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AUTHORS: Musa Bastem, Mete Yanar

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## ***The Effects of Cattle Enterprise Sizes on the Structural Characteristics of Barns in the Northeast Anatolian Region: The Case of Horasan County of Erzurum Province***

Musa BASTEM<sup>1</sup> 

Mete YANAR<sup>2\*</sup> 

<sup>1</sup>East Anatolian Agricultural Research Institute, Erzurum/TÜRKİYE

<sup>2</sup>Atatürk University, Faculty of Agriculture, Department of Animal Science, Erzurum/TÜRKİYE

<sup>1</sup><https://orcid.org/0009-0001-3584-0275>

<sup>2</sup><https://orcid.org/0000-0002-5311-5675>

\*Corresponding author (Sorumlu yazar): mtyanar@gmail.com

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**ABSTRACT:** The objective of this research was to identify the structural characteristics, challenges, and potential solutions for cattle barns in cattle enterprises in the villages of Horasan County, Erzurum Province as well as the relationships between the structural characteristics of the barns and the size of the enterprises ( $\leq 20$ , 21-40, 41-60, 61-80, and  $\geq 81$  heads). To achieve this, a face-to-face survey with 500 cattle breeders from 77 villages was conducted. The analysis group was randomly selected by simple random sampling from 4565 enterprises in Horasan County. The findings of the study indicated that 99.4% of cattle farms had closed barns, while 0.6% had semi-open barns. A statistically significant ( $P < 0.05$ ) relationship was also determined between the size of the cattle enterprise and the number of chimneys in the barns. It was observed that as the size of the enterprises increased, the number of chimneys in the barns also increased. Additionally, the number of windows increased with the number of cattle on the farms, and the relationship between these parameters was statistically significant ( $P < 0.05$ ). Similarly, enterprisers became more meticulous about general cleaning as their number of animals increased. Cattle barn walls were predominantly constructed using stone (91.0%), with concrete blocks (6.6%) and bricks (2.4%) also employed to a lesser extent in Horasan County. The evaluation of the barn floors revealed that 76.0% of the barns were constructed with concrete floors, while 24.0% were constructed with stone floors. Furthermore, the findings of the study indicated that the majority of breeders in Horasan District perceived the atmospheric conditions in their barns to have detrimental impacts on human health (63.0%), milk yield (72.0%) and animal health (70.0%). In conclusion, in addition to the technical and educational programmes offered to livestock farmers, it would be beneficial to increase the incentives offered by the Ministry of Agriculture and Forestry of the Republic of Türkiye to address the structural deficiencies and defects observed in the barns.

**Keywords:** Erzurum province, animal welfare, Horasan county, cattle, structural characteristics of barns.

### ***Kuzeydoğu Anadolu Bölgesi'nde Sığır İşletme Büyüklüklerinin Ahırların Yapısal Özellikleri Üzerindeki Etkileri: Erzurum İli Horasan İlçesi Örneği***

**ÖZ:** Bu araştırmanın amacı, Erzurum İli Horasan İlçesine bağlı köylerdeki sığırçılık işletmelerinde sığır ahırlarının yapısal özelliklerinin, karşılaşılan zorlukların ve potansiyel çözümlerinin belirlenmesinin yanı sıra ahırların yapısal özellikleri ile işletmelerin büyüklükleri ( $\leq 20$ , 21-40, 41-60, 61-80, ve  $\geq 81$  baş) arasındaki ilişkileri belirlemektir. Bu amaçla, Horasan ilçesinin 77 köyündeki 4565 işletmeden basit tesadüfi örnekleme yoluyla rastgele seçilen 500 sığır yetiştiricisi ile yüz yüze anket yapılmıştır. İşletme büyüklükleri ile ahırların yapısal özellikleri arasındaki ilişkileri ortaya koymak amacıyla, işletme büyüklükleri mevcut sığır sayıları dikkate alınarak  $\leq 20$ , 21-40, 41-60, 61-80 ve  $\geq 81$  baş olmak üzere beş kategoride sınıflandırılmıştır. Çalışmanın bulguları, sığır çiftliklerinin %99,4'ünün kapalı ahırlara, %0,6'sının ise yarı açık ahırlara sahip olduğunu göstermiştir. Sığır işletmelerinin büyüklüğü ile ahırlardaki baca sayısı arasında da istatistiksel olarak anlamlı ( $P < 0,05$ ) bir ilişki tespit edilmiştir. İşletmelerin büyüklüğü arttıkça ahırlardaki baca sayısının da arttığı görülmüştür. Ayrıca, pencere sayısı çiftliklerdeki sığır sayısı ile birlikte artmış ve bu parametreler arasındaki ilişki istatistiksel olarak anlamlı bulunmuştur ( $P < 0,05$ ). Benzer şekilde, hayvan sayıları arttıkça işletmelerin genel temizlik konusunda daha titiz davrandıkları tespit edilmiştir. Horasan ilçesinde ahır duvarlarının yapımında ağırlıklı olarak taş (%91,0), daha az oranda da briket (%6,6) ve tuğla (%2,4) kullanılmıştır. Ahır zeminlerinin değerlendirilmesi, ahırların %76,0'sının beton zeminle, %24,0'ünün ise taş zeminle inşa edildiğini

