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Original Research Article

Welfare and Biosecurity in Sheep Farms: Case Study: Bursa Province

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ABSTRACT

This study intends to put forth observation and survey results with respect to analysis on characteristics of animal welfare and biosecurity in sheep farms of Bursa province, Turkey. The farms were divided in three groups: small-size farms (50 to 100 head), medium-size farms (101 to 150 head) and large-size farms (above 151 head). Biosecurity is a new concept to farms; nevertheless, breeders showed various accurate approaches regardless of the size of farm and despite the relative ignorance about the issue. According to hereby study, assessment on certain structural and production characteristics of farms with regard to animal welfare and biosecurity revealed that they were insufficient but open for improvement in terms of husbandry and management practices, maintenance and administration practices, sanitation and structural characteristics.

Key words: Biosecurity principles, Sheep housing, Animal welfare, Herd safety, Welfare

INTRODUCTION

Animal welfare is a combination of objective and subjective (qualitative and quantitative) properties that include health, disease, behaviour, care and management practices. Welfare of an animal can also be defined as to overcome the effects increasing in its environment. To overcome difficulties might be defined as creating a peaceful and good environment against the effects increasing from the incorrect management practice and human-animal interactions. In some developing, there is a prevailing opinion that intensive system generally reduces the welfare of animals. During breeding, environmental conditions provided to animals have quite a lot effect on animal welfare. These are listed as housing conditions (in- housing environmental conditions, area allocated per animal, in- housing arrangements, flooring surface, bedding material), attitudes of keepers to animals and some practices (castration, tail docking, disbudding, foot-care) (Duncan and Fraser 1997, Scott *et al.* 2001).

Biosecurity practices enable protecting animal health through minimization of the effects of diseases; they thus reduce traditionally treatment costs and maximize productivity, whereupon enterprise profitability increases (Anonymous 2014a). In other words, biosecurity serves as insurance for herd health, productivity and welfare. Diagnosis and treatment of diseases is not only costly, but also unfavorable in terms of human and food safety. Therefore, fulfilment of protective measures at enterprises is crucial in order to minimize occurrence and spread of diseases (Anonymous 2014b, Dekker 2011). These protective measures include presence of security camera at workplace, special clothes and gear exclusively used at enterprise, quarantine implementation, measures against wild animal attacks, fetal membrane disposal, examination, and health record control during animal purchase, as well as keeping records and water analysis (Anonymous 2011).

Hereby this study evaluates data through observations and answers to survey questions in relation to structural and husbandry practices within the scope of animal welfare and biosecurity; accordingly, it lays stress on what can be done for improvement of present housing and husbandry practices regarding welfare and biosecurity at sheep farms in Bursa province of Turkey.

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MATERIALS and METHODS

Study area

The research material consisted of data obtained through survey and observation from counties of Yenişehir, Gürsu, Mustafakemalpaşa, Karacabey, Keles, Büyükorhan, İnegöl and Nilüfer, which incorporate 70% of total sheep population Bursa province of Turkey. This province is located in the humid lowland tropics, at an altitude of 100 m above sea level and at a longitude 29.04 °E and latitude 40.11 °N (average minimum temperature 10.39 °C, average maximum temperature 21.37 °C, annual rainfall 660.1 mm).

Data collection

Data collection was carried out by means of a survey that consists of questions which intend to put forth information for analysis of breeding characteristics at sheep farms in Bursa province with respect to animal welfare and biosecurity. The survey was implemented on a face-to-face basis at relevant farms. Thus, it was possible to validate consistency between answers by breeders and actual conditions at farms. This fact helped in testing accuracy of answers to survey questions.

The following characteristics on relationship between housing zone and animal welfare were calculated in the wake of measurements at visited farms.

- Area allocated per animal (m^2/head) = pen width x length / number of sheep
- Airspace volume per animal (m^3/head) = pen width x length x height / number of sheep
- Feeder length per sheep (cm/head) = total feeder length / number of sheep in the pen

During visits to sheep farms, criteria were taken into account with respect to welfare standards on housing conditions (Berge 1997, Defra 2003, Sevi *et al.* 2009, Wand 2014).

