Impact of Sheep Stocking Density and Breed on Behaviour of Newly Regrouped Adult Rams

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ABSTRACT

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Placing animals in cages with certain density and good grouping were two important aspects needed in intensive livestock production system to produce optimal production and animal welfare. The objective of this study was to examine effect of stocking density, breed and elapse of time on behaviour of newly regrouped, unacquainted adult rams from three sheep breeds i.e. Barbados Blackbelly Cross, Local Garut and Composite Garut, as possible factor causing variation in welfare status. Instantaneous scan sampling was used for recording sheep behaviour at three different stocking densities. Thirty-six adult rams were used in this research and divided into three groups (n = 12) on the basis of breed. At each stocking density four rams of the same breed were observed during two consecutive days. The recorded behaviours were agonistic-, self-care-, exploratory-, aberrant-, mating-, locomotive- and standing behaviour. The results showed that during the entire experiment agonistic behaviour was observed at the highest frequency. Stocking density was found to have a significant effect on exploratory-, locomotive- and standing behaviour. The effect of breed was found to cause significant differences in agonistic-, self-care-, aberrant- and mating behaviour. Significant differences were also found between day 1 and day 2 of regrouping for agonistic-, exploratory, self-care- and mating behaviour. It is concluded that the three breeds do differ in their behavioural reactions to different stocking density levels and time needed for adaptation after regrouping.

Key Words: Sheep, Stocking Density, Behaviour, Animal Welfare

ABSTRAK

Engeldal SEC, Subandriyo, Handiwirawan E, Noor RR. 2013. Pengaruh kepadatan kandang dan bangsa terhadap perilaku domba jantan dewasa yang baru dikelompokkan. JITV 18(1): 1-8.

Menempatkan hewan di kandang dengan kepadatan tertentu dan pengelompokan yang baik adalah dua hal penting yang perlu dilakukan dalam suatu sistem produksi ternak secara intensif untuk menghasilkan produksi yang optimal dan kesejahteraan hewan. Penelitian ini bertujuan mengevaluasi pengaruh kepadatan kandang, bangsa dan waktu adaptasi pada perilaku dari tiga bangsa domba yaitu Barbados Blackbelly Cross, Lokal Garut dan Komposit Garut yang baru dikelompokkan, sebagai faktor yang mungkin menyebabkan variasi pada status kesejahteraan. Data penelitian dikumpulkan dengan menggunakan metode *instantaneous scan sampling* pada tiga tingkat kepadatan kandang yang berbeda. Tiga puluh enam ekor domba jantan dewasa digunakan dalam penelitian ini dan dibagi dalam tiga kelompok (n = 12) berdasarkan bangsa. Pada setiap tingkat kepadatan kandang, empat ekor domba dari bangsa yang sama diamati selama dua hari. Sifat tingkah laku domba yang diamati adalah agonistik, merawat diri, eksploratif, yang menyimpang dari kebiasaan, kawin, lokomotif dan berdiri. Hasil penelitian menunjukkan bahwa selama waktu percobaan perilaku agonistik adalah perilaku yang paling sering diperlihatkan. Hasil penelitian juga menunjukkan bahwa kepadatan kandang menyebabkan perbedaan yang nyata terhadap perilaku eksploratif, lokomotif dan berdiri. Pengaruh bangsa juga nyata terhadap perilaku agonistik, merawat diri, perilaku kawin dan tingkah laku yang menyimpang dari kebiasaan. Perbedaan yang nyata juga dijumpai antara hari pertama dan hari kedua pengamatan terhadap kelompok untuk perilaku agonistik, eksploratif, merawat diri dan perilaku kawin. Kesimpulan yang diperoleh dari penelitian ini adalah bahwa ketiga bangsa menunjukkan reaksi tingkah laku yang berbeda untuk tingkat kepadatan kandang yang berbeda dan selama waktu adaptasi setelah pengelompokkan kembali (*regrouping*).