ortaya koymuştur. Ayrıca, çalışmanın bulguları Horasan İlçesindeki yetiştiricilerin çoğunluğunun ahırlarındaki atmosferik koşulların insan sağlığı (%63,0), süt verimi (%72,0) ve hayvan sağlığı (%70,0) üzerinde zararlı etkileri olduğunu düşündüklerini göstermiştir. Sonuç olarak, hayvan yetiştiricilerine sunulan teknik ve eğitim programlarına ek olarak, ahırlarda gözlemlenen yapısal eksikliklerin ve hataların giderilmesi için Türkiye Cumhuriyeti Tarım ve Orman Bakanlığı tarafından sunulan teşviklerin artırılması faydalı olacaktır.

**Anahtar Kelimeler:** Erzurum ili, hayvan refahı, Horasan ilçesi, sığır, ahırların yapısal özellikler.

## INTRODUCTION

Cattle raising is a significant source of milk and meat worldwide, providing livelihoods for millions, especially in rural areas with limited employment opportunities. It supports farmers and related industries such as feed production, animal health services, transportation, and meat processing, thereby influencing local and regional economies.

In Türkiye, a significant proportion of livestock is reared in the Eastern Anatolia Region. Erzurum, one of the provinces in this region, accounts for about 4.2% of Türkiye's total cattle population (TURKSTAT, 2023). The region's abundant and fertile meadows and pastures, along with favorable climatic and topographical conditions, have made animal husbandry the primary source of livelihood in Erzurum. Horasan, one of the 20 counties in Erzurum, is located in the eastern part of the province and borders Ağrı and Kars provinces. The county is predominantly lowland and slightly hilly, with intensive cultivation of sugar beet and grain. Cattle breeding plays a significant role in the county's economy, accounting for 9.3% of the total number of cattle in Erzurum province, with a total of 65 025 cattle. Horasan also produces 61 561 tons of milk annually, with 33 287 animals being milked. According to TURKSTAT data for 2023, 7.4% of the cattle raised in Horasan are native breeds, 17.5% are continental breeds, and 75.1% are crossbred (TURKSTAT, 2023).

Providing appropriate environmental conditions is essential for achieving the highest possible yield from cattle, and is based on their genetic structure. Housing conditions are one of the most significant environmental factors, playing a crucial role in providing cattle with comfortable living environments and mitigating the harmful effects of adverse natural conditions (Kaygısız and Tümer, 2009). Well-designed barns provide optimal conditions for cattle, resulting in higher yields in terms of milk production or weight gain. It is essential to design barns that minimize stressors such as overcrowding, extreme temperatures, and poor ventilation to promote better feed intake and digestion, ultimately leading to improved productivity

(Özhan *et al.*, 2015). Ensuring that barns are designed to minimize stressors and promote cattle well-being is crucial.

The structural characteristics of barns used for cattle breeding vary widely among regions, provinces, and counties in Türkiye. Consequently, county-based studies are important for providing accurate insights to inform policy makers, farmers, and stakeholders about necessary improvements to enhance animal welfare and optimize productivity in cattle farming operations (Özsağlıcak and Yanar, 2022). In recent years, significant research has been conducted on this subject in various regions of Türkiye (Kaygısız and Tümer, 2009; Tilki *et al.*, 2013; Bakan, 2014; Daş *et al.*, 2014; Aydın *et al.*, 2016; Koçyiğit *et al.*, 2016; Özsağlıcak and Yanar, 2022; Doğanay and Yanar, 2023) as well as abroad (Dou *et al.*, 2001; Vasseur *et al.*, 2010; Sheppard *et al.*, 2011). However, no study has been conducted on the structural characteristics of cattle barns in Horasan County of Erzurum province. Therefore, this study aimed to investigate the impact of the size of the cattle farm on the structural characteristics of the barns in the Northeast Anatolian region, with a particular focus on Horasan County in Erzurum Province, as well as the current situation and problems related to the structural elements of the cattle barns.

## MATERIALS AND METHODS

Following approval by the Atatürk University Faculty of Agriculture Ethics Committee (protocol no 2023/11, dated 18/09/2023), data for this study were collected through face-to-face surveys of cattle farms located in 77 villages in the Horasan County of Erzurum province. Interviews were conducted with 500 farm owners selected from 4565 cattle enterprises in the county. The minimum number of farms was determined using the following formula that is applicable when the population is limited, the variance is unknown, and there are qualitative variables dependent on probability (Arıkan, 2007).

$$n = (N \cdot Z^2_{\alpha/2} \cdot p \cdot q) / [(N-1) \cdot D^2 + (Z^2_{\alpha/2} \cdot p \cdot q)]$$

In this formula;  $n$ =Minimum number of samples,  $N$ =Population size,  $D$ =Margin of error (5%),  $Z_{\alpha/2}$ =Table value (1.96) for  $\alpha = 0.05$ ,  $p$ =The rate to be calculated (0.5),  $q=1-p$ .