Sample selection

The research area comprised farms with more than 50 head in 8 counties of Bursa province; a main population of these farms was registered and 99 sample farms were determined for survey through simple random sampling. During the assessment of survey results, the farms were classified as follows in consideration of number of sheep: small-size farms (50 to 100 head), medium-size farms (101 to 150 head), and large-size farms (more than 150 head).

Statistical assessments

The numeric values of data regarding mentioned characteristics at studied farms, as well as their % frequencies, were calculated in form of ensemble average. Fisher's generalized exact chi-square test was employed for comparison between groups. The statistical calculations were carried out in package SPSS v.22 (2013).

RESULTS and DISCUSSION

Housing practices

The necessary measures for sheep housing are to provide sufficient space in the pen so as to meet animal welfare and sanitary requirements, to ensure satisfactory ventilation, as well as accurate feeder length per sheep. The results about housing conditions, analyzed with respect to welfare criteria in the study, are given in Table 1.

Table 1. Structural Characteristics of Farms.

Characteristics	**50-100 head**	**101-150 head**	**> 150 head**	**p-value**
Area per head (m^2)	1,69±1,13	1,68±1,30	1,07±0,68	
Airspace volume per head (m^3)	4,75±3,23	5,22±3,84	3,71±2,68	
Feeder length per head (cm)	25,00±0,08	24,00±0,09	17,00±0,13	
Intensity of illumination source	**% (n)**	**% (n)**	**% (n)**	
40 watt	54,54 (12)	56,00 (14)	35,29 (12)	
60 watt	40,91 (9)	16,00 (4)	29,41 (10)	0,011
100 watt	4,55 (1)	28,00 (7)	35,29 (12)	
Opening direction of housing door	**% (n)**	**% (n)**	**% (n)**	
Inwards	24,14 (7)	12,50 (4)	31,58 (12)	
Outwards	75,86 (22)	81,25 (26)	65,79 (25)	0,228
Slide door	0,0	6,25 (2)	2,63 (1)	

According to results, the space per animal is at sufficient level in small and medium size farms concerning welfare criteria, while the figures are below standards in large size businesses. An assessment on welfare of sheep in Bursa province with regard to space per animal in housing obtained in this study reveals much better results than the results of evaluation from various other provinces of Turkey (Paksoy *et al.* 2006, Kılıç *et al.* 2013). The detected values of airspace volume per animal in sheep farms seem to support the figures prescribed by Kocaman and Günal (2007). All studied sheepfolds were found to have natural ventilation through windows and doors, whereas there was no other opening for ventilation. Besides, farm visits have shown that in most sheep farms, depending on season, ventilation is very insufficient, while ammonia level is high enough to burn eyes. The feeder length per animal in the sheep farms complies with standards and satisfactory conditions. It is important to adjust natural or artificial illumination in the housing so that the breeder can see all sheep within (Defra 2003). The illumination in visited farms was often ensured in artificial way, through bulb. This fact is consistent with the report by Karaman *et al.* (2012) that in most artificially illuminated sheep farms, bulbs of 40 to 75 watt are employed. Pen door should be opened outwards and wide enough in order to prevent squeezing and trampling of the sheep during entrance and exit. The studied enterprises mostly had outwards doors; nevertheless, the interviews with breeders revealed that this was not a conscious choice.

Welfare-related management practices

In all the farms within the scope of present study, the sheep underwent regular health control. The most common vaccines against epidemics were smallpox, alum, brucellosis, enterotoxaemia, and anthrax. Vaccination was generally carried out in line with vaccination schedule. This finding is parallel with the reports that sheep farms have a regular programme on vaccination routine (Dellal *et al.* 2002, Bostancı 2006, Koyuncu *et al.* 2006, Altıoğlu 2007, Kılıç *et al.* 2013), but differs from reports that vaccination is not regularly applied and there are even farms where no vaccination takes place (Tölü *et al.* 2007, Özkan 2008).

Table 2. Welfare-related husbandry practices in farms.

