

## IMPACT OF HOUSING AND BREEDING CONDITIONS ON THE WELFARE OF SHEEP

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### ABSTRACT

Housing and breeding conditions have a significant impact on sheep welfare. Well-designed buildings that ensure an appropriate microclimate, unrestricted access to pastures, proper nutrition, gentle handling, and the opportunity to express natural behaviors are key factors influencing sheep welfare. Play is a crucial indicator of lamb welfare. Frequent play activity reflects positive emotions in the animals, whereas stress can significantly reduce their willingness to engage in play. Positive relationships between humans and animals also play an important role. Interactions with caretakers build trust in sheep and lead to positive emotional responses. Observing sheep behavior is one of the most important methods for assessing their welfare. Regular monitoring of sheep behavior by farmers provides valuable insights into their well-being and needs. This enables the detection of potential problems and the implementation of appropriate preventive measures.

**Key words:** Sheep, welfare, environment, human-animal interactions

### INTRODUCTION

Sheep have significant economic importance as they are raised for milk, meat, hides, and wool. The global sheep population is approximately 1.1 billion (estimated data). Sheep are widely distributed across Asia, Africa, Europe, and both Americas, with the largest populations found in China, India, and Australia, though they are less common in tropical regions. Typically, sheep are better adapted to cold and humid climates [Dwyer 2022].

Sheep are adaptable, resilient, and capable of utilizing poor-quality feed. These traits make them a popular species for farming in some of the planet's most challenging environments. In many countries, sheep are raised in extensive or very extensive conditions, but they can also be kept in semi-intensive systems (in buildings for part of the day or year), as well as in intensive systems (usually dairy) involving permanent housing.

Like other animals, sheep are sentient beings capable of experiencing both positive and negative emotions. These emotions are present regardless of the management

system. Therefore, animal keepers have a duty to minimize negative aspects of their welfare while simultaneously enhancing the positive ones.

Sheep housing must provide an appropriate microclimate, including proper temperature, humidity, and ventilation. Poorly designed buildings and inadequate microclimates can pose serious threats to sheep welfare. Extreme temperatures, whether too high or too low, can cause stress in sheep [Hartung 1994, Casamassima et al. 2001, Sevi et al. 2001]. This stress can lead to decreased production, worsened health, and even death.

Sheep are flock animals with a gentle disposition. They tend to experience fear, anxiety, and frustration, even during simple husbandry tasks in the barn [Lynch et al. 1992, Fitzpatrick et al. 2006].

Sheep are well known for their exceptional adaptive abilities. Their high resilience allows them to adjust to various environmental conditions. However, it is important to understand that adaptability does not equate to complete resistance to adverse conditions. In intensive farming systems, sheep are constantly exposed to a range

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of stressors that can deteriorate their welfare and disrupt their natural behaviors [Nedeva 2020].

## ENVIRONMENT

In Poland, sheep farming is predominantly carried out in an extensive system. This means that the animals are grazed on pastures (Fig. 1) for a significant part of the year, which provides them with freedom of movement, access to natural feed, and the opportunity to express natural behaviors. On pastures, sheep should have access to shade, which offers them comfort during hot weather. Heat stress and exposure to high temperatures can be significant issues in outdoor maintenance [Piirsalu et al. 2020]. Access to shade is an important factor influencing the animals' resistance to high temperatures, and competition for shade may occur if it is insufficient. High temperatures increase water intake [Silanikove 2000] and may reduce feed intake and reproductive behaviors in both males and females.

Generally, sheep breeds from temperate climates have dense, woolly fleeces and are well adapted physically, behaviorally, and physiologically to cold, damp climates. Sheep with full fleeces can remain within their thermoneutral range even in sub-zero temperatures, provided they are dry and can avoid the effects of cold wind through natural or man-made shelters. Given the choice, sheep prefer to stay outside even in very low temperatures [Piirsalu et al. 2020], although young lambs and recently sheared sheep will be less able to cope with low temperatures. The ability to find a dry resting place is important for sheep welfare, as wet, muddy, or contaminated fleece significantly reduces their resistance to low temperatures [Bøe and Ehrlenbruch 2013].

