

Welfare of dairy cows and impact on production

Animal welfare and productivity are closely linked in dairy cow farming. A healthy and comfortable animal not only lives longer but also produces more, delivering higher-quality milk. In this article, we will explore over 2,000 words on the topic of dairy cow welfare and its impact on milk production, with an informative and authoritative approach aimed at farmers, livestock technicians, and veterinarians. We will examine practices, technologies, environmental and management factors that influence welfare and productivity, referring to up-to-date data, European regulations, and good farming practices. The goal is to provide a comprehensive and SEO-oriented overview for those seeking information on animal welfare and milk production, ensuring clear, consistent content with high added value.

Importance of welfare in dairy cows

The welfare of dairy cows is a dynamic condition involving the physical and psychological state of the animal. Practically speaking, ensuring high welfare standards means providing cows with optimal living conditions: adequate nutrition, comfortable environments, timely veterinary care, and the opportunity to express natural behaviors. This is not only an ethical imperative but also a key factor for the sustainability of farming. Indeed, a cow that “feels well” tends to live longer and be more productive throughout its productive life. In other words, investing in animal welfare benefits both the animals and the farmer, creating a virtuous circle where the animal’s health and well-being translate into better productive performance.

The European Union and the scientific community define animal welfare through criteria such as the “Five Freedoms” (freedom from hunger and thirst, discomfort, pain or disease, fear or distress, and the freedom to express natural behaviors). In the context of dairy cows, this translates into practices such as providing sufficient space to move and rest, ensuring comfortable and hygienic bedding, guaranteeing a balanced diet, and preventing stressful conditions. The result of these efforts is not only a better life for the animal but also more sustainable and higher-quality milk production, meeting the expectations of modern consumers who are increasingly attentive to animal welfare and the quality of derived products.

Relationship between welfare and milk production

It is widely proven that improving the welfare of dairy cows has a direct impact on both the quantity and quality of milk produced. Conditions of chronic stress, pain, or poor management lead to reduced

productivity: a stressed cow will eat less, fall ill more easily, and produce less milk. Conversely, a cow raised in optimal conditions will fully express its genetic potential. In practice, the rule is simple: the better the animal's welfare, the higher its production and the greater the profit for the farmer.

Scientific studies provide concrete data on this relationship. For example, it has been observed that each additional hour of rest for a cow corresponds on average to about 1.7 kg more milk per day. This means that providing cows with comfortable environments where they can lie down and rest for extended periods increases daily milk production. On the other hand, overcrowding has negative effects: in farms with excessive density (more cows than available cubicles or space), milk yield decreases. A study conducted on 47 farms estimated a loss of about 0.5 kg of milk per day for every 10% increase in density beyond the optimal capacity. Essentially, if cows have insufficient space and must compete for lying spots or access to feed, their production suffers significantly.

Milk quality is also influenced by welfare. Healthy, unstressed cows tend to produce milk with lower somatic cell counts and better composition, as they are less prone to mastitis and other health issues. In a comparative study cited by the journal *Ruminantia*, farms with higher welfare indices showed more favorable milk quality parameters (such as fat/protein content and bacterial load) compared to farms with lower welfare standards.

Therefore, improving animal welfare means not only more milk but also better milk, a key factor both for the dairy industry and to meet the hygiene and safety requirements imposed by regulations.

Finally, it is worth emphasizing that investing in welfare brings long-term economic benefits. Cows living in optimal conditions have longer productive careers (being able to complete more lactations during their lifespan), reducing replacement costs (purchase or rearing of new heifers) and improving farm efficiency. Additionally, good animal welfare conditions often coincide with a lower incidence of diseases, resulting in reduced veterinary expenses and fewer production losses due to unproductive animals. All this contributes to the economic sustainability of the livestock business.

Environmental and structural factors affecting welfare

Various factors related to the barn environment and housing structures can either promote or compromise the welfare of dairy cows. Below, we analyze the main elements to consider.