The minimum number of surveys required was initially calculated using the formula as 355, which was later increased by 41.0%. Therefore, the survey was carried out with 500 enterprise owners in Horasan County. Furthermore, this study examined the relationships between enterprise sizes and the parameters of barn structural characteristics. For this purpose, enterprises were grouped into 5 categories:  $\leq 20$ , 21-40, 41-60, 61-80, and  $\geq 81$  heads, according to the number of cattle available. The data were statistically analyzed in the SPSS package program (version 22.0). The significance of the relationships between the sizes of the enterprises and the variables was determined using the Chi-square test (SPSS, 2013).

## RESULTS AND DISCUSSION

### Types of Barn

Common barn types in Türkiye include tie-stall closed barns, tie-free stall closed barns, free-stall closed barns, semi-open free-stall barns, and open barns, which vary by region. In Horasan County of Erzurum province, tie-stall closed barns were the preferred type in most cattle farms (78.0%), followed by tie-free stall closed barns (21.4%) and semi-open free-stall barns (0.6%) (Figure 1). The study also revealed that 99.4% of the farms in the county had closed barns. The results are consistent with those of other studies conducted in different regions of Türkiye (Erkan, 2005; Köse, 2006; Soyak *et al.*, 2007; Kaygısız and Tümer, 2009; Akkuş, 2009; Demir *et al.* 2014; Özsağlıcak and Yanar, 2022; Uğurlu and Şahin, 2010; Şeker *et al.* 2012; Bakan, 2014). Similarly, 72.9% of barns in Canada use the tie-stall system, while 27.1% use the free-stall system according to 2022 statistical data published by Agriculture and Agri-Food Canada's Animal Industry Division. Likewise, in Romania, the tie-stall barn system is used in about 75.0% of medium and large farms and in 90.0% of small farms (Popescu *et al.*,

2013). Moreover, other studies reveal that tie-stall housing systems are employed for around 88% of Norwegian dairy cattle (Sogstad *et al.*, 2005), 75.0% of all Swedish dairy herds (Loberg *et al.*, 2004), and more than a third of German dairy cows (Anonymous, 2010). On the other hand, the percentage of closed barns with tie-stalls in Horasan County was lower than those found in studies conducted in both the West Anatolia Region (Kılıç *et al.*, 2020) and the Black Sea Region (Tugay and Bakır, 2006). However, in the South East Anatolia Region, Doğanay and Yanar (2023) reported that the percentages of barn types were 3.7% for open barns, 44.0% for semi-open barns, and 6.7% for tie-stall closed barns.

### Number of Ventilation Chimneys and Windows in the Barns

The ventilation chimneys and windows in the barn serve the main function of removing bad odors and harmful gases, such as ammonia, hydrogen sulfide, carbon dioxide and methane, from the barn environment, along with the heated air in the barn. This provides the optimal temperature and relative humidity conditions required by the animals for optimal production conditions. The result of the present study carried out in Horasan County showed that 2 chimneys were common (35.8 %) (Figure 2). Similarly, Güler *et al.* (2017) found that most of the cattle barns in Narman County in Erzurum province had 1 (45.7%) or 2 chimneys (40.0 %). Other studies on this topic reported that 7.4% of enterprises in the Hınıs County had 1, 29.3% had 2, 32.1% had 3, 27.1% had 4, 3.3% had 5, 0.8% had 6 or more ventilation chimneys, and 3 (36.3%) and 4 (40.0%) windows were common in most enterprises (Aydın *et al.*, 2016). However, the results of Ünalın *et al.* (2013) indicated that 78.1% of the farms in Niğde province did not have ventilation chimneys in their barns, while Öztürk (2009) determined that ventilation chimneys existed in 55.2% of the cattle enterprises in Mardin province. Similarly, in Aydın province, Bardakçioğlu *et al.* (2004) found that 88.5% (207 units) of the barns had ventilation chimneys, 11.5% (27 units) had no ventilation chimneys and the average number of ventilation chimneys was 3.8 per barn.

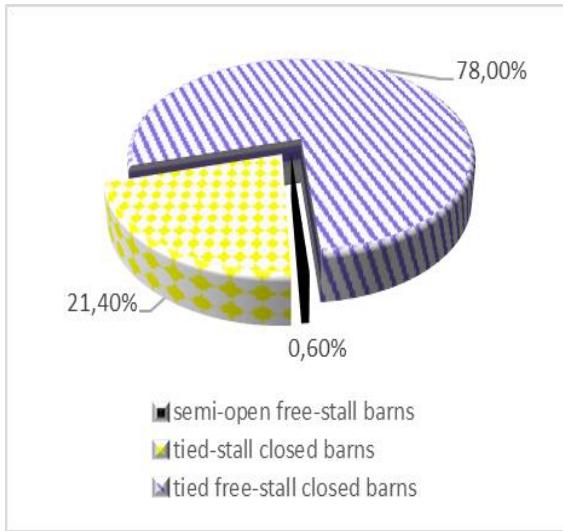


Figure 1. Types of barn.  
Şekil 1. Ahır tipleri.