Kata Kunci: Domba, Kepadatan Kandang, Perilaku, Kesejahteraan Hewan

INTRODUCTION

The feeling that man has a moral obligation to ensure that the welfare of animals which are kept on farm is never poor has become widespread. Animal welfare is a growing issue in modern farming systems due to a perceived mismatch between animals' actual environments and their natural habitats, acknowledgement that animals are sentient beings, and societal awareness not only that animal production matters, but also that the production methods matter (Veissier et al. 2012). There is thus public concern on both the quality of food products and on the way in which these products are obtained (Miele et al. 2011). Welfare, in this context, implies that the biological needs of animals are fulfilled and, more importantly, that the animals feel "well." The welfare of an individual depends on its living environment, genetics, and past experiences, with the result that each individual may perceive a triggering situation differently (Veissier et al. 2012).

Over the past few years research has focused on increasing the understanding of how animals perceive the environments in which they are kept. Behaviour can be defined as that which animals do to interact with, respond to, and control their environment. Behaviour is generally the animal's "first line of defense" in response to environmental change. As such, careful observations of behaviour can provide us with a great deal of information about animals' requirements, preferences, dislikes, and internal states (Mench and Mason, 1997). It has been mentioned by Lawrence and Rushen (1993) that knowledge of animal behaviour may be more important today as intensive husbandry systems place animals in environments far removed from those they were originally selected for, and even more distantly removed from those their wild ancestors were adapted to. This is commonly applied in Indonesian farming system in relation to limited area. In confinement, animals are constrained by the space and conditions provided for them; they cannot disperse or abandon the group when conditions become adverse, as they are restrained within the limits of the enclosure. Inadequate physical and social features of the captive environment can be a source of discomfort and stress that can lead to serious physiological, behavioural and welfare problems (Estevez et al. 2007; Morgan and Tromborg, 2007). It is believed by Fraser and Broom (1990) that many of the current animal husbandry problems are not soluble by investigating nutrition, body physiology, or disease control but require investigations of the behaviour of the animals before progress can be made towards a solution.

According to Whittaker et al. (2012) space provided to animals is one easily recognizable aspect of husbandry systems that is perceived by the public to imply that welfare is poor. Much interest has been shown, and welfare guidelines devised, to define the optimal cage size, physical environment and number of animals per cage according to species and age (Poole and Robinson 1987; Jennings et al. 1998).

In group housed systems agonistic interactions resulting in injury and psychological distress are more likely to be a welfare concern (Whittaker et al. 2012). It has been reported by Stookey and Gonyou (1994) that aggressive interactions mainly occur during regrouping, and that these interactions have been proven to be detrimental to the welfare of farm animals.

A common method using behaviour as an indicator of welfare, is to look for unusual or inappropriate behavioural changes. Duncan (1981) believes that one of the problems in this approach is deciding what is normal, natural or ideal. According to Fregonesi (1999) behavioural indicators of poor welfare include the inability to carry out normal behaviour, misdirected behaviour and attacks on conspecifics. He believes that when a number of elementary patterns of behaviour are occuring less in a system than in another, and abnormal behaviour develops, one can conclude that the animal has problems in adapting. In this context abnormal behaviour is considered as a persistent undesirable action shown by a minority of the population. It is hoped that by doing behavioural research, we are provided insights that may help in avoiding the development of abnormal behaviour in farm animals.

The objective of the present study was to highlight the effects of space allowance on the behaviour of newly regrouped rams. At the same time, particular emphasis laid on the influence of breed and the time needed for social stability to form within the new groups.

MATERIAL AND METHODS

Study subjects and housing

The experiment was conducted at the Indonesian Research Institute for Animal Production situated in Bogor. Thirty-six clinically healthy rams from three different breeds i.e. Barbados Blackbelly Cross (BC) (50% Local Sumatera, 50% Barbados Blackbelly), Local Garut (LG) and Composite Garut (KG) (50% Local Garut, 25% St. Croix, 25% Moulton Charollais) were used in the experiment. Three groups, each consisting of twelve animals from the same breed, were formed. The animals were all 2-3 years old and weighed a mean of 32.22 ± 5.01 kg (mean ± SD). In selecting the experimental subjects care was taken to only include those animals which had never before been housed together.

