Preventive culling of livestock in case of a disaster (A last resort)

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September 2019

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Abstract

Natural disasters can create such circumstances that it is not possible anymore to house and take care of livestock in an appropriate way. The lack of appropriate management of livestock can result in decreased welfare, sickness and death. Many of these animals will have to cope with extreme stress due to the lack of food, water and/or a bad environment. This has not only a direct effect on the individual animal but also an indirect effect on the flock. The coping with stress many times lead to deviant behaviour, for example feather pecking in chickens or tail biting in pigs, which is aimed at other animals in the flock or herd. A solution is to cull the animals preventively in order to save them from unnecessary suffering. Such a decision is morally difficult to make but can be a last resort. In this paper it is examined whether there are possible parameters which can assess the start of preventive culling and if Dutch veterinary practitioners are capable to make the such decision in the same was as a group of experts.

Key words: natural disasters, culling, animal welfare, assessment, parameters

Introduction

It is possible to evacuate livestock from the area they live in, in case of a disaster, however many difficulties are associated with this. It is very difficult for farmers to find a safe place for their livestock for either a short or long-term period. However, this is necessary because when a disaster strikes it can take up from weeks to years before the area is habitable again. Transporting animals out of the disaster areas brings many problems with it. Logistic problems like the number of animals that can go on transport and the availability of vehicles. These problems also involve major costs In the Netherlands, different health statuses and hygiene protocols between farms makes it difficult for farmers to take in animals out of the disaster area. For this reason farmers can only take animals in from the disaster area that have at least the same vaccinations and health statuses as their own livestock. Otherwise the evacuated livestock can bring diseases with it and infect other livestock. In addition, maybe even humans can be affected what will result in these farmers losing their health certificates, as not all animals meet the required standards anymore

(Mei et al., 2010; van Duin, 2013). An additional negative effect would be the loss of production (e.g. milk, meat, eggs) and animal reproduction (Remmelink et al., 2018).

Figure 1 Cattle trapped by a flood, June 2014, Northland (New Zealand)

It is also possible to not evacuate the animals and sit the disaster out. This can lead to animal suffering and brings its own difficulties with it. There is the possibility of damage to the housing where the animals are held. This is a hazard for the animals not only because they can be physically injured by collapsing of the housing but also they can get exposed to the elements and the climate inside cannot be regulated any more. This has negative effects on animals, as the temperature drops poultry need a higher feed intake to compensate (Ferket & Gernat, 2006). Also a drop of temperature in combination with a draught will influence the immune system negatively in pigs (Stärk, 2000). Very high temperatures can result in so-called heat stress. Mammals experience difficulties like profuse sweating, which can cause dehydration, and a decrease of feed intake (Silanikove, 1992). In poultry, heat stress is even one of the most important environmental stressors with great consequences. It decreases feed intake, reduces weight gain and egg production but most importantly it has an immunosuppressing effect (Lara & Rostagno, 2013).

A disaster can result in water deprivation for the animals. While water is essential for animals to live and without it animal welfare will be affected in a very negative manner. In poultry without sufficient water the feed intake will decrease and so the weight in the flock will decline (Ravindran 2013; Duncan 2005).

Livestock is kept in different kinds of housing depending on the kind of animal. The housing is adapted to the kind of animal so they can display their different kinds of social behaviour. Additionally, they are kept away from external stress factors like predators and environmental events. If the housing is damaged all these factors can cause negative effects

on the livestock, like anxiety, fear and panic (Mellor & Beausoleil, 2015).

As mentioned above, a disaster can destroy animal housing partly or even completely what results in an bad environment for the animals. An environment what makes the animals unable to express normal behaviour like close confining, isolation and barren environments can cause anxiety, fear, panic, frustration, anger, helplessness, boredom and depression (Mellor, 2016). This could lead to stereotypic behaviours, because stress from these events affects the brain and changes the behaviour abnormally. This is the so called frustration-induced stereotypic behaviours. Stereotypic behaviours are a sign of poor welfare but this behaviour helps the animals to cope with the stress from the environment (Mason et al., 2007).