During the winter, sheep are kept in barns where they should have sufficient space and freedom of movement to choose their resting spots [Fitzpatrick et al. 2006]. For animals housed indoors, stocking density, floor quality, bedding provision, and air quality are important factors affecting physical comfort. Heat stress can also be a concern indoors, as inadequate ventilation, even at relatively low ambient temperatures, can cause panting and distress, particularly in pregnant ewes with full fleeces. At stocking densities below 1 square meter per animal, movement, aggression, and activity increase [Averos et al. 2014], suggesting competition for preferred lying areas. Research has shown that sheep prefer straw bedding [Gordon and Cockram 1995]. Straw not only provides warmth and comfort to lambs but also offers opportunities for play, which helps reduce stress and adapt better to the new environment (Fig. 2). Lambs with access to straw were more active than those in the control group without straw access [Aguayo-Ulloa et al. 2014]. Aguayo-Ulloa et al. [2015] observed greater behavioral diversity and fewer negative stereotypical behaviors in

lambs with straw access. The authors suggest that straw may positively impact the mental welfare of lambs by reducing stress and improving interactions with other animals. However, other studies have shown that, given a choice, sheep prefer softer flooring materials such as mats. They tend to lie on mats for longer periods than on straw [Færevik et al. 2005, McGreevy et al. 2007, Wolf et al. 2010]. In animals kept in confined indoor spaces with overly hard flooring or inadequate bedding, calluses may develop on knees and hocks [Stubsjøen et al. 2011].

Air quality is an important aspect of welfare in indoor sheep housing, as sheep are susceptible to respiratory infections and heat stress if ventilation is insufficient [Navarro et al. 2019]. Low ventilation levels can lead to poor air quality (ammonia, carbon dioxide, and particulate matter), increasing physiological stress markers and reducing behavioral activity, including feeding behaviors, immune responses, and milk production in lactating dairy ewes [Sevi et al. 2006].

One indicator of good welfare in sheep housed in barns may be the prone lying position with legs tucked underneath (Fig. 3) [Wemelsfelder and Farish 2004].

## FEEDING OF SHEEP

Constant access to drinking water is a very important aspect of sheep welfare. However, the best feeding solution for sheep is farm-produced feed, with pastures being the most ideal. Pasture grass is the most natural feed, and unrestricted access to pastures provides the best conditions for welfare. In extensive farming systems, sheep have the opportunity to freely choose preferred types of grasses and herbs. Through sensory stimuli, they can determine their preferred diet [Favreau et al. 2010]. Additionally, sheep on pasture can freely explore their environment.

Sheep have a strongly hierarchical flock structure. Individuals higher in the hierarchy often drive away those of lower rank from feeders and water troughs. This situation can lead to disturbed welfare among the flock. Besides the type of feed, the form of feed provided to sheep is also crucial. An excessive proportion of finely ground ingredients can negatively affect the functioning of the animals' stomachs. Sheep's stomachs are adapted to digest fibrous, bulky feeds. Finely ground feed can hinder chewing and saliva production, which in turn may lead to digestive disorders, bloating, and other health issues.

## DISEASES AND WELFARE

Sheep are susceptible to numerous endemic diseases that impact their welfare, including lameness, internal and external parasites, mastitis, and reproductive disorders, particularly difficult births. They are also prone to several infectious diseases, such as coccidiosis, Maedi-Visna,



**Fig. 1.** Sheep grazing on a pasture, with trees and a shaded area visible in the distance where the animals can shelter from the sun (Photo: B. Pilarczyk)



**Fig. 2.** Sheep on straw bedding (Photo: B. Pilarczyk)

paratuberculosis, and Peste des Petits Ruminants (PPR) or pseudo-lumpy skin disease. Some of these diseases can be prevented through vaccination. Health management of sheep poses challenges in extensive environments, where infrequent inspections may reduce the likelihood of early detection and treatment of diseases [Rioja-Lang et al. 2020]. The occurrence and severity of specific diseases can be a clear indicator of suboptimal welfare.