Characteristics	50-100 head	101-150 head	> 150 head	P-value
Compliance with vaccination schedule	**% (n)**	**% (n)**	**% (n)**	
Yes	93,10 (27)	100,0 (32)	94,74 (36)	0,349
No	6,90 (2)	0,0	5,26 (2)	
Umbilical cord care	**% (n)**	**% (n)**	**% (n)**	
Yes	27,59(8)	62,50(20)	47,37(18)	0,024
No	72,41(21)	37,50(12)	52,63(20)	
Foot-bathing presence	**% (n)**	**% (n)**	**% (n)**	
Yes	10,34 (3)	31,25 (10)	31,58 (12)	0,086
No	89,66 (26)	68,75 (22)	68,42 (26)	
Foot-bathing methods	**% (n)**	**% (n)**	**% (n)**	
Entire herd	66,67 (2)	70,00 (7)	100,00 (12)	0,102
All sheep	33,33 (1)	30,00 (3)	0,0	
Deep-bathing frequency	**% (n)**	**% (n)**	**% (n)**	
Never	96,55 (28)	75,00 (24)	84,21 (32)	
Before shearing	0,0	15,62 (5)	10,53 (4)	0,214
After shearing	3,45 (1)	9,38 (3)	5,26 (2)	
Ecto/Endo parasites treatment	**% (n)**	**% (n)**	**% (n)**	
Yes	100,0 (29)	93,75 (30)	100,0 (38)	0,186
No	0,0	6,25 (2)	0,0	
Ecto/Endo parasites control season	**% (n)**	**% (n)**	**% (n)**	
Spring	24,14 (7)	26,67 (8)	7,90 (3)	
Autumn	6,90 (2)	6,67 (2)	5,26 (2)	
Winter	10,34 (3)	3,33 (1)	7,90 (3)	0,434
Spring + Winter	0,0	3,33 (1)	2,63 (1)	
Spring +Autumn	58,62 (17)	60,00 (18)	76,31 (29)	
Treatment methods	**% (n)**	**% (n)**	**% (n)**	
Medication	6,90 (2)	13,33 (4)	21,05 (8)	
Injection	6,90 (2)	6,67 (2)	15,79 (6)	0,286
Medication + Injection	86,20 (25)	80,00 (24)	63,16 (24)	
Housing disinfection	**% (n)**	**% (n)**	**% (n)**	
Yes	93,10 (27)	100,0 (32)	94,74 (36)	0,349
No	6,90 (2)	0,0	5,26 (2)	
Housing disinfection frequency	**% (n)**	**% (n)**	**% (n)**	
Once a year	17,2 (5)	31,2 (10)	31,6 (12)	
Twice a year	34,5 (10)	18,8 (6)	31,6 (12)	
Three times a year	20,7 (6)	12,5 (4)	5,3 (2)	0,337
Four times a year	10,3 (3)	9,4 (3)	10,5 (4)	
Every month	10,3 (3)	28,1 (9)	15,8 (6)	
Manure handling frequency	**% (n)**	**% (n)**	**% (n)**	
Once a year	37,93 (11)	46,87 (15)	57,89 (22)	
Twice a year	27,59 (8)	12,50 (4)	13,16 (5)	0,250
Three times a year	24,14 (7)	12,50 (4)	13,16 (5)	
Four times a year	10,34 (3)	28,13 (9)	15,79 (6)	
Bedding material using	**% (n)**	**% (n)**	**% (n)**	
Yes	58,62 (17)	71,87 (23)	76,32 (29)	0,297
No	41,38 (12)	28,13 (9)	23,68 (9)	
Bedding material using season	**% (n)**	**% (n)**	**% (n)**	
Spring	5,88 (1)	4,35 (1)	0,0	
Summer	0,0	0,0	0,0	
Autumn	0,0	0,0	0,0	
Winter	58,82 (10)	86,95 (20)	0,0	0,053
Whole year	23,53 (4)	0,0	65,52 (19)	
Spring +Autumn	0,0	0,0	20,69 (6)	
Autumn +Winter	5,88 (1)	4,35 (1)	0,0	
Spring +Winter	5,88 (1)	4,35 (1)	13,79 (4)	