During the entire experiment a naturally ventilated group pen with a surface area of 13m^2 with slatted

flooring was used, where the animals had *ad libitum* access to water. Every day the animals received both concentrate (16% crude protein and 68% total digestible nutrient) and King grass (*Pennisetum purpuroides*). Each animal received concentrate on the basis of 2.5% and roughage on the basis of 10% of its body weight. Both the grass and concentrate were offered in one communal food trough. Each study subject was marked with a number (1-4, randomly assigned) on both flanks using a marker spray for animals. No adverse effect of the markings was noticed.

Experimental setup and procedure

The experimental design consisted of randomly allocating a group consisting of four male animals from the same breed and introducing them into the observation pen, after which they were observed simultaneously (Table 1). Rams were randomly selected but matched for weight, so that animals within the same stocking density group were of similar weight. The animals entered the observation pen approximately 30 minutes before the start of the behavioural recordings. In order to achieve the different stocking density levels, the measurements of the observational pen were reduced by using wooden slats to achieve the appropriate space allowance per animal. Three space allowances were considered, namely 3.2 m^2, 1.6 m^2 and 0.8 m^2 per animal. The second stocking density corresponds with the guidelines provided by Ewing et al. (1999) on optimum space allowance for adult rams.

During the entire experiment the observer was situated at about 4 meters from the subjects in an adjacent pen, which had been emptied especially for this purpose. The observer moved into position immediately after the sheep had entered the experimental area. The experiment consisted of observing the entire group (four focal animals) on two consecutive days at each stocking density. This was done similarly for each of the three breeds. Behaviour was registered by instantaneous scan sampling. The sheep were observed at four times of day namely, 07.00, 09.30, 12.00 and 14.30 h for a period of 30 minutes. During the 30 minutes observation periods, the observer scanned each of the four subjects alternately at 1-min intervals, so that each animal was sampled once every minute and a total of 30 times during each observation period.

During the entire experiment both the temperature and relative humidity in the group pens were measured on each day of observation. Frequencies of specific behaviours were observed and registered using a predefined ethogram (Table 2). During the data analysis some behaviour patterns were pooled in overall categories based on guidelines given by Ewing et al. (1999) (Table 3).

Table 1. Experimental design. number of animals per breed group and per stocking density

Number of rams	Stocking density		
	Low 3.2 m^2/ram	Medium 1.6 m^2/ram	High 0.8 m^2/ram
Group 1	4	4	4
Group 2	4	4	4
Group 3	4	4	4

Data analysis

A preliminary analysis to determine the suitability of using parametric tests was carried out. The behavioural data were checked for normality and homogeneity of variances. The results showed that the data did not satisfy the assumptions of parametric statistics (Kolmogorov–Smirnov test). The results could also not be brought into normal distribution by using the decimal logarithm to transform the data. Therefore non parametric statistics were used. Statistical analysis was done using the program package SPSS 16.0 for Windows (SPSS Inc., Chicago, IL, U.S.A.). After a preliminary descriptive analysis of statistical parameters, frequency of all behaviours exhibited were subjected to a Kruskal–Wallis one-way ANOVA test. When the Kruskal-Wallis test showed that the three experimental groups were significantly different ($P < 0.05$), a two-tailed Mann-Whitney U test was used to compare significant difference between treatments (i.e. experimental groups).

RESULTS AND DISCUSSION

General behavioural

The descriptive analysis of the behavioural data revealed that agonistic behaviour showed the highest frequency, in general. According to Fraser and Broom (1990) aggressive behaviour is most seen when groups of farm animals are first formed. Excessive aggressive behaviour is considered as something adverse to welfare of both the perpetrator and of the individual which is the target of the aggression (Broom 1996). However, it seems to be difficult to interpret in terms of type, frequency, intensity and in which context these agonistic interactions could be adverse or not to the welfare of different farm animal species. The data on vocalization frequency could not be tested statistically, since individual number of bleats and growls were not recorded. Breed differences in vocalizations have been found by others (Handiwirawan, 2012), with variations probably associated with differing levels of behavioural distress due to temperament and habituation. No firm conclusions could, however, be drawn from the results

Table 2. Ethogram used for studying behaviour of rams at various stocking densities (frequency)