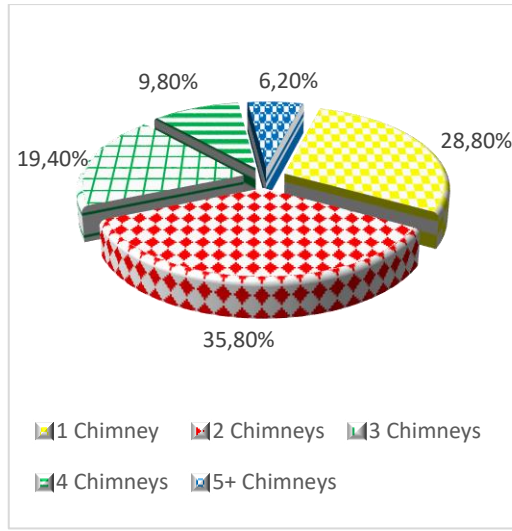


Figure 2. Number of ventilation chimney in the barn.  
Şekil 2. Ahırda bulunan havalandırma bacası sayısı.

The current study revealed that the size of the cattle enterprises in Horasan County had a significant ( $P<0.01$ ) ( $X^2=222.3$ ) effect on the number of chimneys of the existing barns. While the number of chimneys in the enterprises with 61-80 and 81+ cattle were concentrated in the group of 5 chimneys or more with 31.3% and 77.8% respectively, the enterprises with 41-60 cattle were most predominant in the group of 4 chimneys with 25.5%, the enterprises with 21-40 cattle were concentrated in the group of 2 chimneys with 42.0% (Table 1). Furthermore, the enterprises with

fewer than 20 cattle mainly had (48.0%) barns with 1 chimney. As a result, it was determined that as the number of cattle decreased, the number of chimneys in the barns also decreased. Furthermore, although the number of chimneys in the barns of some cattle farms in Horasan County is sufficient, some of these chimneys are kept closed continuously, especially during the long and harsh winter period, which causes the number of functional chimneys to be much lower than the number of available chimneys (Figure 3).

Table 1. Relationships between size of the enterprises and the number of chimneys of the barns.  
Çizelge 1. İşletmelerin büyüklüğü ile ahırların baca sayıları arasındaki ilişkiler.

		Number of chimney in the barn					Total
Number of Cattle		1	2	3	4	≥5	
≤20	NE <sup>1</sup>	106.0	77.0	31.0	5.0	2.0	221.0
	%	48.0	34.8	14.0	2.3	0.9	100.0
21-40	NE	34.0	87.0	53.0	26.0	7.0	207.0
	%	16.4	42.0	25.6	12.6	3.4	100.0
41-60	NE	4.0	11.0	10.0	12.0	10.0	47.0
	%	8.5	23.4	21.3	25.5	21.3	100.0
61-80	NE	-	4.0	3.0	4.0	5.0	16.0
	%	-	25.0	18.8	25.0	31.3	100.0
≥81	NE	-	-	-	2.0	7.0	9.0
	%	-	-	-	22.2	77.8	100.0
Total	NE	144.0	179.0	97.0	49.0	31.0	500.0
	%	28.8	35.8	19.4	9.8	6.2	100.0

<sup>1</sup> NE: Number of enterprises



Figure 3. A barn with 2 of its 3 chimneys wrapped and dysfunctional and its window covered with a second layer of plastic sheeting.  
Şekil 3. Üç bacasından ikisi sarılarak işlevsiz hale getirilmiş ve penceresi ikinci kat plastik örtü ile kapatılmış bir ahır.

Data on the number of windows in the existing enterprises in the research area are presented in Figure 4. The majority of barns (40.0%) had 5 or more windows, followed by barns with 4 windows (24.8%), 2 windows (14.8%), 3 windows (14.6%), and 1 window (5.8%). Similarly, Aydın *et al.* (2016) also reported that 3 (36.3%) and 4 (40.0%) windows were common in most farms in Hınıs County of Erzurum province. In contrast, Güler *et al.* (2017) determined that 2 (47.5%) windows were more common in barns of existing livestock enterprises in Narman County of Erzurum province. Likewise, results of a study conducted in the center of Kars province revealed that 43 enterprises had no windows in their barns, while only 23 had 1 window. Özsağlıcak and Yanar (2022) reported that 82.7% of the cattle barns in Erzurum, a province located in Eastern Anatolia with a mild microclimate, kept their chimneys open throughout the year. Furthermore, according to Doğanay and Yanar (2023), ventilation in cattle farms in the Eyyubiye County of Urfa province was achieved through windows (43.0%), ventilation chimneys (9.6%), gaps between the roof and wall (48.9%), and ventilators or fans (39.3%). However, in Kahramanmaraş province, Kaygısız and Tümer (2009) reported that only 10.0% of enterprises had adequate ventilation, while 67.0% had moderately adequate ventilation.

