian visit?
- Does a sick or wounded red deer get isolated from the herd?
- Is there an infirmary present?
- What is the average yearly death rate of the hinds?
- What is the average yearly death rate of the stags?
- What is the average yearly death rate of the calves and yearlings?

Appendix 7.3 - Survey questions

About the farm

- How many people work on the farm?
    - 1-3
    - 4-6
    - 7-9
    - 10 or more
- How many years of experience with red deer does the farmer have?
    - <1 year
    - 1-3 years
    - 4-6 years
    - 7-9 years
    - 10 or more years
- Which people work with the red deer?
    - Owner/farmer
    - Family members
    - Permanent employees
    - Temporary employees
    - Seasonal workers
- How many years are red deer farmed on this farm?
    - <1 year
    - 1-3 years
    - 4-6 years
    - 7-9 years
    - 10 or more years

About the animals

- Are there any other commercially kept animals on this farm (for the production of meat, milk, fur or eggs)?
    - No
    - Big ruminants
        - Dairy cattle
        - Beef cattle
        - Dual purpose cattle
        - Veal calves
        - Fallow deer
        - Water buffalo
        - Other
    - Small ruminants (also llamas or alpacas)
        - Sheep
        - Goats
        - Llamas
        - Alpacas
        - Other
    - Herbivores

        - Rabbits
        - Horses
        - Camels
        - Other
    - Poultry
        - Rearing laying hens
        - Parent or grandparents laying hens
        - Laying hens
        - Parent or grandparents broilers
        - Broilers
        - Turkeys
        - Ducks
        - Ostriches
        - Pheasants
        - Other
    - Pigs
        - Breeding sows
        - Sows
        - Fattening pigs
        - Other
    - Other
        - Mink
        - Fish
        - Shellfish
        - Insects
        - Invertebrates
        - Other
- If so, is there a possibility that these species can have physical contact?
    - Not applicable
    - No
    - Yes
    - Other
- Are there any companion animals kept on this farm?
    - No
    - Dog
    - Cat
    - Horse
    - Pony
    - Donkey
    - Fallow deer
    - Cattle
    - Sheep
    - Goat
    - Llama
    - Alpaca

    - Chicken
    - Turkey
    - Duck
    - Rabbit
    - Pig
    - Other
- If so, is there a possibility that these species can have physical contact?
    - Not applicable
    - No
    - Yes
- How many herds are on this farm?
    - 1
    - 2
    - 3
    - More than 3
- How many red deer are on this farm?
    - Less than 10
    - 10-20
    - 20-30
    - 30-40
    - 40-50
    - 50-60
    - 60-70
    - 70-80
    - 80-90
    - 90-100
    - 100 or more
- How are the red deer grouped outside the rutting time?
    - Stag(s), hinds and slaughter animals all apart
    - Stag(s) apart, hinds and slaughter animals together
    - Stag(s) and hinds together, slaughter animals apart
    - Stag(s), hinds and slaughter animals all together
    - Other
- How many hinds are on this farm for breeding purposes?
    - 0-5
    - 5-10
    - 10-15
    - 15-20
    - 20-25
    - 25-30
    - 30-35
    - 35-40
    - 40-45
    - 45-50
    - 50 or more

- How many years do the hinds stay on this farm on average?
    - Less than 5 years
    - 5-10 years
    - More than 10 years
- How many stags are on this farm for breeding purposes?
    - 0
    - 1
    - 2
    - 3
    - 4
    - 5 or more
- How many years do the stags stay on this farm on average?
    - Less than 5 years
    - 5-10 years
    - More than 10 years
- At what age do the animals for slaughter go to slaughter?
    - Less than 12 months
    - 12-14 months
    - 14-16 months
    - 16-18 months
    - 18-20 months
    - Older than 20 months
- At what (live) weight are the slaughter animals slaughtered?
    - Less than 80 kg
    - 80-100 kg
    - 100-120 kg
    - 120-140 kg
    - More than 140 kg
- Where are the animals slaughtered?
    - On the farm
    - At the slaughterhouse
- If the animals are slaughtered on the farm, by whom and how is this performed?
    - Always on the slaughterhouse
    - By a hunter
    - By the farmer
    - By a butcher
    - By a veterinarian
    - Sedation with rifle, kill with rifle
    - Sedation with rifle, kill with neck cut
    - Sedation with shooting mask, kill with neck cut
    - No sedation, kill with rifle
    - Other
- If the animals go to the slaughterhouse alive, do they get sedation for transport?
    - No
    - Yes, but not always