Space, housing, and freedom of movement

The space available to each animal is fundamental. Dairy cows are large, highly social animals that need to move freely and interact with their herd mates. In the barn, this translates into adequate housing where each cow has space to eat, drink, rest, and move without excessive competition. Overcrowding beyond the facility's capacity causes stress and abnormal or aggressive behaviors.

It is therefore essential to size the herd according to the available space, ensuring the number of resting places (cubicles) is at least equal to the number of cows, along with sufficient feeding alley space. Recent regulations and guidelines provide precise recommendations. The European Food Safety Authority (EFSA), in its 2023 scientific opinion on dairy cow welfare, recommends providing each cow with at least 9 m² of total indoor space (including resting areas).

Moreover, EFSA advises avoiding systems that excessively restrict movement: for example, tie-stall housing (where cows are permanently tied) should not house animals for prolonged periods, as permanent tethering severely limits welfare. The ideal solution is loose housing that allows cows to move, stand up, and lie down freely.

Access to pasture is also highly recommended: allowing cows to go outdoors and graze, at least part of the year, enables natural behaviors and improves muscle tone and hoof health. Notably, EFSA identifies risk factors for poor welfare including less than two months per year of pasture access, less than 7 m² indoor space per cow, or more than one cow per resting place. These conditions should raise alarms and prompt farmers to review space management.

Practically, ensuring sufficient space means following technical recommendations for barn size and management areas: at least 10–12 m² per cow in loose housing is often cited by experts, and some studies indicate productivity per cow increases up to about 14 m² per animal, after which it stabilizes. Likewise, every cow should have easy access to the feeding trough (discussed in the feeding section) and waterers without excessive competition.

Proper group structuring—for example, separating first-lactation cows from multiparous ones, or grouping animals in early versus late lactation—can reduce competition and social stress, thereby improving overall welfare.

Comfort of resting areas and bedding

Dairy cows spend many hours a day lying down and ruminating; rest is an essential activity for both their welfare and milk production. For this reason, cubicles (the stalls or beds where the animals lie down) must be designed and maintained to maximize comfort.

A comfortable cubicle is spacious and long enough to allow the cow to lie down and stand up without bumps or difficulties. It has a soft, clean surface to lie on—such as rubber mats, water beds, or bedding made of straw or sand—and is kept dry and free of sharp edges or objects. Unsuitable elements in the resting area—for example, abrasive floors, protrusions, or hard surfaces—can cause injuries, hock calluses, and reduce resting time, with negative consequences.

Forward-thinking farmers invest in quality mattresses or bedding because they know a comfortably resting cow will produce more milk: as mentioned earlier, more hours of rest mean higher daily production.

An often underestimated aspect is the cleanliness and hygiene of the cubicles. Dirty or wet bedding is not only uncomfortable but also increases the risk of udder infections (mastitis) and other diseases. It is good practice to regularly add clean material (chopped straw, sawdust, sand, depending on the system) and remove manure at least once a day. This helps keep bacterial load in contact with the udder low, preventing health problems. At the same time, a clean resting environment encourages cows to lie down willingly whenever they feel the need, without hesitation.

Alongside this, the flooring of movement areas must be well cared for: alleys where cows walk should be non-slip and not too hard to prevent falls and reduce the incidence of injuries or hoof problems. The use of rubber coverings in passageways and waiting areas (e.g., milking parlors) helps prevent hoof wear and lameness.

Lameness (leg and foot problems) is one of the main causes of poor welfare in dairy cows, often due to a combination of factors: uneven or slippery floors, poor hygiene (which favors digital dermatitis), lack of regular hoof trimming, and unbalanced diets can cause laminitis. A lame cow experiences pain, moves and feeds less, consequently producing less milk and suffering fertility declines. Moreover, untreated lameness often leads to premature culling, causing significant economic loss for the farmer.

Therefore, ensuring appropriate walking surfaces and implementing preventive measures (such as regular hoof baths and scheduled trimming) are integral parts of improving both welfare and productivity.

Ventilation, temperature, and climate control

The barn's microclimate has a huge impact on the welfare of dairy cows. In particular, heat stress is one of the main challenges during the summer months in our latitudes. Dairy cows, especially high producers, are very sensitive to high temperatures and excessive humidity: when the ambient temperature exceeds the animal's thermal comfort zone (around 20–22 °C, also considering relative humidity which determines the THI index), cows begin to suffer from heat.