Foot-care control	**% (n)**	**% (n)**	**% (n)**	
Yes	65,52 (19)	62,50 (20)	81,58 (31)	0,166
No	34,48 (10)	37,50 (12)	18,42 (7)	
Foot-care frequency	**% (n)**	**% (n)**	**% (n)**	
Upon growing	68,42 (13)	65,00 (13)	77,42 (24)	
Once a month	21,05 (4)	20,00 (4)	16,13 (5)	
Once in two months	0,0	5,00 (1)	0,0	0,882
Semi-annually	5,26 (1)	10,00 (2)	6,45 (2)	
Once a year	5,26 (1)	0,0	0,0	
Lameness cases in herd	**% (n)**	**% (n)**	**% (n)**	
Yes	93,10 (27)	96,87 (31)	100,00 (38)	0,192
No	6,90 (2)	3,13 (1)	0,0	
Season of lameness	**% (n)**	**% (n)**	**% (n)**	
Spring	18,52 (5)	0,0	15,79 (6)	
Summer	3,70 (1)	9,68 (3)	13,16 (5)	
Autumn	0,0	0,0	2,63 (1)	
Winter	74,07 (20)	87,10 (27)	65,79 (25)	0,057
Summer +Winter	3,70 (1)	0,0	0,0	
Spring +Autumn	0,0	3,22 (1)	2,63 (1)	
Exclusion of lame animals from herd	**% (n)**	**% (n)**	**% (n)**	
Yes	25,93(7)	29,03(9)	5,26(2)	0,017
No	74,07(20)	70,97(22)	94,74(36)	
Foot diseases treatment methods	**% (n)**	**% (n)**	**% (n)**	
Antibiotics	18,52 (5)	32,26 (10)	42,11 (16)	
Spray	3,70 (1)	0,0	5,26 (2)	
Vaccine	0,0	0,0	0,0	0,188
Antibiotics +Spray	44,44 (12)	41,93 (13)	42,11 (16)	
Antibiotics + Vaccine	3,70 (1)	0,0	0,0	
Antibiotics + Vaccine +Spray	29,63 (8)	25,81 (8)	10,52 (4)	

As is shown in Table 2, breeders in small size farms were not informed enough about umbilical cord care; breeders in middle and large size farms were aware of its importance, but neglect the practice on the pretext of insufficient labour force. The sheep farms in various cities did not carry out umbilical cord care of sheep (Dellal *et al.* 2002, Bostancı 2006, Altıoğlu 2007, Özkan, 2008). Foot-bathing is an efficient way for prevention of foot diseases. Nevertheless, most sheep farms had no foot-bathing and only large size ones implemented foot-bathing for entire herd. However, very few of the studied farms applied deep-bathing. Unlike the results of our research, Kaymakçı *et al.* (1999), Dellal *et al.* (2002) and Bostancı (2006) have indicated that most farms employ deep-bathing for the sheep. Breeders often prefer for treatment instead of sanitation practices. Ecto/endo parasite control was implemented twice a year, mostly in spring and autumn, and the most treatment methods for fight against parasites was collective use of medications and injection. Parasite prevention should be applied not only on the sheep, but also in the pen and on dogs in the farm for the health of sheep, breeder and own family. The sheep farms, where one annual cleaning takes place, underwent disinfection in spring while animals are rangeland; on the other hand, the second disinfection was carried out in autumn. Liming was the common method for housing disinfection in all farms. Breeders indicated they clean the shelter every month and apply liming twice a year (in spring and autumn), in addition to disinfection by dusting lime on and around feeders and watering troughs in strolling areas during other months. Results from researches by Soysal *et al.* (2005), Bostancı (2006), Tölü *et al.* (2007), Özdemir (2009), Kılıç *et al.* (2013) bear similarity with ours in terms of method, time and frequency of disinfection. The occasional removal of manure from sheep farms will prevent accumulation within; this is very important for both the cleanliness of the pen and animal health and welfare. Some sheep farms reportedly carried out manure handling once to three times per year, while other breeders preferred monthly implementation. All farms utilised straw, which is not suitable for animal nourishment after barley and wheat harvest, as base material in sheep farms. The flooring surface in pens was often employed in winter, when the sheep are in the housing due to cold weather. Some breeders, however, state they used base throughout the year. The frequency of foot-care of the sheep hugely varied according to breeders, while most of them asserted the foot-care as they grow. For breeders, an animal is called lame in case it can no more walk or

step on that foot. In this respect, breeders in sheep farms reported that the sheep suffered lameness and that it was observed only in breeding sheep. Nevertheless, the lameness was mostly observed in rainy winter season when animals spend more time the pen; breeders add they separated the lame animals from the herd and heal them, and only excluded from the flock only if lameness attains extreme level.