    - Yes, always
- Are there red deer bought? If so, which group of deer?
    - No
    - Yes, only the stags
    - Yes, only the hinds
    - Yes, stags and hinds
    - Other
- Are the bought deer always from the same source?
    - Not applicable
    - Yes
    - No, through a dealer or company
    - No, through multiple/different dealers or companies
    - Other
- Are bought deer kept in quarantine? If so, how long?
    - Not applicable
    - No
    - Yes, less than a week
    - Yes, 1-2 weeks
    - Yes, 3-4 weeks
    - Yes, 1-2 months
    - Yes, 2-3 months
    - Yes, longer than 3 months
- How often are red deer bought?
    - Not applicable
    - Every week
    - Every month
    - Every quarter
    - Every half year
    - Every year
    - Other
- Do bought deer get more attention?
    - Not applicable
    - No
    - Yes
    - Other

Housing and climate

- Do the red deer have access to the outside?
    - No
    - Yes, just the stags
    - Yes, just the hinds
    - Yes, just the calves
    - Yes, just the stags and hinds
    - Yes, just the hinds and the calves
    - Yes, all red deer

    - Other
- How many days a year do the deer have access to the pasture?
    - Not applicable
    - 0-30 days
    - 30-60 days
    - 60-90 days
    - 90-120 days
    - 120-150 days
    - 150-180 days
    - 180-210 days
    - 210-240 days
    - 240-270 days
    - 270-300 days
    - 300-330 days
    - 330-365 days
- How many hours a day are the red deer outside?
    - Not applicable
    - 1-5 hours
    - 5-10 hours
    - 10-15 hours
    - 15-20 hours
    - More than 20 hours
- How many days a year are the deer kept inside?
    - Not applicable
    - Just the calves
    - 0-30 days
    - 30-60 days
    - 60-90 days
    - 90-120 days
    - 120-150 days
    - 150-180 days
    - 180-210 days
    - 210-240 days
    - 240-270 days
    - 270-300 days
    - 300-330 days
    - 330-365 days
- Is the pasture fenced?
    - Not applicable
    - No
    - Yes
- How high is the fence of the pasture?
    - Not applicable
    - Lower than 1 meter
    - 1-2 meters

    - Higher than 2 meters
- Is there a possibility that the animals can get a mud bath?
    - No
    - Yes
    - Other
- Are visitors allowed on this farm?
    - No
    - Yes, just inside the stables
    - Yes, just at the pastures
    - Yes, inside as well as outside
- If they are, are they allowed to touch the deer?
    - Not applicable
    - No
    - Yes
    - Other
- Is there a climate computer present and in use inside the stables?
    - No
    - Yes, but not in use
    - Yes, sometimes in use
    - Yes, always in use
    - Other
- What temperature is maintained inside the stables?
    - Lower than 0 degrees Celsius
    - 0-5 degrees Celsius
    - 5-10 degrees Celsius
    - 10-15 degrees Celsius
    - 15-20 degrees Celsius
    - 20-25 degrees Celsius
    - 25-30 degrees Celsius
    - More than 30 degrees Celsius
    - About the same as the temperature outside
- Are there fans inside the stables?
    - Not applicable
    - No
    - Yes
    - Other
- Are there options to help the stags shed their antlers?
    - No
    - Yes, trees
    - Yes, bushes
    - Yes, scouring posts
    - Yes, tree trunks
    - Other
- Do the red deer have the ability to shelter outside?
    - Not applicable

