PRECISION POULTRY FARMING IN CAGE-FREE LAYING HEN SYSTEMS: A REVIEW OF COMPUTER VISION, ARTIFICIAL INTELLIGENCE AND SENSOR TECHNOLOGIES FOR WELFARE AND PRODUCTION MONITORING

A. Hamzău, A. A. Ionete*, S.-T. Vlad, M. Tudorache, I. Custura

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania
**e-mail: andreeaionete@yahoo.com*

Abstract

The global transition toward cage-free egg production has increased opportunities for laying hens to express natural behaviors, while simultaneously creating new challenges for monitoring large flocks in complex housing environments. Precision Poultry Farming offers technological solutions for continuous and automated assessment of bird behavior, welfare, health and production. This review examines recent applications of computer vision, artificial intelligence and sensor-based technologies in cage-free laying hen systems. Particular attention is given to deep-learning models for bird detection and tracking, recognition of perching, dustbathing, feeding, nesting and feather-pecking behaviors, spatial distribution and activity monitoring, as well as RFID, accelerometers, acoustic sensors and thermal imaging. Current research demonstrates high potential for automated detection of welfare and management indicators under experimental conditions. However, occlusion, variable lighting, flock density, equipment interference, sensor attachment, data requirements and limited validation under commercial conditions remain important constraints. Integrating multiple sensing technologies with artificial intelligence could enable earlier detection of welfare problems and support more precise, individual and flock level management in future cage-free egg production.

Key words: *precision poultry farming; laying hens; cage-free systems; computer vision; welfare monitoring*