Figure 2, effects of Hurricane Floyd, September 1999

It is seen in pig housing that frustrated pigs start biting the tail of other pigs. This all starts because the tail biter is frustrated because of certain environmental stressors. These stressors are mostly cold and/or bedding that is not suitable. Tail biting has a great economical and welfare impact. The tail of the bitten pig can get contaminated with bacteria what can lead to abscesses in the hindquarters, in the lower part of the spinal column and also to a secondary infection in the lungs. There are also behavioural consequence for the bitten pig. They become more apathetic, they lie down a lot and seldom changes position. In the end they only react faintly on being bitten (Schrøder-Petersen& Simonsen, 2001).

In poultry feather pecking is a major welfare and economic problem. It is natural behaviour for poultry do express their dominance but it can also be learned and enhanced by environmental stressors. This will result in feather loss, exposure of the skin and injury's with even blood loss. These chickens also need to take in more feed to generate heat and are more susceptible for disease. The reasons that enhance feather picking are: stocking density, boredom, not enough nests, not enough feed or water and excessive heat (Hall, 2011; Ravindran, 2013).

For poultry farmers the profitability is very quickly undermined by unsafe products. Twenty percent of the gross value of production is lost due to economic costs of disease which include vaccines. So every difficulty has severe consequence like growth slow and reduced production. This makes it commercially hard for farmers (Campbell & Knowles, 2011; Ravindran, 2013).

Livestock is more often used for commercial purpose, like the sale of eggs, milk and meat, than for own consumption. Farmers invest in their livestock to keep their livestock healthy and be as profitable as possible. Due to a disaster the farmer loses his/hers investment because of the setback in production. It is possible that it will not be cost efficient anymore and there only will be financial losses (Campbell & Knowles, 2011).

Veterinarians play an important role in the management of farms. These days they do not solely diagnose and treat diseases but they are also consulted by farmers to improve their management. More analytical skills have been integrated in the work and education of veterinarians to optimize the health of the animals on the farms. This approach helps veterinarians to work more preventive towards improving the health and welfare of the herd and improved productivity of farm animals (LeBlanc et al. 2006; Mee, 2007; Haine et al. 2017).

One of the most important skills is the ongoing process that veterinarians learn to bring knowledge into practice and understand that the farm is an integrated system with different components (Leblanc et al. 2006).

Making the decision to cull an animal is multifactorial for a farmer. It is based on financial, social and psychological factors. Farmers have multiple sources to help them to make the decision to cull the animals, of which veterinarians play an important role. They often routinely visit the farm and know the most common problems specific for that farm. Culling animals is a hard decision to make for a farmer, but in extreme situations like created by a natural disaster it is important to consider this solution because of the possibly decreased animal welfare, veterinary public health, business continuity but also to keep people safe. Together the farmer and the veterinarian can come to the best solution to ensure these factors are well considered (Glassey & Wilson, 2001; Wilson et al. 2012; Haine, 2017).

Aim of the study

The aim of this research is to examine whether Dutch farm animal veterinarians can, based on suitable parameters, make the same decision as an expert group to assess in advance the appropriateness to cull livestock because of the probable negative effects during a natural disaster in its aftermath. Thus, whether unnecessarily animal suffering can be prevented and the veterinary public health kept to a minimum risk.

The hypothesis is “the application of suitable parameters to decide culling livestock is indicated to prevent livestock from suffering in extreme situations caused by a natural disaster by either a defined expert group or Dutch farm animal veterinarians, does not lead to a significant difference in the outcome of their decisions between the two groups”.

Materials and Methods

Questionnaire

Based on available literature a questionnaire for veterinarians is developed to help to make a decision to cull livestock pre-emptive in case of a natural disaster or not. With the help of opinions from veterinarian practitioners and of veterinarians who are experts in the field of the effects of natural disasters on animals, it will be possible to see if Dutch veterinarian practitioners can make the same assessment as the experts. Also it will be possible to make a distinction between the significance of the relevant parameters. When a certain benchmark is reached due to the fact that specific parameters are answered with "no", culling of the animals will be advised. The parameters are based on the primary necessities and social interactions of livestock. These are described in the introduction and include aspects of animal health and welfare. To assess the relevance of these parameters the Likert scale was used, which makes it possible to assess each parameter individually.