    - No
    - Yes, one or more trees
    - Yes, one or more bushes
    - Yes, a hutch
    - Other
- What does the ground cover consist of inside the stables?
    - Not applicable
    - No ground cover (concrete)
    - Wood
    - Wood shavings
    - Hemp
    - Sawdust
    - Straw
    - Chopped straw
    - Beech chips
    - Coconut fibers
    - Tiling
    - Grass
    - Sand
    - Rubber
    - Other
- How many m^2 per red deer do the animals have at their disposal outside?
    - Not applicable
    - 0-10 m^2
    - 10-20 m^2
    - 20-30 m^2
    - 30-40 m^2
    - 40-50 m^2
    - 50-60 m^2
    - 60-70 m^2
    - 70-80 m^2
    - 80-90 m^2
    - 90-100 m^2
    - 100 or more m^2
- How many m^2 per red deer do the animals have at their disposal inside?
    - Not applicable
    - 0-5 m^2
    - 5-10 m^2
    - 10-15 m^2
    - 15-20 m^2
    - 20-25 m^2
    - More than 25 m^2
    - Other

Reproduction

- How many calves are yearly born on this farm on average?

    - None
    - 1-10
    - 10-20
    - 20-30
    - 30-40
    - 40-50
    - More than 50
- How many female calves are yearly kept for breeding purposes?
    - None
    - 1-10
    - 10-20
    - 20-30
    - 30-40
    - 40-50
    - More than 50
- How many male calves are yearly kept for breeding purposes?
    - None
    - 1-10
    - 10-20
    - 20-30
    - 30-40
    - 40-50
    - More than 50
- How many calves are yearly kept for slaughter?
    - None
    - 1-10
    - 10-20
    - 20-30
    - 30-40
    - 40-50
    - More than 50
- Are hinds housed separately during farrowing?
    - No, no possibility to seclusion
    - No, with possibility to seclusion
    - Yes, entire pregnancy housed separately
    - Yes, couple of months before farrowing housed separately
    - Yes, couple of weeks before farrowing housed separately
    - Yes, couple of days before farrowing housed separately
    - Yes, when the hinds farrowing
    - Other
- When are the calves removed from the hind?
    - Directly after birth
    - Within a week after birth
    - Right before the rut
    - Right after the rut

    - Other
- How does the calf get milk?
    - Everything only from their own mother
    - Own mother and from other hinds
    - Own mother and milk replacer
    - Only milk replacer
    - Other
- Do the calves get more attention?
    - No
    - Yes
    - Other

Water and feeding

- What does the basic ration consist of in the summer months?
    - Grass
    - Hay
    - Herbs
    - Leaves and branches
    - Bark
    - Corn silage
    - Grass silage
    - Straw
    - Berries
    - Acorns
    - Beechnuts
    - Concentrate
    - Lick stone
    - Other
- What does the basic ration consist of in the winter months?
    - Grass
    - Hay
    - Herbs
    - Leaves and branches
    - Bark
    - Corn silage
    - Grass silage
    - Straw
    - Berries
    - Acorns
    - Beechnuts
    - Concentrate
    - Lick stone
    - Other
- What extra food do the pregnant hinds get?
    - Nothing more than the basic ration

    - Grass
    - Hay
    - Herbs
    - Leaves and branches
    - Bark
    - Corn silage
    - Grass silage
    - Straw
    - Berries
    - Acorns
    - Beechnuts
    - Concentrate
    - Lick stone
    - Other
- What extra food do the lactating hinds get?
    - Nothing more than the basic ration
    - Grass
    - Hay
    - Herbs
    - Leaves and branches
    - Bark
    - Corn silage
    - Grass silage
    - Straw
    - Berries
    - Acorns
    - Beechnuts
    - Concentrate
    - Lick stone
    - Other
- What extra food do the stags get?
    - Nothing more than the basic ration
    - Grass
    - Hay
    - Herbs
    - Leaves and branches
    - Bark
    - Corn silage
    - Grass silage
    - Straw
    - Berries
    - Acorns
    - Beechnuts
    - Concentrate
    - Lick stone