Biosecurity-related management practices

Table 3. Biosecurity-related husbandry practices in farms.

Characteristics	50-100 head	101-150 head	> 150 head	P-value
Exposure to predator attacks	**% (n)**	**% (n)**	**% (n)**	
Yes	51,72 (15)	50,00 (16)	44,74 (17)	0,833
No	48,28 (14)	50,00 (16)	55,26 (21)	
Predator attack season	**% (n)**	**% (n)**	**% (n)**	
Spring	6,67 (1)	6,25 (1)	41,18 (7)	0,030
Summer	60,00 (9)	68,75 (11)	17,65 (3)	
Autumn	0,0	6,25 (1)	11,76 (2)	
Winter	33,33 (5)	18,75 (3)	29,41(5)	
Precautions for predator attacks	**% (n)**	**% (n)**	**% (n)**	
Sheepdog	13,33 (2)	31,25 (5)	41,18 (7)	0,312
Gun	0,0	0,0	0,0	
Withdrawal from attack area	6,67 (1)	0,0	5,88 (1)	
Sheepdog + Gun	80,00 (12)	68,75 (11)	52,94 (9)	
Water analysis	**% (n)**	**% (n)**	**% (n)**	
Yes	27,59 (8)	37,50 (12)	36,84 (14)	0,659
No	72,41 (21)	62,50 (20)	63,16 (24)	
Record keeping	**% (n)**	**% (n)**	**% (n)**	
Yes	31,03 (9)	68,75 (22)	57,89 (22)	0,010
No	68,97 (20)	31,25 (10)	42,11(16)	
Recorded facts	**% (n)**	**% (n)**	**% (n)**	
Vaccination – medication	0,0	4,55 (1)	4,55 (1)	0,116
Lambing	100,00 (9)	68,18 (15)	50,00 (11)	
Milk yield	0,0	0,0	0,0	
Vaccination – medication+ Lambing	0,0	27,27 (6)	40,90 (9)	
All	0,0	0,0	4,55 (1)	
Practices on fetal membranes	**% (n)**	**% (n)**	**% (n)**	
Bury	48,28(14)	28,12(9)	26,31(10)	0,001
Give to dog	17,24(5)	59,38(19)	44,74(17)	
Toss out	3,45(1)	12,50(4)	10,53(4)	
Nothing	31,03(9)	0,0	18,42(7)	

Table 3 shows characteristics and results with respect to determination of biosecurity level at livestock farms, engaged in sheep farming in Bursa province. None of the breeders in the sheep farms known biosecurity, nevertheless, they put the newly purchased animals in quarantine so as to prevent transmission of disease to present flock. Likewise, Laanen *et al.* (2014) indicate that only 10% of 558 sheep breeders accurately define the term “biosecurity”, that investment costs is the biggest obstacle before implementation of biosafety measures, that breeders are not informed enough about early diagnosis of diseases, and that relevant compulsory training is needed. According to hereby study, no sheep breeder in any farm wore special protective vehicle, equipment and footwear or gear during feeding or milking, and such practice was deemed unnecessary. However, the accurate implementation of this protection system, which has recently come to the fore, will minimize the risk regarding contamination of biological organisms that pave way for spread of diseases (Taşkın and Koyuncu 2013).