(Tilki *et al.*, 2013). Similarly, Bakır (2002) investigated the structural status of private dairy cattle farms in Van province and reported that ventilation was not possible due to the inadequate ventilation chimneys in the farms and the fact that the doors and windows in the barns were kept closed in winter. In a study conducted in Şenpazar County of Kastamonu province, Şahin (2016) observed the accumulation of toxic gases in 64% of cattle enterprises. However, Köse (2006) reported that climatic conditions have a significant impact on ventilation practices in barns, and 88.0% of barns in Uşak province, which has relatively milder climatic conditions, were adequately ventilated. Similarly,

Table 2 demonstrates a statistically significant ( $P < 0.01$ ) ( $X^2 = 160.1$ ) relationship between the size of the enterprise and the number of windows present in the barns. The number of windows increased with the number of cattle on the farms. Enterprises with more than 20 cattle had 5 or more windows in their barns. Although the barns had a sufficient number of windows, it was observed that most of them were small, closed, and covered with a second layer of nylon, particularly during the long winter season (Figure 4). This practice has a negative impact on ventilation and lighting in the barns.



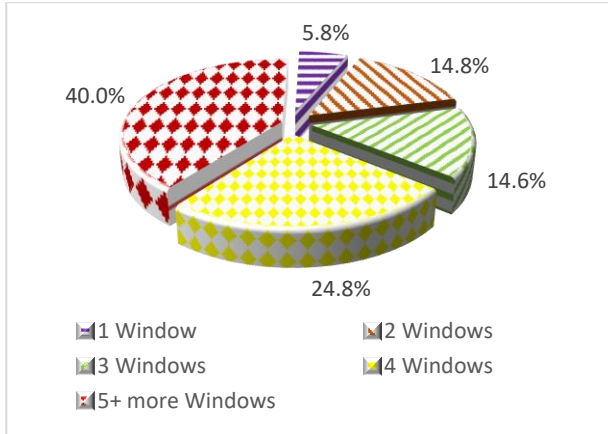


Figure 4. Number of windows in the barn.  
Şekil 4. Ahırda bulunan pencere sayısı.

Table 2 demonstrates a statistically significant ( $P < 0.01$ ) ( $X^2 = 160.1$ ) relationship between the size of the enterprise and the number of windows present in the barns. The number of windows increased with the number of cattle on the farms. Enterprises with more than 20 cattle had 5 or more windows in their barns. Although the barns had a sufficient number of windows, it was observed that most of them were small, closed, and covered with a second layer of nylon, particularly during the long winter season (Figure 3). This practice has a negative impact on ventilation and lighting in the barns.

Table 2. Relationships between size of the enterprises and the number of windows in the barns.  
Çizelge 2. İşletmelerin büyüklüğü ile ahırlardaki pencere sayısı arasındaki ilişkiler.

		Number of windows in the barn					Total
Number of Cattle (Head)		1	2	3	4	≥5	
≤20	NE <sup>1</sup>	25.0	61.0	44.0	56.0	35.0	221.0
	%	11.3	27.6	19.9	25.3	15.8	100.0
21-40	NE	4.0	12.0	23.0	62.0	106.0	207.0
	%	1.9	5.8	11.1	30.0	51.2	100.0
41-60	NE	-	1.0	6.0	6.0	34.0	47.0
	%	-	2.1	12.8	12.8	72.3	100.0
61-80	NE	-	-	-	-	16.0	16.0
	%	-	-	-	-	100.0	100.0
≥81	NE	-	-	-	-	9.0	9.0
	%	-	-	-	-	100.0	100.0
Total	NE	29.0	74.0	73.0	124.0	200.0	500.0
	%	5.8	14.8	14.6	24.8	40.0	100.0

<sup>1</sup> NE: Number of enterprises

### Building Materials Utilized for the Construction of Barns' Walls and Floors

It is crucial to use materials for the walls and floor of the barn that are easy to clean and disinfect, when implementing biosecurity rules in cattle barns. These materials should also be low-cost, suitable for the local climate, and readily available in the surrounding environment. According to Figure 6a, stone in Horasan County was the most commonly used material for the walls of the barn (91.0%), followed by concrete blocks (6.6%) and bricks (2.4%).