A cow exposed to excessive heat reduces feed intake, increases respiratory rate (panting), and may experience metabolic alterations—all factors leading to a significant drop in milk production. In severe cases, heat stress can predispose animals to conditions such as collapse or ruminal acidosis caused by decreased feed intake.

To prevent this, barns must be well ventilated. Forced ventilation systems with ceiling or wall fans, and if necessary, cooling systems (e.g., water misting or sprinklers above feeding alleys) help maintain the perceived temperature within an acceptable range during summer. A good practice example is installing large axial or ceiling fans that create a constant airflow in animal resting areas, combined with systems that lightly wet the cows (for example, before or after milking), using evaporation to remove heat from the body.

Shade is also important: in open barns, shade curtains or well-insulated roofs reduce direct solar radiation on the cows.

In winter, dairy cows tolerate cold relatively well if they are dry and well fed, but it is important to avoid direct drafts when they are wet and prevent excessively harsh temperatures, especially for calves. The goal is to maintain a well-aerated environment without drafts: ammonia from manure and excess humidity must be removed by airflow to prevent respiratory problems, but without creating cold zones.

Many modern barns are equipped with adjustable side openings (roll-up curtains, sliding panels) that allow natural ventilation to be modulated according to climatic conditions, always ensuring fresh air while avoiding thermal stress.

A clean-air, climate-controlled environment keeps cows healthier and more productive, and is part of the welfare improvement measures recognized by regulations.

Lighting and photoperiod

A less intuitive but well-documented factor is the effect of light on the welfare and production of dairy cows. Managing barn lighting (photoperiod) can influence cows' hormonal cycles, particularly melatonin secretion, regulating their biological rhythms.

Several studies have shown that maintaining a "long day" photoperiod for lactating cows—about 16–18 hours of light per day at adequate intensity, followed by 6–8 hours of darkness—stimulates increased feeding activity and hormonal response, benefiting milk production and fertility. Practically, extending light hours (for example, with programmed artificial lighting in barns) encourages cows to eat more and can boost milk yield by 6–10%, also improving reproductive indices.

Artificial lighting in the barn must be properly managed: the recommended light intensity is around 150 lux in feeding areas and about 80–100 lux in resting areas. It is also essential to ensure a sufficient dark period (a "short day" photoperiod during the dry period, with only about 8 hours of light), as dry cows benefit from a hormonal rest period that prepares their body for a more productive subsequent lactation.

Many advanced farms have installed programmable LED lighting systems capable of delivering the right light intensity and color at different times of the day, often differentiating lighting between feeding alleys (kept illuminated longer) and resting zones (where darkness is respected).

This approach is part of so-called precision livestock farming and is another example of how technology can improve welfare and performance: proper lighting keeps cows more active during desired hours, stimulating regular feeding, while also allowing adequate rest during nighttime.

Health management: disease prevention and welfare

Health is a cornerstone of animal welfare: a sick or painful cow cannot be considered truly well. Moreover, diseases and health disorders have a direct impact on productivity (reduced milk yield, discarded milk, veterinary costs, fertility decline). Therefore, animal welfare and health management go hand in hand. An effective prevention program and timely treatment are indispensable.

Among the most significant health issues for dairy cows are mastitis, lameness, and metabolic disorders (such as ketosis, ruminal acidosis, and milk fever). These conditions not only cause animal suffering but drastically reduce milk production and quality, often leading to significant economic losses.

Mastitis: This is an inflammation of the mammary gland, often caused by infection, and is considered the most economically burdensome disease in dairy farming. A cow with mastitis produces less milk of poorer quality (high somatic cell count, presence of bacteria, and sometimes visible milk alterations). Preventing mastitis involves maintaining a clean and comfortable environment. As mentioned earlier, dry and well-maintained bedding reduces mammary exposure to environmental pathogens. Good milking practices (cleaning teats before and after milking, using disinfectants post-milking, maintaining milking equipment to avoid teat injuries) are fundamental. Continuous monitoring of milk quality (somatic cell count) helps detect subclinical cases early and intervene before conditions worsen. Special attention is needed during the dry period and around calving: selective dry cow therapy and the use of internal teat sealants are modern strategies to prevent new infections during this critical phase.

