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THE IMPACT OF WEATHER CHANGE ON CATTLE MILK PRODUCTION AND MILK SALES LOGISTICS

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Abstract: *Within the food industry, the biggest challenge for the dairy sector is that dairy cattle are highly sensitive to extreme weather conditions caused by climate change, as the physiological processes of cattle are closely linked to ambient temperature, humidity and feed quality. These changes affect the yield of forage crops, the thermal comfort of the animals, and the quality and transportability of milk. The impacts of climate change on milk production and milk logistics require long-term systemic adaptation. Overall, it can be stated that it affects the milk chain in a complex way, from production to consumption: it reduces production efficiency, increases energy demand, and poses new challenges to cooling and transport infrastructure.*

• Introduction

The work seeks to answer the question of to what extent weather changes affect the production of dairy cows, and through this the quantity and quality of milk, as well as the costs and logistical activities of farmers and dairy processors.

• Material and method

This article highlights the weather factors affecting milk production and the resulting problems in milk sales by producers and the logistical problems of milk purchasing by dairy processors. The work serves as a literature basis for a thesis.

• Results and discussion

The biggest challenge for the dairy sector within the food industry is that dairy cattle are very sensitive to extreme weather conditions caused by climate change, as the physiological processes of cattle are closely linked to ambient temperature, humidity and feed quality. These changes affect the yield of milk, the thermal comfort of animals, and the quality and transportability of milk. Poorer quality feed leads to quality deterioration, and like heat stress, it also reduces the quality of raw milk, such as its fat and protein content. When temperatures exceed 25–27°C, cows' body temperature increases, feed intake decreases, and milk yield can drop by up to 10–25%. The same effect occurs when the temperature-humidity index (THI) exceeds the comfort threshold. Even the constantly developing technological innovations cannot offset the harmful consequences of heat. Climate change has a negative impact on reproductive performance and milk production, and the expected effects of climate change on cattle include an increased susceptibility to microbial infections associated with heat stress. Bacterial contamination is a critical determinant of milk quality and safety, with higher bacterial counts in summer and lower counts in winter, suggesting that climate change has a direct impact on milk contamination.

It should be noted that while modelling studies predicting a decline in milk production due to heat stress caused by climate change are well established, models for predicting milk contamination due to climate change are still limited. Evidence-based strategies to support food system transformation are essential. A quantitative approach based on facts can help to understand the impacts of climate change on food hygiene and safety.

• Results and discussions

Climate change has a direct impact on transport infrastructure. During periods of drought, dust and pollutant loads on the road network increase, while extreme rainfall damages the road surface, increasing the risk of slipping and the uncertainty of transport times. The predominance of road transport makes the dairy industry particularly vulnerable: in the European Union, the vast majority of raw milk is collected and transported to processing plants by road tankers, which is closely linked to the state of the transport network. Digitalisation and the use of IoT (Internet of Things) devices can help monitor the supply chain. Smart temperature sensors and GPS-based tracking systems provide real-time data on the cooling status and the status of transport. These devices not only improve food safety, but also optimise routes and reduce unnecessary energy consumption. Artificial intelligence and data-driven management can predict routes, optimize delivery times, and reduce energy consumption of refrigeration equipment. Modernizing refrigeration systems, using natural refrigerants, introducing CO₂-based systems, and using better insulation are also important steps. New technologies are not only more environmentally friendly, but also reduce operating costs and maintenance requirements.

Climate-adaptive infrastructure development – such as road network maintenance, flood protection systems and emergency energy reserves – is also part of dairy logistics adaptation. Several adaptation strategies have been developed to ensure the sustainability of the dairy logistics system. The most important goals include reducing cooling energy demand, increasing transport efficiency and mitigating greenhouse gas emissions. One of the most important development directions is the integration of renewable energy sources into the logistics chain, which can reduce fossil energy dependence.

The effects of climate change on milk production and dairy logistics require long-term systemic adaptation. Overall, it can be stated that it affects the dairy chain in a complex way, from production to consumption.

In the future, the key to the sustainability of the dairy sector will be technological innovation. Protection against heat stress, improving animal welfare and the use of low-emission cooling technologies will not only increase the stability of production, but also contribute to reducing the environmental footprint. Climate-adaptive infrastructure development, intelligent route optimization and the establishment of decentralized milk processing capacities can mitigate logistics risks. Support for sustainable milk supply chains should be given a prominent role in agricultural policies, as mitigating the effects of climate change is no longer just an environmental issue, but also an economic and food security issue.