Behaviour	Description
Pushing:	Ram pushes opponent with shoulders or side of the body
Head push:	Initiating ram only uses his head to move another ram out of his position
Threat :	The aggressor stands at a distance of less than 10 cm from another ram with provocative displays
Submission:	Ram walks, runs or moves away from opponent in an attempt to avoid confrontation
Charging	Ram runs towards an opponent with its head lowered and held straight in an attempt to attack
Butting (Head butt):	Ram pushes or runs into (onto) another and crashes its head and horns into its opponent's
Initiating-charge:	Ram backs up in an attempt to attack an opponent
Front kick:	Ram kicks opponent with stiff foreleg
Forward swing:	Ram swings forward with its head in an attempt to ward off an opponent
Interference:	Disruption of combat of rams by moving between the fighting individuals, pushing or simply approaching the combating animals
Circling:	Ram is closely beside another, head-to-tail and walks in circles
Following:	Ram runs or walks directly after another in the same path
Running:	Ram moves fast across pen moving away from or towards another animal
Resting:	Ram lies down either sleeping or chewing cod
Feeding:	Ram's head is in the feeder and is chewing feed
Drinking:	Use of water bucket to obtain water
Olfactory investigation:	Ram sniffs various parts of another's head, body or the surroundings
Sniffing :	Ram sniffs anogenital area and urine of another followed by flehmen response
Mounting:	Ram raises his chest and forelegs onto another's back with the forelegs on either side (just as during copulation)
Behaviour	Description
Head butting object:	Ram is seen hitting horns against an object
Wood-biting:	Ram is seen biting off pieces of wood (from cage, floor or feed trough)
Wool-biting:	Ram pulls wool out of another's fleece
Standing:	All standing while not eating, drinking or exhibiting other motor behaviour

Vocalizing: Ram bleats or growls

Table 3. Pooled behavioural categories

Behavioural categories	Behaviours
Agonistic	pushing, charging, front kick, forward swing, interference, initiating charge, butting, head push, threat, submission, circling, following
Self-care	eating, drinking, resting
Exploratory	olfactory investigation
Aberrant	wool-biting, wood-biting, head butting object
Mating	mounting, sniffing
Locomotion	walking, running
Inactivity (Standing)	standing
Vocalization	bleats, growls

of the current study due to the fact that no clear pattern was detected in the registered vocal data.

Effect of space allowance on behaviour of rams

It has been suggested that animals have both qualitative and quantitative space requirements. Qualitative space is needed for occupation, social dominance, flight distance and quantitative space to achieve activities such as lying down, body care, exploration, kinetics and social behaviour (Fraser and Broom, 1990). Table 4 showed mean ranks for the number of times that particular behaviours were observed at different stocking density levels.

Table 4. Frequencies of displayed behaviour at different stocking densities.

Behaviour	Stocking density		
	3.2 m^2/ram	1.6 m^2/ram	0.8 m^2/ram
Agonistic	147.03	149.97	136.49
Exploratory	156.80[a]	149.30[a]	127.40[b]
Self-care	142.96	144.14	146.40
Aberrant	134.18	149.79	149.53
Mating	148.83	137.78	146.89
Locomotion	183.17[a]	141.99[b]	108.34[c]
Standing	155.91[a]	125.67[b]	151.92[a]

Values are mean ranks
Different superscript letters in the same row indicate significant difference between treatments ($P < 0.05$ Mann-Whitney U test)

The results reveal that there were no significant differences in agonistic - self - care - and mating behaviour of rams between stocking density levels. Results found in other studies (Barnett et al. 1992; Morisse and Maurice 1997) showed a higher level of offensive initiated behaviour for farm animals in the high level density than in lower densities. The results of this study, however, failed to support those findings. This is due to every breed of sheep has a different characteristic behavior in response to density. Significant differences ($P < 0.05$) were found between stocking densities for exploratory behaviour, with the lowest mean rank found at the highest stocking density (0.8 m^2/animal). Rams kept at the lowest stocking density (3.2 m^2/ram), had the highest mean rank for exploratory behaviour. High stocking densities are characterized by lower levels of space available per animal and therefore offer physical constraints on their movement. This might result in frustration. The decrease in mean rank between the different stocking densities indicates a decrease in movement frequency with decreasing space allowance which can possibly be explained by the decrease in available space, therefore limiting the animals in their ability to move around freely.