Lameness (hoof problems): As discussed, foot diseases (digital dermatitis, laminitis, abscesses, etc.) cause severe pain, leading cows to reduce activity and feed intake. A lame cow often lies down longer than usual to avoid limb pain or, conversely, struggles to find a comfortable resting position if pain is acute. In both cases, feed intake decreases along with milk production. Preventing lameness includes regular floor maintenance (avoiding sharp cracks or manure buildup that soften and infect hooves), functional hoof trimming 1–2 times a year by specialized professionals, use of disinfectant footbaths to control skin infections, and balanced diets in fiber and energy to prevent subclinical laminitis. Chronic lameness reduces longevity: many animals with severe hoof problems are culled early, causing welfare and economic losses.

Metabolic disorders: High-producing cows are exposed to metabolic risks, especially around calving and early lactation. Ketosis (energy deficit with ketone body accumulation), excessive fat mobilization, milk fever (hypocalcemia), displaced abomasum, and subclinical ruminal acidosis all negatively affect welfare and performance. Particular attention to nutrition during the transition phase is crucial: providing diets tailored for the dry period that avoid excess energy and calcium, and ensuring adequate physically effective fiber and antioxidants, can prevent many of these diseases.

Metabolically balanced animals are more active, eat well, and have stronger immune defenses, reducing the incidence of postpartum diseases (such as metritis and secondary mastitis).

A welfare-conscious farmer implements rigorous veterinary and biosecurity protocols: vaccinations (against major reproductive or respiratory diseases), periodic pregnancy and health checks, and isolation/treatment of sick animals. Monitoring the herd is easier today thanks to technology: wearable sensors tracking activity, rumination, and temperature can early detect decreased activity, signaling possible health or welfare issues. Precision livestock farming tools—such as smart collars or pedometers—allow early identification of lameness or missed heats, improving both welfare (timely intervention) and productivity (better reproductive management).

In summary, health and welfare are inseparable. Studies confirm that farms with healthier cows achieve superior technical performance: for example, research on Austrian farms showed that improving welfare standards (through better housing and health management) also increased technical and economic efficiency. Investing in disease prevention means having more productive, fertile, and long-lived animals. It is an investment that pays off ethically and economically.

Feeding and welfare of dairy cows

Feeding plays a crucial role in ensuring welfare and maximizing milk production. An adequate diet allows cows to maintain health, perform at their best, and prevent many metabolic diseases. Conversely, nutritional errors can cause discomfort, weaken immune defenses, and predispose cows to illnesses such as acidosis, displaced abomasum, ketosis, or hypocalcemia. Let's explore the key principles of feeding management focused on welfare.

Balanced diet tailored to needs: Dairy cows, especially high producers, have high nutritional requirements. It is essential to provide a balanced total mixed ration (TMR) or traditional ration containing the right proportion of fibrous forages and energy/protein concentrates. Physically effective fiber (long forage particles) stimulates rumination and saliva production, which buffers rumen acidity. This prevents subclinical ruminal acidosis, a disorder causing abdominal pain and reduced intake. On the other hand, starch should not be excessive: it is recommended to keep starch below about 27-30% of the dry matter, balancing starch and fiber to avoid dangerous ruminal acidification. Similarly, prepartum diets should limit excess dietary calcium to prevent milk fever and ensure proper vitamin-mineral supplementation to support immune function and metabolism.

Phase-specific feeding: Different categories require specific diets: calves, growing heifers, dry cows, fresh cows (early lactation), and cows in peak lactation have different needs. For example, dry cows benefit from low-energy, high-fiber diets to keep them fit without gaining excess weight and to prepare the rumen for lactation diets. Fresh cows need high-energy density diets but also long fiber to stimulate rumen motility and prevent displacements. Dividing the herd into homogeneous feeding groups helps greatly: feeding animals by production group (e.g., high production, medium production,

late lactation) allows ration adjustments for the most productive cows without wasting nutrients on lower producers. This avoids top cows going into deficit or lower producers becoming overweight.