When evaluating other studies on the subject, it was found that in the construction of cattle barns in Erzincan, concrete blocks were used in 50.6% of enterprises for the construction of barn walls, followed

by stone (22.7%), mudbrick (12.6%), brick (11.6%), pumice blocks (2.2%), and wood (0.3%) (Özsağlıcak and Yanar, 2022). However, results of a study conducted in the Erzurum region indicated that stone was the primary material (62.9%) used to construct the walls of the barns. As the farmers' experience increased, the use of stone decreased and the use of concrete blocks increased (Han and Bakır 2010). In the Eyyubiye County of Şanlıurfa province, Doğanay and Yanar (2023) found that 30.3% of the building materials used in the walls of existing cattle barns were stone, 26.7% were concrete block, 23.0% were wood, 17.0% were brick, and 3.0% were mudbrick. Tugay and Bakır (2006) reported that in Giresun province, the primary materials used for the construction of the walls

in existing cattle barns were stone (62.5%), concrete block (27.9%), wood (8.6%), and mudbrick (1.1%).

In the present study, the materials used in the construction of the barn floors were evaluated and it was found that concrete is the most commonly used material (76.0%), followed by stone (24.0%) (Figure 6b). The breeders in Horasan County preferred concrete floors for ease of cleaning of animals and manure. Özsağlıcak and Yanar (2022) stated that 98.2% of the cattle barns in the cattle farms operating in the central county of Erzincan province were constructed with concrete floors, 0.3% with soil, 1.0% with wood, and 0.5% with other materials such as

ceramic andesite. Similarly, Yaylak *et al.* (2015) reported that 75.9% of the enterprises in Ödemiş County of İzmir province had soil and concrete floors, 19.6% had concrete floors, and 6.5% had soil floors. According to Mundan *et al.* (2018), 85.2% of farmers in Şanlıurfa province preferred concrete as the floor of cattle barns, while 14.8% preferred compacted soil. This preference was also reported in other studies conducted by Bardakçioğlu *et al.* (2004) in Aydın, Tugay and Bakır (2006) in Giresun, Kaygısız and Tümer (2009) in Kahramanmaraş, Akkuş (2009) in Konya, Akbay (2010) in Tekirdağ, and Köseman and Şeker (2016) in Malatya.

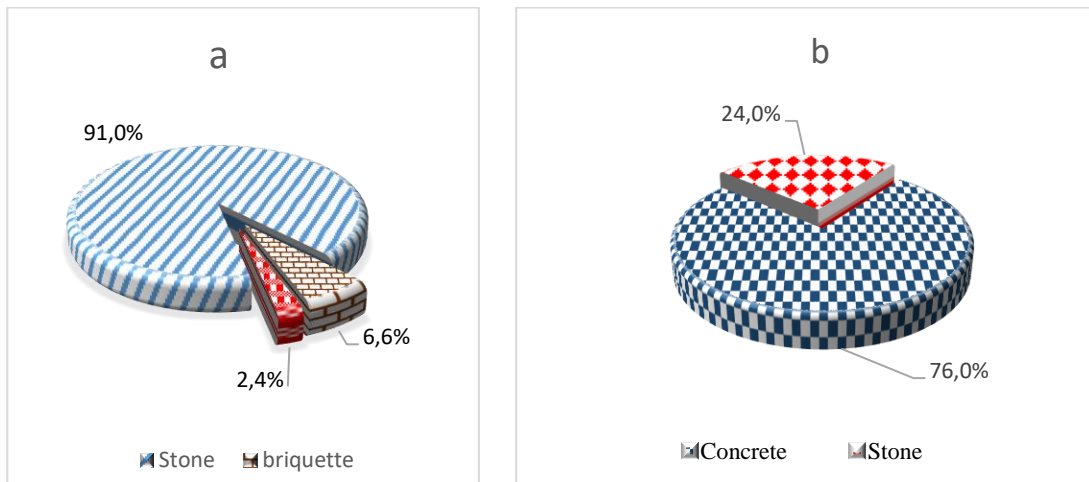


Figure 6. Materials used for building walls (a) and floor (b) of the barn.  
Şekil 6. Ahır duvarları (a) ve zeminin (b) yapımında kullanılan materyaller.

According to cattle breeders, the enterprises in Horasan County prefer stone as a wall material due to its easy availability in the region. Additionally, concrete is preferred for barn floor construction because of its durability and ease of cleaning. Furthermore, the variations in the materials utilized to construct barn walls and floors across different regions of Türkiye can be attributed to the preferences and practices of the breeders, influenced by climatic, economic, and socio-demographic variations between provinces, as well as the availability of suitable resources for building purposes in the respective regions.

### General Cleaning of the Barns

The results of the survey on the annual practice of general cleaning, including whitewashing, painting of barn walls, and disinfection, are presented in Figure 7. Of the farmers surveyed in Horasan County, 51.0%

reported carrying out general cleaning of their barns, while 49.0% responded negatively. Studies on this topic have reported that farmers in central Kars province did not have sufficient knowledge about the use of disinfectants in barns, but 75.9% of them answered "yes" to the question "Do you use liming?" (Demir *et al.* 2014). In Narman County, 36.5% of barns undergo general cleaning 5 times a year, while 24.0% undergo general cleaning 4 times a year (Güler *et al.* 2017). Aydın *et al.* (2016) reported that in Hınıs County, general cleaning was carried out 3 times a year (39.0%) in farms. Upon comparison of the findings of the present study with previous research, it was found that the cleaning practices of the enterprisers in Horasan County were higher than the values reported by Güler *et al.* (2017) and Aydın *et al.* (2016), and lower than the results indicated by Demir *et al.* (2014).