Dwyer (2009) describes several different behaviour patterns that may be associated with chronic stress. Under some conditions, especially those of behavioural restriction and confinement, sheep may be apathetic or show low levels of activity. This statement agrees with the results found in this study, where the lowest level of activity and the highest level of inactivity were found at the highest stocking density. The findings of Verga et al. (2004), whom examined the effect of stocking density on the behaviour of rabbits also support the findings of this study. Their results showed that the rabbits kept in the smallest stocking density exhibited the highest movement frequency. Barnett et al. (1992) looked at aggressive interactions following grouping of unfamiliar pigs and interestingly agonistic encounters were fewer in pens with smaller space allowance. This agrees with the results of this study, where indeed the lowest mean rank for or lowest frequency of agonistic behaviour was found at the highest stocking density. The amount of agonistic behaviour displayed at the different stocking densities were, however, not found to differ significantly. The results from a study by Fraser and Broom (1990) have, however, shown that decreasing space allowance leads to increased agonistic behaviour in farm animals.

Breed effect

Animal behaviour is the result of different factors related to both the animal itself and the environment. There is a lot of direct evidence of genetically determined behavioural differences among domestic animals (Malmkvist and Hansen, 2001). Table 5 showed mean ranks for the number of times that particular behaviours were observed for animals within different breed groups.

Examining the effect of breed, significant differences were found in mean ranks for agonistic-, self-care -, aberrant- and mating behaviour. The breed Composite Garut (KG) had the highest mean rank for agonistic behaviour, meaning that this breed exhibited the lowest amount of this type of behaviour. There were no differences found in the mean ranks for agonistic behaviour between the two other breeds. In group housed systems agonistic interactions resulting in injury and psychological distress are more likely to be a welfare concern (Whittaker et al*.,* 2012). Aggressive interactions which occur during regrouping, have been proven to be detrimental to the welfare of farm animals (Stookey and Gonyou 1994). The significant difference found in the amount of aggressive behaviour displayed by the animals of different breeds might be caused by genetic differences in their temperament.

Table 5. Frequencies of displayed behaviour based on breed

Behaviour	Breed		
	BC	LG	KG
Agonistic	153.18[a]	155.66[a]	124.67[b]
Exploratory	148.50	147.23	137.77
Self-care	132.24[b]	137.24[ab]	164.01[a]
Aberrant	142.61[a]	130.32[b]	160.57[a]
Mating	147.89[a]	156.30[ab]	129.32[b]
Locomotion	134.60	153.66	145.24
Standing	136.54	140.71	156.25

Values are mean ranks
Different superscript letters in the same row indicate significant difference between groups (P < 0.05 Mann-Whitney U test)
BC = Barbados Blackbelly Cross
LG = Local Garut
KG = Composite Garut

Animals from the breed Barbados Blackbelly Cross (BC) displayed the lowest amount of self-care behaviour, while the opposite is true for the breed Composite Garut. The breed Local Garut (LG) showed significantly less aberrant behaviour compared to the other two breeds. This might be related to the higher reactivity of both Barbados Blackbelly Cross and Composite Garut, whose behaviour might be more affected by the anxiogenic characteristics of the experiment. According to Fraser and Broom (1990) the performance of aberrant behaviour, while recognized as coping mechanisms, must also be viewed as a reflection of suffering that is the basis for their development. They have also noted that animals that exhibit these behaviours do so because they experience frustration and boredom, which lead to depression thus compromising their welfare.

Frequency of mating behaviour, which is also used as a means of dominating over conspecifics in farm animals, was found to be highest in Barbados Blackbelly Cross and lowest in Composite Garut. Dwyer (2009) stated that there appears to be a genetic difference between breeds in their responsiveness to stressors which may be modified or potentiated by experience. Thus sheep may behave differently in different situations depending on their prior exposure or rearing experience. Genetic selection of desired behaviour, or against undesired behaviour, is therefore also an important means for improving animal welfare (Malmkvist and Hansen, 2001). Genetic variation between breeds in the reactivity of sheep in standard tests has been reported by Boissy et al. (2005). The origins of these differences are unclear, but may have arisen from direct selection for behavioural characteristics or as correlated changes in response to selection for productivity.