Lameness is a behavioral indicator of changes in the hoof, ranging from mild gait abnormalities to the animal avoiding the affected limb or adopting a recumbent position. The prevalence of lameness can reach up to 9–10%, but it can be halved in sheep through the implementation of best practices in hoof care [Winter et al. 2015]. The main causes of lameness in sheep are infectious microorganisms, with nearly 90% of lameness associated with infection by *Dichelobacter nodosus*. This bacterium is

widely distributed and can be transmitted between sheep in warm and moist conditions through contamination of pastures or bedding. The infection causes pain and inflammation, and if untreated, can lead to a loss of condition, reduced lamb survival, growth rates, and milk production. Treating each case as it arises helps reduce welfare deterioration and can limit disease spread between animals. Acceptance of a certain level of lameness as “normal” by some farmers can also contribute to delays in treatment [Dwyer 2009]. If sheep have access to hard surfaces, their hooves naturally wear down. Allowing access to hard surfaces and frequent observation of the flock can improve welfare in this regard.

Gastrointestinal parasites are a concern, particularly for sheep kept outdoors on contaminated pastures. Many of these parasites cause anemia. Gastrointestinal parasites also cause discomfort, diarrhea, dehydration, and



**Fig. 3.** Prone lying position with legs tucked underneath as an indicator of good welfare (Photo: B. Pilarczyk)

loss of condition, as well as behavioral changes [Grant et al. 2020]. In young lambs, parasitic infection can be a significant cause of pre-weaning mortality. High stocking density contributes to the spread of infections, as does poor pasture management. Treatment of gastrointestinal parasites often involves deworming the entire flock. However, the rise of drug-resistant parasites has led to more targeted, alternative strategies to limit resistance development. Specifically, using alternative forage types or mixed swards, such as chicory or plantain, can provide a more natural approach to reducing parasite burdens. There is also evidence that sheep infected with parasites engage in self-medication by increasing their intake of plants containing condensed tannins, which reduce parasite loads [Villalba et al. 2017].

Ectoparasites are organisms that attack the skin, wool, or hair of animals and can cause disease (and subsequently secondary infections) as well as severe discomfort, irritation, and itching. Major ectoparasites affecting small ruminants include mites, lice, ticks, and fly larvae. Infected animals often rub against fences, pens, or other structures, bite at their fleece, and interrupt feeding, resting, or other behaviors to scratch. Over time, if left untreated, these discomfort-causing behaviors occupy more time, leading to wool loss, emaciation, skin lesions, and ultimately seizures and death [Corke and Broom 1999]. Preventing ectoparasite infection involves following hygiene procedures, providing appropriate housing, quarantining incoming animals, and regular monitoring of animal behavior and periodic examination of fleece, especially in areas most susceptible to parasite attacks.

Mastitis is a bacterial infection of the udder in lactating ewes, primarily caused by *Streptococcus* and *Staphylococcus* species, resulting in inflammation, fever, and sometimes severe pain in the infected animal. This disease is more commonly observed in dairy breeds, where it can be detected when animals are restless or at-

tempt to avoid being connected to the milking machine, but it can also affect other breeds. In a study conducted in Australia on meat breeds, 1% of ewes annually had clinical mastitis [Munoz et al. 2018], and subclinical infections can also raise welfare concerns. Clinical mastitis includes physical changes in the udder (such as swelling and fever), sick behavior (lethargy), and ewes may appear lame and unwilling to allow lambs to nurse. This can lead to slower growth rates of lambs or increased pre-weaning mortality. Mastitis can be managed by improving housing conditions and hygiene. This is particularly important in group pens to prevent the spread of infectious agents through contaminated bedding. In dairy ewes, infection can also be caused by poor hygiene of milking staff, with hand milking associated with higher cases of mastitis compared to machine milking [Marogna et al. 2010]. Mastitis is more common in high milk-producing ewes and those raising multiple offspring, so extra attention should be given to these animals. Mastitis can be effectively treated with antibiotics and anti-inflammatory drugs to reduce pain [Dwyer 2022].