The scale to assess the parameters is from zero to ten, where zero is not relevant, one is the least relevant and ten is the most relevant. If the respondents do not think they are capable to assess a parameter properly they do not have to fill it in.
The parameters to assess are:

1. *Is it possible to evacuate the animals?*
2. *Will the animals have access to sufficient amounts of feed necessary to prevent starvation throughout the disaster and the aftermath?*
3. *Do the animals have access to enough suitable drinking water to prevent dehydration throughout the disaster and the aftermath?*
4. *Does the living environment pose an increased risk for the animals' physical safety throughout the event and the aftermath?*
5. *Can an acceptable level of mental discomfort of the animals be ascertained during the event and the aftermath?*
6. *Can specific stress indicators be scored that indicate (permanent) behavioural issues endangering the animals' health status throughout the event and aftermath?*
7. *Do the animals have sufficient level of protection against the development of (chronic) disease throughout the disaster and the aftermath?*
8. *Are the animals expected to be able to recover sufficiently after the event to fulfil their original task or purpose (e.g. slaughter, egg production, milk production)?*
9. *Is it safe from a veterinary public health perspective to keep the animals alive throughout the event and aftermath?*
10. *Is it possible to have regular evaluations of the current situation?*

Expert panel

The questionnaire was completed by 24 European veterinarian participants of the Better Training for Safer Food workshop "Strengthening veterinary preparedness for natural disasters" held from 11th until the 13th of December 2018 in Grange, Ireland. The focus of the workshop was to share lessons learned strengths and opportunities by Veterinary Services with experiences from natural disaster. These participants were invited to this workshop because they are the representatives of these Veterinary Services from different European

countries. Within their organisation they are the ones with the veterinary knowledge and experience about the effects of natural disasters on animals, making them the assigned experts.

Farm animal veterinarians

The questionnaire was also completed by 26 veterinarians who work as a practitioner in the farm animals sector in The Netherlands and are a member of 'Group Healthcare Farm animals' (GGL) of the Dutch veterinarian professional association 'KNMvD'.

The questionnaire was sent prior to the workshop via Google Forms to prevent biases. To get more information about the participants there were also questions included about their profession, age, gender and years of experience in the veterinary sector.

Validation

During the workshop a panel discussion on this topic was held with 42 veterinary experts. The importance and use of the stated parameters of the questionnaire were the basis of the discussion. With background information and the sharing of experience, the expert group reached consensus that the parameters were suitable to assess the problem of pre-emptive culling of livestock to prevent them from unwanted suffering in extreme situations caused by a natural disaster.

Statistics

To analyse the results of the experiment the Mann–Whitney–Wilcoxon test was applied to the outcomes of the Likert scale from both the assigned veterinarian experts and the Dutch veterinary practitioners. The Mann-Whitney-Wilcoxon test is almost identical to a t test, except it is also suitable for non-parametric data, such as the ordinal Likert scale outcomes. This is done by ranking the data and then comparing the sum of the ranks (Conover & Iman, 1981; Fagerland & Sandvik, 2009).

The setup to perform the test (Fagerland & Sandvik, 2009):

Tests MWW: Mann-Whitney-Wilcoxon	
Null hypotheses	equal sum of ranks
Nominal significance level	$\alpha = 0.05$
Sample sizes (n1, n2)	(24, 26)
Programming language	R

Results

Since the outcome variable was ordinal (Likert scale) a Mann-Whitney-Wilcoxon test was applied. Data analysis was done with the programming language R in Rstudio (© 2009-2019 RStudio, Inc.) . The summary variables of the data (N, mean, sd and medians) can be found in table 1. On forehand it was not possible to determine the exact sample sizes (n) with a power calculation. The total population of the expert group consisted out of 40 from which 24 responded (n1) to the questionnaire. The total population of the group practitioners is unknown but 26 responded (n2) to the questionnaire.