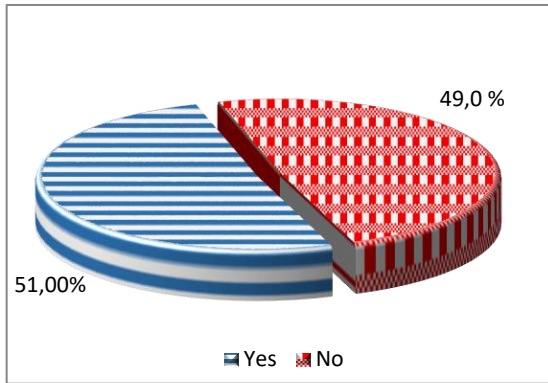


Figure 7. Status of performing of general cleaning in the barns.  
Şekil 7. Ahırlarda genel temizlik yapılması durumu.

The study results indicate a significant relationship ( $P < 0.01$ ) ( $X^2 = 32.8$ ) between enterprise size and barn cleaning frequency. Enterprises with 21-40, 41-60, 61-80 and 81+ animals had a 'yes' response rate of 54.6%, 70.2%, 81.3% and 88.9%, respectively, to the general cleaning question. However, those with fewer than 20 animals answered 'no' with a percentage of 61.5%. This suggests that owners become more meticulous about general cleaning as the number of animals increases (Table 3).

Table 3. Changes in general cleaning status according to enterprise size.  
Çizelge 3. İşletme büyüklüğüne göre genel temizlik durumundaki değişimler.

Number of Cattle (Head)		General cleaning of the barns		
		Yes	No	Total
≤20	NE <sup>1</sup>	85.0	136.0	221.0
	%	38.5	61.5	100.0
21-40	NE	113.0	94.0	207.0
	%	54.6	45.4	100.0
41-60	NE	33.0	14.0	47.0
	%	70.2	29.8	100.0
61-80	NE	13.0	3.0	16.0
	%	81.3	18.8	100.0
≥81	NE	8.0	1.0	9.0
	%	88.9	11.1	100.0
Total	NE	252.0	248.0	500.0
	%	50.4	49.6	100.0

<sup>1</sup> NE: Number of enterprises

### Duration of the Barn's Usage

Data on the duration of barn use in cattle enterprises in Horasan County in Erzurum province are presented in Figure 8. Most of the respondents indicated that the barns were used for a period of between 11 and 15 years (48.4%), with a smaller proportion stating that they were in use for between 6 and 10 years (40.6%). A further 7.0% of respondents indicated that the barns were in use for between 16 and 20 years, while 3.0% stated that they were in use for between 0 and 5 years. The remaining 1% of the respondents indicated that the barns were in use for a period of 21 years or more. Previous studies by Tilki *et al.* (2013), Güler *et al.* (2017), and Bakan (2014) reported that the average age of cattle barns in the central County of Kars and Narman County of Erzurum province, and Ağrı

province are 18.2 years, 17.1 years, 13.0 years, respectively.

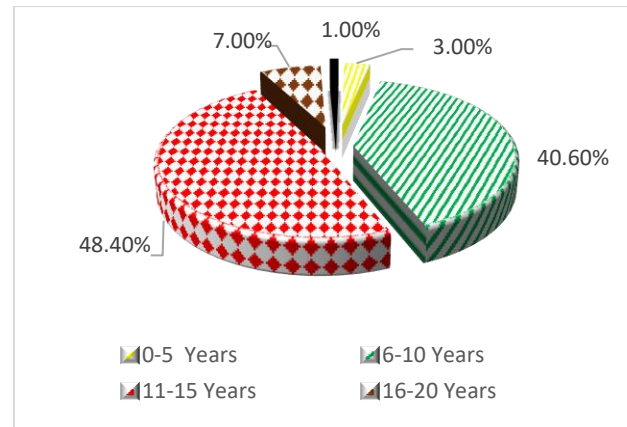


Figure 8. The duration of the barn's use in Horasan County.  
Şekil 8. Horasan İlçesindeki ahırın kullanım süresi.

Table 4 illustrates the significant relationship ( $P<0.05$ ) ( $X^2=27.8$ ) between the size of the barn and the duration of use of the barn. The duration of the barn's use in enterprises with fewer than 20 cattle (small farms) is mainly concentrated in the range of 6-10 years with 46.2%. In enterprises with 21-40, 41-60 and 81+ heads of cattle, the duration of barn's use was found to be concentrated in the range of 11-15 years with 54.1%, 48.9% and 55.6%, respectively. For enterprises with 61-80 cattle (large farms), the age of the barns was found to be equally distributed in the 6-10 and 11-15 year intervals.