#### WELFARE DURING THE PERIPARTURIENT PERIOD

Dystocia, also known as complicated labor in sheep, is a primary welfare concern during the periparturient period. Dystocia usually requires human intervention for the delivery of offspring, which can cause pain, bleeding, and exhaustion in the ewe, and increases the risk of uterine infection and damage to the birth canal. For the offspring, dystocia can lead to hypoxia and birth injuries, including cerebral hemorrhage and central nervous system damage. Difficult births are a significant factor contributing to the mortality of both ewes and their lambs [Refsauge et al. 2016, Robertson et al. 2020]. Dystocia also increases the incidence of stillbirths and the mortality of live-born lambs, as ewes may exhibit reduced maternal

care [Dwyer and Lawrence 1998], which also affects the vitality of the newborns, their search for teats, and their thermoregulation [Dwyer 2003]. Dystocia is associated with various causes, including both genetic and environmental factors. It can result from abnormal fetal positioning, disproportion between fetus and pelvis, uterine inertia, delayed or incomplete dilation of the cervix, or fetal disease or developmental abnormalities. Genetic factors (including poor selection), litter size, maternal nutrition, environmental stress, and exposure to phytoestrogens can increase the risk of difficult labor. Implementing breeding practices that promote easier births can reduce the risk of dystocia [Matheson et al. 2012], thereby improving welfare. Sheep, inheriting sensitivity during birth from their wild ancestors, have physiological mechanisms to delay labor if they feel threatened. Continuous anxiety or poor human-animal relations can cause parturient ewes to delay or prolong labor due to reduced effectiveness and frequency of uterine contractions caused by stress.

Pregnancy toxemia, occurring in late pregnancy in ewes, is primarily caused by inadequate nutrition. Poor feeding practices lead to the mobilization of fat reserves to ensure sufficient glucose for the developing fetuses. When the demand is high, the liver's capacity to produce glucose is exceeded, resulting in the production of ketones. Pregnancy toxemia is more common in ewes carrying multiple fetuses, thus it is also known as twin disease or ketosis. The presence of ketones in the blood leads to lethargy and reduced appetite, and in severe cases, neurological symptoms due to ketone toxicity. In the advanced stages of untreated disease, it can lead to recumbency, coma, and death of the animal. Some studies consider pregnancy toxemia to be one of the leading causes of sheep mortality [Politis et al. 2021].

Ewes that are underweight (with a body condition score below 2) or overweight (with a body condition score above 4) at the end of pregnancy are particularly at risk. Sudden changes in feed, stress, and health problems such as lameness or dental issues also increase the incidence of this condition. Ewes in the early stages of pregnancy toxemia can be treated orally with propylene glycol and encouraged to eat by providing highly palatable feeds, such as molasses, and by modifying management practices to allow increased feeding space or protection from adverse weather conditions. In the later stages of the disease, treatment is challenging, and euthanasia is often necessary [Dwyer 2022].

## BEHAVIORAL INTERACTIONS

Sheep are commonly kept in social groups, typically consisting of groups of ewes with or without their offspring, groups of lambs of various ages, and separate groups of breeding rams. An exception is during the breeding season when groups of breeding ewes and rams are com-

bined into one group. In such a management system, animals can freely express most normal social behaviors and interactions, and if not kept in high densities or with limited resources, aggression is rare. Mating in both species often occurs naturally through contact between ewes in heat and rams over a period of several weeks, allowing for the expression of courtship and mating behaviors. Stereotypic or abnormal behaviors are rarely observed in sheep on pasture but can occur in animals kept indoors, especially if kept individually. The most common behavior in such cases is the biting or chewing of wool pulled from another, more submissive animal. Other forms of oral stereotypies (such as licking, biting, or chewing cage components, or eating non-nutritive materials) and locomotor stereotypies (such as following the paths of other animals or handlers, and repetitive lifting or jumping) almost always occur in conditions where animals are confined alone in small pens [Dwyer 2022].