Table 1. data used for the Mann-Whitney-Wilcoxon test

	Group 1 (experts)					Group 2 (practitioners)			
	n1	mean	sd	median		n2	mean	sd	median
Q1	24	7.83	2.41	9.0	Q1	25	7.52	2.69	9.0
Q2	23	7.48	2.54	8.0	Q2	26	7.50	2.35	8.0
Q3	23	7.74	2.65	9.0	Q3	25	7.80	2.14	8.0
Q4	23	7.74	1.86	8.0	Q4	25	7.24	1.61	7.0
Q5	22	5.59	2.46	5.5	Q5	25	6.04	2.13	6.0
Q6	22	5.77	2.07	5.5	Q6	26	6.96	2.24	7.5
Q7	24	6.29	1.97	6.5	Q7	26	6.15	2.31	6.0
Q8	23	6.30	2.01	7.0	Q8	26	6.27	2.65	6.5
Q9	23	7.43	2.27	8.0	Q9	25	7.48	2.18	7.0
Q10	23	7.48	2.09	8.0	Q10	25	7.08	2.04	8.0

Legenda table 1

Q	parameters
n1	sample size group experts
n2	sample size group Dutch veterinarian practitioners
mean	the average of the sum of the data
sd	standard deviation
median	middle value of the dataset

]

Table 2. Results Mann-Whitney-Wilcoxon rank sum test with continuity correction

	Sum of the ranks (W)	Probability value (p)
Parameter 1	W = 268.5	p-value = 0.5196
Parameter 2	W = 295	p-value = 0.9432
Parameter 3	W = 272	p-value = 0.751
Parameter 4	W = 235.5	p-value = 0.2805
Parameter 5	W = 305.5	p-value = 0.5189
Parameter 6	W = 377	p-value = 0.05792
Parameter 7	W = 305	p-value = 0.8985
Parameter 8	W = 303	p-value = 0.9435
Parameter 9	W = 285.5	p-value = 0.9748
Parameter 10	W = 253	p-value = 0.4753

In table 2 the results of the analysis of the parameters with the Mann-Whitney-Wilcoxon test are displayed. With a probability value (p-value) ≤ 0.05 the null hypothesis of the parameter (there is no difference between the expert group and the Dutch veterinarian practitioners) will be rejected. The results show that there was no significant difference between the two samples which assessed the parameters. The p-value of each parameter was higher than 0.05, thereby failing to reject the null hypothesis and there is no evidence that the hypothesis as formulated as above is wrong for all the parameters assessed in the questionnaire.

Discussion

Likert Scale

A ten point Likert scale was used to measure whether a group of Dutch veterinary practitioners would validate the relevance of the parameters mentioned earlier the same as an expert group to make the decision to start pre-emptive culling of livestock in case of a natural disaster. The Likert scale ranged from one to ten, with one meaning it was the least relevant and ten the most relevant. The respondent also had the option to score a parameter with zero, which meant that the respondent could not or did not want to assess the specific parameter. The data from the Likert scale is ordinal which means that the interval size between the values do not necessarily have to be equal, this is known as a non-parametric dataset (Norman, 2010). Advantages of the Likert scale is that it is easy to make, one response doesn't influence another response and it is easy to read and understand for the respondents. On the other hand, there are also some disadvantages like biases from respondents to avoid extreme responses, respondents may tend to give more favourably responses and respondents have different weighing for the same values (Jamieson, 2004; Bertram, 2007).

Mann-Whitney-Wilcoxon

The values from the parameters given on the Likert scale by the expert group were compared with the values given by Dutch veterinarian practitioners. To this end, a Mann-Whitney-U test was applied since the values of the Likert scale represent a non-parametric dataset. The Mann-Whitney-Wilcoxon test is very well suited to assess if two sample distributions are from the same population or not (Bergmann et al. 2000; Nachar, 2008). Therefore, it is possible to use the Mann-Whitney-Wilcoxon test to analyse the results (Jamieson, 2004; Bertram, 2007; Murray, 2013). To make a correct analysis a test must have enough power to reject the null hypothesis. This depends on the sample size (and the effect size). To get an α value of at least 0.05 and reject the null hypothesis the sample size of the Mann-Whitney-Wilcoxon test must have a minimum of 8 samples, with 4 in each group (Fay & Proschan, 2010).