    - Other
- What extra food do the slaughter animals get?
    - Nothing more than the basic ration
    - Grass
    - Hay
    - Herbs
    - Leaves and branches
    - Bark
    - Corn silage
    - Grass silage
    - Straw
    - Berries
    - Acorns
    - Beechnuts
    - Concentrate
    - Lick stone
    - Other
- How is the basic ration given?
    - Unlimited
    - 1 feeding moment per day
    - 2 feeding moments per day
    - Other
- How is the food offered?
    - Feed grape
    - Feed front/path
    - Tub/bin
    - Other
- How many red deer are there per feeding place outside?
    - Not applicable
    - 1-10
    - 10-20
    - 20-30
    - 30-40
    - 40-50
    - More than 50
- How many red deer are there per feeding place inside?
    - Not applicable
    - 1-10
    - 10-20
    - 20-30
    - 30-40
    - 40-50
    - More than 50
- How is the water offered?
    - Float bowl

    - Drinking bowl with valve
    - Trough
    - Meadow drinking trough
    - Nipple drinker
    - Other
- How many red deer are there per drinking place outside?
    - Not applicable
    - 1-10
    - 10-20
    - 20-30
    - 30-40
    - 40-50
    - More than 50
- How many red deer are there per drinking place inside?
    - Not applicable
    - 1-10
    - 10-20
    - 20-30
    - 30-40
    - 40-50
    - More than 50

Health

- Do the red deer get antiparasitic treatment? If so, which animals get this treatment (write this in the 'other' section)?
    - No
    - Yes, once a year
    - Yes, twice a year
    - Yes, only with problems
    - Other
- Do the red deer get vaccinated? If so, against what and which animals get this treatment (write this in the 'other' section)?
    - No
    - Yes, once a year
    - Yes, twice a year
    - Yes, only with problems
    - Other
- Are interventions performed?
    - No
    - Yes, just castration
    - Yes, just antler removal
    - Yes, castration and antler removal
    - Other
- How are the antlers of the stags removed?
    - They are not removed

    - Sedation on the pasture or inside the stables, and sawn
    - In the crush or cradle without sedation
    - Other
- How are the antlers of the spikers removed?
    - They are not removed
    - Sedation on the pasture or inside the stables, and sawn
    - In the crush or cradle without sedation
    - Other
- Is there a cradle or crush present?
    - No
    - Yes, a cradle with dropdown floor
    - Yes, a hydraulic crush
    - Other
- Is there a regular veterinarian for this farm?
    - No
    - Yes, always the same practice but no regular veterinarian
    - Yes, always the same veterinarian
    - Other
- How often does the veterinarian visit?
    - Once every 2 weeks
    - Once every 4 weeks
    - Once every 6 weeks
    - Once per quarter
    - Once every 6 months
    - Once a year
    - With calamities
    - With interventions
    - Other
- Does a sick or wounded red deer get isolated from the herd?
    - No
    - Yes
- Is there an infirmary present?
    - No
    - Yes
- What is the average yearly death rate of the hinds? These are all hinds that have died, euthanised, or had an emergency slaughter
    - 0-5%
    - 5-10%
    - 10-15%
    - 15-20%
    - 20-25%
    - More than 25%
- What is the average yearly death rate of the stags? These are all stags that have died, euthanised, or had an emergency slaughter
    - 0-5%

    - 5-10%
    - 10-15%
    - 15-20%
    - 20-25%
    - More than 25%
- What is the average yearly death rate of the calves and yearlings? These are all yearlings that have died, euthanised, or had an emergency slaughter
    - 0-5%
    - 5-10%
    - 10-15%
    - 15-20%
    - 20-25%
    - More than 25%

Appendix 7.4 - Body Condition Score

BCS chart for deer from Deer Industry New Zealand (www.deernx.org/deerhub)