Feeding space and water access: To ensure welfare during feeding, each cow must have sufficient space at the trough. The recommendation is at least 60-70 cm of feeding space per large breed cow (e.g., Holstein), and about 50 cm for heifers and smaller breeds. This prevents competition and aggression during meals, especially protecting subordinate cows. Ideally, each animal should find a spot at the feed bunk simultaneously with others (total feed space at least equal to the number of cows); if not feasible, feeding more frequently or continuously (e.g., with automatic feed pushers) ensures all cows can feed adequately. Water is the most important nutrient: a lactating cow can drink 100 liters or more daily. Therefore, sufficient waterers (at least 1 per 10-15 animals, placed at multiple points) that are regularly cleaned must always be available. Water should be fresh and clean: animals drinking freely maintain better thermal balance and produce more milk, while preventing heat stress.

Feeding frequency: Offering feed multiple times a day benefits welfare and production. In nature, cows graze many hours; in barns, the farmer must provide fractionated feeding. Providing fresh feed or mixing TMR 2-3 times daily stimulates intake and reduces long fasting periods that may cause ruminal acidity. Studies show that multiple daily feedings increase intake and milk yield compared to a single meal. Also, the herd is calmer: when feed is always available and palatable, cows do not crowd excessively at the trough, and dominant animals more easily allow subordinate ones to feed, reducing stress. Advanced systems use feed pushers or automatic distributors releasing feed multiple times daily (up to 6-8 times); alternatively, farmers frequently push feed forward and add small concentrate portions throughout the day.

Feed quality: Welfare is also influenced by the quality of what cows eat. Moldy forages, spoiled feed, or mycotoxin contamination can cause intoxications, weaken immunity, and reduce appetite. Proper forage storage (well-compacted and sealed silos, dry hay storage) and hygiene checks are essential. Clean and safe feeding supports a stronger immune system: deficient or unbalanced diets depress immunity, making animals more susceptible to infections like mastitis and foot diseases. Conversely, optimal feeding puts animals in the best condition to face stress and pathogens.

In summary, correct feeding is an indispensable pillar of dairy cow welfare. A traditional livestock saying goes, “the cow produces what she eats,” and we can add that she produces at her maximum only if she eats well and peacefully. Efforts to optimize feeding—from balanced formulations to ideal distribution, dedicated space, and water—are rewarded with healthy, productive, and long-lived animals. As highlighted in a specialist article, the rule still stands: the better the animal feels, the more she produces, and the higher the profit. It should also be remembered that a cow going through multiple healthy lactations dilutes her environmental impact per liter of milk produced (thanks to a longer productive life and fewer early culls). Therefore, feeding welfare also means sustainability.

European regulations and standards on animal welfare

The issue of animal welfare in livestock production, particularly in dairy cow farming, is a key focus at the regulatory level as well. In Europe, there are specific laws and regulations—some currently under revision—aimed at ensuring minimum welfare standards on farms.

The EU's foundational legislation is Directive 98/58/EC, transposed in Italy through Legislative Decree 146/2001, which sets general principles for the protection of all farmed animals. This directive establishes requirements regarding space, adequate feeding, regular animal inspections, care of injured or sick animals, and other general measures.

For certain specific categories (such as calves, pigs, and laying hens), dedicated directives with more detailed standards exist, but for dairy cows there is currently no sector-specific directive, except for rules on transport (Regulation EC 1/2005) and welfare at slaughter (Regulation EC 1099/2009).

However, growing public awareness and farmer interest in animal welfare have led to voluntary initiatives and quality programs. For example, in Italy, the Ministry of Health has promoted the ClassyFarm system, a protocol for assessing welfare and biosecurity in cattle farms (and other species), which uses checklists based on the European Welfare Quality® protocol to assign welfare scores and provide improvement guidelines.