In Turkey, biosecurity practices are almost non-present in animal husbandry business. In recent years, the term “biosecurity” became common with respect to safe food production, and has been subject to certain researches. In relation to biosecurity criteria, only 1.1% of sheep farms in Izmir (Turkey) apply disinfection procedure to incoming vehicles, 18.2% of sheep farms in Şanlıurfa (Turkey) have a security camera at the

entrance of facilities, while 80.3% of employees wear protective clothes during farming activities (Alkan *et al.* 2013, Yener *et al.* 2013). On the other hand, the sheep breeders in Chile, Spain, Sweden, Ireland and England consciously act with regard to biosecurity and farms in these countries take precautions as below: to place "no entry" signs at the entrance, nets on windows to prevent access of birds, to have guests change their clothes and have shower, to use boots and clothes exclusively for the facility, disinfection of incoming vehicles, foot-bathing at the entrance of farm, to check the health record of purchased animal, put the newly purchased animals in quarantine, to prevent close contact with animals in neighboring farms, and to fence the facility. Apart from these precautions, agricultural consultants regularly inform breeders about biosecurity (Pinto and Urcelay 2003, Casal *et al.* 2007, Nöremark *et al.* 2010, Sayers *et al.* 2013, Toma *et al.* 2013). Marshall *et al.* (2006) assert that effective communication plays an important part in reduction and health sheep recovered from disease, accurate and objective information about health status of animals, and contributing to national and regional decision-making processes.

On the other hand, damages caused by predators are among important factors on success of sheep and goat breeding (Taşkın and Koyuncu 2013). The damages of predators mostly include death of lambs and kids, as well as rarer demise of adult ovine, due to attacks by jackal, wolf, fox, wild dog, lynx, bear, etc. According to a USA study, wild animals cause 34% of total livestock deaths (Wade and Bowns 1997, McNeal 2001). In theory, it is possible to avoid infection of many diseases, such as plague, foot-and-mouth disease, rabies, brucellosis and pneumonia through prevention of contact between the herd and the predators with infection risk (Vengust *et al.* 2006). According to hereby study, almost 50% of sheep breeders state they had been subject to predator attacks. In small and medium size farms, most predators attacks occurred in summer, while the assaults intensified in spring in large size ones. The general measures by sheep breeders against predators were "to have sheepdogs and carry gun." Likewise, Alkan *et al.* (2013) detected that 35.2% of sheep farming businesses suffer attacks by predators. Besides, for animal health and welfare, the water, provided for the sheep, has to be potable. Our survey revealed that most sheep breeders had no idea about the quality of water they use in sheep farming. Asked about why they had no analysis performed, breeders responded, "we also drink the same water," or "we would get sick if it were harmful". Similarly, Pinto and Urcelay (2003) manifest that only 8% of sheep breeders are aware of the quality of water used in the farm. For a better monitoring and assessment of animals, the vaccines and information relating to periods such as insemination, lambing and lactation for each animal should be regularly recorded. Nonetheless, small size farms refrained from keeping records despite the low number of sheep, since they considered this as extra workload. The breeders in middle and large size farms explained the lack of records with lack of time. Some farms did keep records, but their records mostly included only the lambing. According to relevant researches, most sheep farms keep health-care records but no productivity registry (Pinto and Urcelay 2003, Tölü *et al.* 2007, Bilginturan and Ayhan 2009, Sayers *et al.* 2013). After the birth, the fetal membrane should be immediately removed and ideally buried at a distant location so that sheep does not attempt to eat it. The breeders interviewed under hereby study were not well-informed about necessity of moving away the fetal membrane; consequently, they cannot act in a conscious manner, regardless of the size of farm. In case the postnatal wastes are not buried, are left around or eaten by dogs, etc., serious problems may occur with regard to health and hygiene of rangeland, animals and humans. According to Racicot *et al.* (2012), simple biosecurity precautions in a farm can be possible by changing the traditional practices of sheep breeders; therefore, breeders should be duly convinced and motivated for such new practices or approaches.

CONCLUSIONS

The assessment on welfare-related structural and management practices at farms revealed deficiencies with regard to points of view on herd management, housing conditions, feeding and sanitation issues among sheep breeders. Biosecurity is a new concept to farms; nevertheless, sheep breeders showed various accurate approaches regardless of the size of farm and despite the relative ignorance about the issue. The higher acceptance of these issues in sheep and goat production will evidently contribute to profitability of business and herd safety within the scope of sustainable animal production.

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