

# Precision Livestock Farming: Essential for Sustainability in Climate Change

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## Abstract

With rising environmental temperatures, livestock production efficiency is drastically affected, affecting animal growth, production (milk, meat, etc.) and reproductive capacity. The interaction between genotype and environment cannot be ignored. The effect is more pronounced in non-adapted livestock species. Temperature fluctuations have led to changes in species composition and breed due to variations in feed resource availability. When resources are inadequate and infrastructure is lacking, animals become more prone to the effects of extreme climate. Stress in animals is causing a loss in production, leading to malnutrition in the human population. To achieve sustainable development goals, innovative technical interventions are being applied to animal resource management.

**Keywords:** *precision livestock technologies, climate change, stress*

## Introduction

Climate change refers to significant variations in average weather, leading to warmer, drier, and wetter conditions in the long run. This has both direct and indirect effects on livestock health, reproduction and production. Ambient temperature rise has decreased water availability, feed conversion efficiency, feed intake, meat and milk production, maturity age, semen quality, and reproductive efficiency, and has increased mortality. An increase in relative humidity is the main factor driving increases in pathogen populations, parasitic infestations, disease spread and transmission, and the faster spread of vector-borne diseases, affecting forage quality and growth, as well as biodiversity. With increasing carbon dioxide levels, forage quality, production, and composition are highly affected.

Precision livestock farming is one of the technological interventions in resource management. Tools and data analytics related to animals are used to improve animal health, productivity, and welfare, while reducing environmental pollution. Available resources are efficiently utilised. This technology enables automated, continuous, real-time monitoring of livestock, which is essential for future reference. Data is collected and analysed using sensors, cameras, and acoustic devices, combined with artificial intelligence technology. This helps farmers gain an overall perspective of their animals to inform future decision-making. Records are available regarding animal behaviour, animal health and environmental conditions at the farm. Animal gait and posture are studied using a camera, pressure mats, and an accelerometer. Body condition score and live weight are assessed using a camera, a 3-dimensional view and a weighing system. Smart collars and wearable sensors enable one to track behaviour, vital signs and patterns of movement to assess early detection of

disease or deformity while activity and location using a pedometer and an accelerometer. All the sensors are being interconnected using the Internet of Things.

The automated feeding system with smart feeders plays a major role in ensuring optimal nutrition while reducing waste and increasing farmers' gains. Automated systems make animals more comfortable, reducing a stressful environment by controlling the climate of the barn. Such technologies help in enhancing productivity, animal welfare and sustainability. At the same time, nutrient runoff can be prevented or minimised through increased resource efficiency. Near Infra-red technologies (NIR-4-Farm) integration aids in feed mixes tailoring and minimising wastes. As feed quality and rumination process are interrelated, by monitoring rumination 24/7 using sensors, productivity can be assessed, and accordingly, feed can be adapted. The development and promotion of species and breeds more tolerant of stressors (drought, heat, and disease) related to climate change are a need of the hour. New feed resources like algae and insect-based protein have come into demand to fulfil nutritional requirements. Precision farming techniques help optimise resource use, reduce the carbon footprint, and minimise environmental impact. Incorporation of renewable energy sources like wind and solar would reduce dependency on fossil fuels. Methane capture and reduction operations in livestock contribute to lowering greenhouse gas emissions.

About a 69% reduction in carbon dioxide has been reported by the use of the AfiMilk MCS milk parlour system. In an automated milking system, mastitis can be easily detected in the early stage of lactation, enabling one to take timely action, preventing later side effects. Maximising fertility rate in cattle reduces GHG emissions by more than 20% per herd. Fertility management and Heat detection using PLF technologies play a pivotal role in the improvement of reproductive efficiencies. Data is captured, linked to animal health status, like lameness detection by floor pressure plate systems, 3D gait analysis or accelerometers. Another important technology is the smart bolus, used for fertility and disease detection. Drones also help monitor animals and, when equipped with a sensor, can easily detect methane leaks in gas pipelines. The effect on the environment was studied through a trial conducted in Brazil on pigs during the growing-finishing phase, in which the animals were shifted from conventional to precision feeding. In the first treatment, used as the control, conventional feeding was performed. In the second treatment, precision daily feeding in a group was followed, while in the third treatment, precision daily feeding by individual was done. Results indicated a mitigated environmental effect in the precision feeding group (treatments 2 and 3). This was reduced about 4% by eutrophication and 3% by acidification compared to the control in treatment 2, while the values were 6% and 5% respectively, in treatment 3. At two Scottish dairy farms, the potential effects of PLF tools were evaluated using the Grecale Carbon Footprinting tool. The main parameters studied were fertility and production. Reduced emissions were observed with the use of sensors for fertility improvement and management intervention in high- and low-input systems.

### **Challenges in the Adoption of Precision Livestock Farming Technologies:**

Mostly, knowledge of these technologies at the farm level by users is lacking. Skill development for tool application is required with competency. Initially, the high financial requirements also hinder technology adoption.

## Conclusion

The use of Precision livestock farming tools helps improve animal health, reduce antibiotic use, and boost productivity in a changing climate. There is a need to mitigate the impact of heat stress on animals and increase resilience.

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