Major welfare concerns related to behavioral interactions arise from fear or anxiety, often caused by separation from the social group, interactions with humans, or interactions with other animals, such as predators.

Sheep have specific and highly motivated behavioral adaptations to cope with potential threats from predators. These adaptations are maintained regardless of whether the predator threat is present or whether the sheep are in enclosed spaces or open areas. This includes highly organized social behaviors, fear and anxiety when socially isolated or in new conditions, and escape from danger [Dwyer 2004]. Sheep also use aggression, particularly head butting and striking, with rams being more aggressive than ewes. Sheep are generally very timid and rarely use aggression as a response to new environments or events.

## LAMB WEANING

Sheep and lambs form a strong bond that develops from the very first moments after birth. Ewes care for their lambs through grooming and licking, instinctively striving to stay close to them. Sucking not only provides nourishment to the lambs but also strengthens the bond with the mother [Nowak and Boivin 2015, Dwyer 2014].

In meat or wool-producing sheep, the offspring typically stay with their mothers for a relatively long period, up to 50% or more of the natural lactation period. Dairy sheep management can vary from highly intensive systems that require separating the offspring from the mothers within one day of birth to less intensive systems where lambs may suckle from their mothers for up to six weeks before the milking period [Dwyer 2003, 2022].

The optimal solution for lambs is to be reared and fattened with their mothers throughout the entire period. This arrangement benefits both the lambs and the ewes, avoiding the significant stress and welfare deterio-

ration caused by separation when the bond is still strong. Studies show that separating lambs from their mothers at this time can lead to behavioral problems, weakened immune systems, and reduced growth rates. Conversely, lambs that remain with their mothers show lower stress levels, better production parameters, and higher disease resistance [Borys 2007, Nowak et al. 2008].

Intensive fattening systems after weaning are less favorable for animal welfare compared to rearing with mothers. However, if the weaning procedure is carried out correctly, it can significantly reduce associated stress. It is crucial not to wean lambs before they are 45 days old. At this stage, lambs are still strongly bonded with their mothers and receive emotional support from them. Early weaning can lead to stress, anxiety, and welfare deterioration. Weaning should be gradual, over a period of at least 7 days. Gradual weaning allows lambs to adapt better to the new situation and reduces stress levels. The best practice is to wean lambs in groups, as the presence of other lambs provides a sense of security and reduces fear of isolation. It is also beneficial to feed lambs with either maternal milk or replacement milk [Borys 2007].

Play is a crucial aspect of lamb welfare and can be a valuable indicator of their emotional state. Play activities include hopping, running, jumping on lying ewes, playing with straw bales, or uneven terrain on pasture. Attempts at wrestling and sparring are also observed. Male lambs tend to engage more in social play compared to females. Lambs form peer groups and may spend a lot of time playing away from their mothers [Oliveira et al. 2010]. Studies have shown that lambs that play frequently experience more positive emotions, such as joy, and fewer negative emotions, such as stress and anxiety. In stressful situations, animals become less willing to play and engage in other pleasurable behaviors. Play itself has a calming effect on animals, as endorphins are released during these activities [Dwyer 2017, Held and Špinka 2011, Anderson et al. 2015].

## HUMAN-ANIMAL INTERACTIONS

Animal welfare is closely linked to the quality of care provided by their keepers. Neglect and inadequate living conditions negatively impact both the physical and mental health of animals, leading to stress and even illness.