At the national level, the SQNBA (National Quality System for Animal Welfare) is under development—a voluntary certification that will allow animal-origin products (such as milk) to be labeled according to the welfare level under which they were produced, offering consumers additional guarantees and potentially economic value for farmers.

At the European level, a revision process of farm welfare rules is underway. The EU Commission, supported by EFSA's scientific opinions, is evaluating new regulations to be implemented in the coming years. As noted earlier, EFSA's 2023 recommendations for dairy cows include: banning permanent tie-stall housing (cows always tied), requiring at least 9 m² per animal in loose housing, pasture access, and stricter criteria on cubicle dimensions and other structural aspects.

These recommendations will likely be incorporated into future EU regulations, raising the minimum welfare standards required throughout the Union. Already today, some Northern European countries have more advanced national regulations: for example, in Sweden and in certain Swiss cantons (outside the EU), summer grazing for dairy cows is mandatory, and tie-stall housing is banned or strongly restricted. Although such rules are not yet uniform everywhere, they indicate the direction in which policies are moving.

Another regulatory tool encouraging welfare is the Common Agricultural Policy (CAP). In the 2014–2020 Rural Development Plans, and now in the new CAP Strategic Plans 2023–2027, there are specific agro-livestock measures and payments for animal welfare. For example, Measure 14 – Animal Welfare funded, in many Italian regions, farmers who voluntarily adopted standards above legal requirements (such as increasing space per animal, avoiding tail or horn docking unless necessary, improving feeding, etc.). These financial incentives recognize that improving welfare involves costs and investments but aim to compensate because of their social benefits.

In the new CAP period, many countries have introduced Eco-schemes or similar interventions to promote animal welfare. This means that farms attentive to welfare can receive additional support, thereby integrating their income.

Finally, it should be noted that market demand also drives attention to animal welfare. Major milk purchasers (dairies, cooperatives, dairy industry) are increasingly sensitive to the topic and sometimes require high welfare standards for milk procurement, also anticipating possible “ethical” quality labeling. According to Eurobarometer surveys, the vast majority of European consumers consider animal welfare on farms very important and would support stricter regulations. This translates into initiatives such as “Animal Welfare Friendly” labels or requests from large retail chains for products obtained under certain welfare standards.

For farmers, aligning with these trends is not only about legal compliance but also about better positioning their production in future markets.

Conclusions

In conclusion, animal welfare and the productivity of dairy cows are not opposing concepts but two sides of the same coin. A farm that invests in welfare—providing adequate space, comfort, health care, optimal nutrition, and attention to the animals’ behavioral needs—will be rewarded with healthier, longer-living cows capable of producing more high-quality milk. Conversely, neglecting welfare inevitably leads to production declines, higher disease incidence, increased veterinary costs, and excessive herd turnover, all factors that reduce profitability in the medium to long term.

We have seen how every management aspect matters: from facilities (well-designed, ventilated, illuminated, and clean barns) to daily practices (milking, feeding, climate and group management), up to new technologies that help monitor individual animals. European regulations are pushing for increasingly higher standards, aligned with scientific evidence and social awareness. Modern farmers must stay informed and adapt their farms to best practices in animal welfare—not only to comply with laws but also to improve their performance.

From an SEO perspective, terms like animal welfare, dairy cows, milk production, and milk quality recur consistently throughout this article because they represent the key concepts around which the

topic revolves. Beyond SEO, these keywords are the pillars of sustainable and successful livestock farming: welfare, quality, and productivity.

In an era when agriculture faces scrutiny for its environmental and ethical impacts, improving dairy cow welfare is a winning strategy that meets consumer expectations, respects animals, and helps farmers achieve better results. Ultimately, caring for the welfare of one's cows is not only a moral duty but an investment that leads to higher, better-quality, and more sustainable production.

As the saying goes, "the better the animal feels, the more it produces"—this motto should guide every management decision in the barn. By implementing the right practices and staying updated on innovations and regulations, farmers can ensure a prosperous future for their businesses while guaranteeing a dignified life for their cows, in harmony with the principles of animal welfare. Positive outcomes in milk yield, dairy quality, reduced health issues, and cow longevity will confirm that welfare is the master key to efficient and resilient farming.

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