Impact of day of regrouping on ram behaviour

Regrouping of animals is a very common management practice in animal production systems, which is recognized to cause disruptions in the social structure or rank order known to exist especially in farm animal groups. Table 6 showed the behavioural repertoire of rams on the day of (day 1) and the day after regrouping (day 2). Kruskal-Wallis one-way ANOVA showed that the elapse of time had a significant effect on the frequency of agonistic - , exploratory - , self-care - and mating behaviour of rams while its effect on the frequency of locomotion, aberrant and standing behaviour did not reach statistical significance (P < 0.05). As predicted, subsequent Mann-Whitney U tests revealed a lower level of agonistic behaviour on the day after regrouping compared to that exhibited on the day of regrouping itself.

Table 6. Frequencies of displayed behaviour on day 1 and 2 of regrouping

Behaviour	Day of regrouping	
	1	2
Agonistic	154.74[a]	134.26[b]
Exploratory	165.33[a]	123.67[b]
Self-care	129.92[b]	159.08[a]
Aberrant	148.21	140.79
Mating	158.91[a]	130.09[b]
Locomotion	144.86	144.14
Standing	137.83	151.17

Values are mean ranks
Different superscript letters in the same row indicate significant difference between groups (P < 0.05 Mann-Whitney U test)

The agonistic behaviour shown after grouping unfamiliar animals follows the continuum from threat to aggression until a period of social stability (level of aggression not statistically different from zero) is reached. During this period of social stability, only an occasional threat or attack is necessary for an animal to reinforce dominance. If greater amounts of agonistic behaviour are observed, the group may have an unstable dominance order (Jensen 2002). These results are consistent with the results found by Fernández et al. (2007) for newly regrouped goats. Their results showed that aggression was higher during the day of regrouping and tended to decrease to pre-regrouping levels the day after regrouping.

The high frequency of exploratory behaviour on day 1 can possibly be explained by the novelty of the environment in which the animals were placed.

Amongst competing animals, same-sex mounting may be used to impose social dominance. According to Fraser and Broom (1990), at high stocking densities social contests may occur more intensively, resulting in a greater amount of this behaviour. Each behaviour form not only has potential fitness benefits to the performer, but also costs (may consume valuable energy). Jensen (2002) mentioned that when individual animals are in frequent competition over resources, they can avoid the costs associated with this competition by establishing which one is "boss". This may offer a possible explanation for the significant decrease in frequency (lower mean rank) of both agonistic- and mating behaviour displayed on the day after regrouping.

CONCLUSION

The findings of the study suggest that the most behaviour of newly regrouped rams is significantly affected by the stocking density level and that the animals' response differs between breeds. The rams displayed significantly less locomotory behaviour as the available space per animal decreased. Inactive- and exploratory behaviour were significantly affected by the stocking density, with the highest amount of these behaviours found at the lowest stocking density.

Animals from the breed Composite Garut (KG) displayed significantly less agonistic- and mating behaviour compared to animals from the breeds Barbados Blackbelly Cross (BC) and Local Garut (LG). Animals from the breed Local Garut were found to display significantly less aberrant behaviour compared to the animals from the breeds Barbados Blackbelly Cross and Komposite Garut. Rams from the breed Barbados Blackbelly Cross displayed the lowest amount of self-care behaviour in general.

The time spent in the new group setting also had a profound effect on the displayed behaviour. Agonistic-, exploratory and mating behaviour all significantly decreased 24 hours after the new groups had been formed, while self-care behaviour increased.

It is believed that the welfare of the animals might be negatively affected by some of these effects. A better knowledge of the weight of the various parameters influencing the measured behaviours such as, genotypic relationship between reaction to novelty and social tendency would certainly facilitate the design of production systems which promote animal welfare.

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