### Effect of the Structure of the Barn on the Health of the Breeders, the Milk Yield of the Cattle and the Development of the Animals

The results of the present study revealed that the structural characteristics of 63.0% of the barns on cattle farms in Horasan County have a negative impact on human health according to enterprisers. Furthermore, they also stated that 72.0% of these barns had a

negative effect on the milk yield of the cattle, while 70.0% of them had a negative effect on the growth characteristics of the animals. Aydın *et al.* (2016) conducted a similar study in Hınıs County of Erzurum province and obtained comparable results. Their study indicated that the existing barns in Hınıs County negatively affected the health of the owners (88.8%), the milk production of the cows (88.6%), and the growth of the animals (81.0%). Tilki *et al.* (2013) also reported that in Kars province, 48.7% of the owners' health was negatively affected by the barn structure, 60.9% reported a low milk yield of the animals due to the barn structure, and 57.0% reported that the barn structure negatively affected animal development. The poor conditions of the examined barns in Horasan County, including insufficient light, poor ventilation, and lack of hygiene, may have contributed to these results.

Table 4. Relationships between the sizes of the enterprises and the duration of the barn's use.  
Çizelge 4. İşletmelerin büyüklükleri ve ahırların kullanım süreleri arasındaki ilişkiler.

		The duration of the use of the barn (in years).					
Number of Cattle (Head)		0-5	6-10	11-15	16-20	≥21	Total
≤20	NE <sup>1</sup>	7.0	102.0	97.0	13.0	2.0	221.0
	%	3.2	46.2	43.9	5.9	0.9	100.0
21-40	NE	3.0	73.0	112.0	17.0	2.0	207.0
	%	1.4	35.3	54.1	8.2	1.0	100.0
41-60	NE	3.0	15.0	23.0	5.0	1.0	47.0
	%	6.4	31.9	48.9	10.6	2.1	100.0
61-80	NE	-	8.0	8.0	-	-	16.0
	%	-	50.0	50.0	-	-	100.0
≥81	NE	2.0	5.0	2.0	-	-	9.0
	%	22.2	55.6	22.2	-	-	100.0
Total	NE	15.0	203.0	242.0	35.0	5.0	500.0
	%	3.0	40.6	48.4	7.0	1.0	100.0

<sup>1</sup> NE: Number of enterprises

### Ability of the Barn to Meet the Needs of the Enterprisers

A total of 87.2% of the respondents answered 'yes' to the question 'Does your barn meet your needs?', while 12.8% of the farmers in Horasan County answered 'no'. Furthermore, it was found that there was a significant ( $p<0.05$ ) ( $X^2=11.9$ ) relationship between the number of

cattle and the ability of the barns to meet the needs of the farmers. It can be stated that the existing barns in small (<20 cattle) and large (≥81 cattle) enterprises met the needs of the cattle breeders to a greater extent than other size of enterprises (Table 5).

Table 5. The relationship between the size of the enterprises and the barn's ability to meet the needs of the cattle breeders.  
Çizelge 5. İşletmelerin büyüklüğü ile ahırın sığır yetiştiricilerinin ihtiyaçlarını karşılama kabiliyeti arasındaki ilişkiler.

		The barn's ability to meet the needs of the cattle breeders		
Number of Cattle (Head)		Yes	No	Total
≤20	NE <sup>1</sup>	204.0	17.0	221.0
	%	92.3	7.7	100.0
21-40	NE	170.0	37.0	207.0
	%	82.1	17.9	100.0
41-60	NE	40.0	7.0	47.0
	%	85.1	14.9	100.0
61-80	NE	13.0	3.0	16.0
	%	81.3	18.8	100.0
≥81	NE	9.0	-	9.0
	%	100.0	-	100.0
Total	NE	436.0	64.0	500.0
	%	87.2	12.8	100.0

<sup>1</sup> NE: Number of enterprises

## CONCLUSIONS

The findings of the study revealed that most barns in the County are equipped with 1 or 2 ventilation chimneys, typically closed during winter, which hampers effective ventilation. Furthermore, despite having 4 or 5 windows, many barns are covered with nylon during the extended winter period, further restricting ventilation. The practice of keeping ventilation shafts and windows closed has led to increased temperatures and humidity levels inside the barns, significantly affecting air quality. Consequently, concentrations of harmful gases inside barns, such as ammonia, hydrogen sulfide, and carbon dioxide, may have risen to levels that pose risks to both human and animal health. However, although breeders in Horasan

County widely recognize that these indoor atmospheric conditions have adverse effects on human and animal health, as well as animal productivity, a considerable proportion of the respondents (87.2%) indicated that their existing barns were adequate to meet their needs. These results point out that there is a need for targeted education programs to raise awareness among cattle breeders about the importance of proper barn ventilation and its impact on health and productivity. In addition to the technical educational programs that will be provided to cattle breeders, it would also be beneficial to intensify the incentives offered by the Republic of Türkiye Ministry of Agriculture and Forestry to eliminate the structural deficiencies and problems observed in the barns.

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