Small ruminants, especially sheep, perceive humans as potential predators unless they are well-treated and familiarized with their keepers from a young age. The presence of humans can trigger similar behavioral reactions (such as fleeing when approached too closely or too quickly) as when encountering a predator. In extensively managed systems in some countries, this reaction is utilized to move animals, often reinforced by the use of herding dogs. Small ruminants tolerate the presence of people (and dogs) from a distance but maintain

a so-called “flight zone,” which, if breached, will result in movement and distancing from the perceived threat [Grandin 2020]. The size of the comfort zone will vary depending on experience, breed, and context. Sudden movement into this zone, especially by unfamiliar individuals or animals, can cause panic and flight, leading to the opposite effect of what was intended and potentially resulting in injury.

In extensive grazing systems, groups of small ruminants can be moved by following a shepherd. Sheep exhibit a distinct “following” response, where they tend to follow the animal in front (the lead), which can be used to move animals in a way that causes less stress compared to driving them from behind [Dwyer 2022].

Animals that have had positive experiences with people in the past are more trusting when forming bonds with new individuals. Studies have shown that sheep can form bonds with caretakers who feed and pet them [Boivin et al. 2000, Tallet et al. 2005]. Lambs that were petted had slower heart rates and displayed positive emotional responses compared to lambs that were not petted. Behavioral and physiological observations confirmed the hypothesis that gentle physical contact with the caretaker is positively perceived by lambs [Coulon et al. 2015]. Reefmann et al. [2009] observed long intervals between heartbeats and high heart rate variability in sheep during human grooming. These physiological parameters indicate reduced stress and relaxation in sheep.

## SUMMARY

The conditions under which sheep are raised and managed have a significant impact on their welfare. Well-designed facilities, appropriate microclimate, access to pasture, proper nutrition, gentle handling, and opportunities for expressing natural behaviors all contribute to sheep welfare.

Extensive sheep farming relies on grazing animals on natural pastures. This approach largely meets the biological needs of sheep by providing them with freedom of movement, access to fresh grass and water, and interaction with other animals.

Intensive sheep farming involves keeping animals in enclosed spaces, which allows for better control over the microclimate, nutrition, and health of the sheep, potentially leading to increased productivity. However, this type of farming can also present challenges, such as insufficient space for the sheep. In such conditions, animals may become aggressive towards one another, which can result in injuries and stress.

Play is a crucial indicator of lamb welfare. Frequent play activity indicates positive emotions in the animals, while stressful situations may decrease their willingness to engage in play. Human-animal interactions are also vi-

tal for sheep welfare. Positive interactions with caretakers can build trust and lead to positive emotional responses.

Observing animal behavior is one of the most important ways to assess their welfare. Farmers should regularly monitor their animals' behavior, as it provides valuable information about their well-being and needs.

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## WPLYW WARUNKÓW CHOWU I HODOWLI NA DOBROSTAN OWIEC

### STRESZCZENIE

Warunki chowu i hodowli owiec mają ogromny wpływ na ich dobrostan owiec. Dobrze zaprojektowane budynki zapewniające odpowiedni mikroklimat, swobodny dostęp do pastwisk, właściwe żywienie, łagodne obchodzenie się ze zwierzętami i możliwość swobodnego wyrażania naturalnych zachowań to czynniki kształtujące dobrostan owiec. Zabawa stanowi istotny wskaźnik oceny dobrostanu jagniąt. Częsta aktywność zabawowa świadczy o pozytywnych emocjach zwierząt, podczas gdy stres może znacząco ograniczać ich chęć do zabawy. Pozytywne relacje między człowiekiem a zwierzęciem również odgrywają ważną rolę. Interakcje z opiekunami budują zaufanie u owiec i prowadzą do pozytywnych reakcji emocjonalnych. Obserwacja zachowań jest jednym z najważniejszych sposobów oceny dobrostanu owiec. Regularny monitoring zachowań owiec przez hodowców stanowi cenne źródło informacji na temat ich samopoczucia i potrzeb. Dzięki temu możliwe jest wykrycie ewentualnych problemów i podjęcie odpowiednich działań profilaktycznych.

**Słowa kluczowe:** Owce, dobrostan, środowisko, interakcje człowiek-zwierzę