In essence, it is concluded that Dutch veterinary practitioners can make the same decision as the expert group with the use of the suitable parameters to decide whether culling livestock is indicated to prevent livestock from suffering in extreme situations caused by a natural disaster.

Parameters

The results show that with an outcome of 0.05792 ($p \leq 0.05$) parameter 6: "Can specific stress indicators be scored that indicate (permanent) behavioural issues endangering the animals' health status throughout the event and aftermath?", is close to being significant. This may imply that, the expert group and the Dutch veterinarian practitioners group have a different opinion on this particular parameter.

Although it is known that deviant behavioural changes in animals can be a marker for decreased welfare, not all changes in behaviour occur because of decreased welfare.
A change of behaviour can occur, for example, because the surrounding of animal can change and the animals adapt to it, but do not necessarily experience stress from it. Also if animals change their behaviour because of stress and decreased welfare, deviant behaviour can occur at different levels. The interpretation is open to at what level suffering of the animal is accepted. This is a moral question and differs not only between different cultures but also between people in the same culture (Barnett & Hemsworth, 1990; Broom, 2008). It is also important to first establish a baseline for the behaviour of the animals in normal housing conditions without the effects of an occurring or an imminent natural disaster. Many times only people who work with the animals have knowledge of this, but often they are not trained to notice or assess deviant behaviour. Even if a baseline for the behaviour is established by a professional, it costs much time to evaluate and re-evaluate the behaviour of the animals to see how they behave in different and worsening circumstances.

Aspects of parameter 6 are also taken in consideration in parameter 5 and 8. Regarding parameter 5, this parameter is already taken account in the assessment about the level of mental discomfort of the animals, which can result in deviant behaviour. The (permanent) effects of the possible stress on the animals are assessed with parameter 8. That makes parameter 6 possible unnecessary to use as an assessment.

Also to see changes in behaviour, first a baseline for the behaviour of the animals in the normal housing conditions must be established without the effects of an occurring or an imminent natural disaster. This is why parameter 6 may not be very well suited and can explain the statistic tendency to be inconclusive between the expert group and the Dutch veterinary practitioners group.

Recommendations

The result of this research does not give information about the degree of relevance between the parameters and thus which one is the most important. Recommended is that with further research a distinction in importance between the parameters could be made.

In the questionnaire there was also a section were the respondents were given the opportunity to make suggestions. There were some interesting suggestions that can be used as suitable parameters and can be included in further research. An important one was: 'Can we implement in a short time mitigation measures to reduce the impact on animal health/welfare?'. This is a potential parameter which should be take into account when making an assessment about culling pre-emptive because with the right mitigations livestock could just survive a natural disaster without suffering from unnecessary extreme situations.

Figure 3 Cows take refuge on higher ground, Australia February 2019

Another suggestion was; "Can carcasses be dealt with safely before the event?". This is important because the carcasses can be a public health threat. Firstly it should be researched in what situations the carcasses cause a threat and to what extent.

Also if the livestock will not be culled preventively, it is be possible that they will not survive the event and still cause public health problems.

In conclusion it can be recommended that the parameters researched in this paper becomes part of a general situational assessment for a protocol how to handle with livestock in case of natural disaster.

Acknowledgements

Firstly, the author wants to thank Joris Wijnker for all his feedback and suggestions, they were very valuable for this paper. All the time he made available to discuss and brainstorm were not only helpful but also very interesting. Furthermore, thanks to the "Better Training for Safer Food organization and the non-profit foundation "Bijzondere bijscholing vleeskeuringspersoneel", for not only making it possible to gather the data first hand but also for the unique opportunity to join and learn from the workshop 'Strengthening veterinary preparedness for natural disasters', held in Grange, Ireland in December 2018. Also all the respondents must be thanked, their contribution was essential. Without these data there was no research possible. Who also helped facilitate this paper is the Dutch veterinary professional association 'Koninklijke Nederlandse Maatschappij voor Diergeneeskunde' (KNMvD). Their facilitation and role between veterinarians and students was helpful and also important for sharing knowledge and experience.

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Figure 2: Photograph: Alan Marler/AP

Figure 3: Australian Broadcasting Corporation