https://doi.org/10.17221/40/2026-CJAS

Decision Support Systems in dairy cows farming: A 20-year scoping review of characteristics, applications, and future challenges

Jan Saro[1]*, *Jaromír Ducháček*[2], *Luděk Stádník*[2], *Helena Brožová*[1]

[1]*Department of Systems Engineering, Faculty of Economics and Management, Czech University of Life Sciences, Prague, Czech Republic*
[2]*Department of Animal Husbandry, Faculty of Agrobiology, Food, and Natural Resources, Czech University of Life Sciences Prague, Czech Republic*

**Corresponding author: saroj@pef.czu.cz*

The authors are fully responsible for both the content and the formal aspects of the electronic supplementary material. No editorial adjustments were made.

Electronic Supplementary Material (ESM)

Table S1. Summary of included studies and DSS classification

Table S1. Summary of included studies and DSS classification

Order	DSS type	Problem solved	Dairy cow sector	Model used	Author	Purpose	Input data
1	Data-driven, Model-driven	Early mastitis detection	Animal Health, Welfare	Support Vector Machine (SVM)	(Khan et al. 2024)	IoT mastitis prediction system	IoT sensor data (milk parameters, activity, temperature)
2	Data-driven	Proactive herd health improvement	Animal Health, Welfare	Disease scoring system	(Saro et al. 2024a)	Disease scoring DSS	Disease scores, farmer observations
3	Data-driven, Model-driven	Milk production forecasting	Milk Production, Quality, Farm Business, Management	Deep learning algorithms	(Alwadi et al. 2024)	Milk yield prediction DSS	Historical milk production, animal characteristics, environmental data
4	Knowledge-based, Model-driven	Optimal diagnostic strategy selection	Animal Health, Welfare	Multi-Criteria Decision Analysis (MCDA)	(Um et al. 2024)	Infectious disease diagnostic tool	Diagnostic test results, disease prevalence, cost data
5	Knowledge-based, Model-driven	Mastitis test selection	Animal Health, Welfare	AHP, TOPSIS	(Akkose and Polat 2023)	Mastitis test selection DSS	Test characteristics, farm data, expert knowledge
6	Model-driven	Late-lactation milk forecasting	Milk Production, Quality, Reproduction, Genetics	Dijkstra, Wood, Wilmink	(Innes et al. 2024)	Lactation curve forecasting DSS	Historical milk yield data, lactation stage
7	Data-driven, Model-driven	Herd health management optimisation	Animal Health, Welfare, Farm Business, Management	LSTM, linear trend model	(Saro et al. 2024b)	Web-based herd health DSS	Farm records, animal health data, milk yield
8	Communication-driven, Data-driven	Ketosis risk prediction	Animal Health, Welfare	Extreme Gradient Boosting (XGBoost)	(Wang et al. 2023)	Ketosis risk prediction app	Prenatal indicators, cow health records
9	Knowledge-based, Model-driven	Farm sustainability analysis	Farm Business, Management, Environmental Impact, Resource Management	DEXi framework	(Wilfart et al. 2023)	Dairy sustainability assessment tool	Farm characteristics, sustainability indicators
10	Data-driven, Model-driven	Weed detection and control	Nutrition, Pasture Management	Fuzzy inference, neuro-fuzzy	(Chegini et al. 2023)	Pasture weed management DSS	Image data, weed density, GPS location
11	Knowledge-based, Model-driven	Plan disease control	Animal Health, Welfare	EuFMDiS	(Bradhurst et al. 2022)	Transboundary disease simulation model	Disease outbreak data, animal movement, geographical data

Czech Journal of Animal Science, 71, 2026 (5): 191–207
https://doi.org/10.17221/40/2026-CJAS

https://doi.org/10.17221/40/2026-CJAS

Table S1 to be continued

Order	DSS type	Problem solved	Dairy cow sector	Model used	Author	Purpose	Input data
12	Data-driven, Model-driven	Farm energy use optimisation	Farm Business, Management, Environmental Impact, Resource Management	Artificial Neural Networks (ANN)	(Shine et al. 2022)	Dairy energy assessment tool	Energy consumption data, farm size, equipment type
13	Communication-driven, Knowledge-based	Reduction of emissions and improvement of sustainability	Farm Business, Management, Environmental Impact, Resource Management	ICT, multi-actor platforms	(Amon et al. 2022)	Emissions, sustainability DSS	Farm data, emission sources, sustainability metrics
14	Data-driven	Robotic farm efficiency improvement	Farm Business, Management	ML (future)	(Perov 2022)	Robotic dairy management support	Robotic milking data, animal behavior, milk yield
15	Data-driven, Model-driven	Early disorder detection	Animal Health, Welfare	ML algorithms (Rpart)	(Zhou et al. 2022)	Predict cow health disorders	Automatic monitoring data (activity, feed intake, milk yield)
16	Data-driven, Model-driven	Heat stress and mastitis detection	Animal Health, Welfare	Data-mining hub	(Nogoy et al. 2021)	Real-time cow condition AI	Real-time sensor data, environmental conditions
17	Model-driven	Cow thermal comfort improvement	Housing, Infrastructure, Environmental Impact, Resource Management	Computational Fluid Dynamics (CFD)	(Tomasello et al. 2021)	Optimise barn ventilation	Barn design parameters, environmental conditions (temperature, airflow)
18	Data-driven, Model-driven	Lameness incidence prediction	Animal Health, Welfare	Naive Bayes, RF, MLP	(Shahinfar et al. 2021)	Lameness prediction tool	Locomotion scores, health records, sensor data
19	Model-driven (simulation)	Mitigating supply chain disruptions	Supply Chain, Logistics	Simulation-based framework	(Tsiamas and Rahimifard 2021)	Food supply chain resilience	Supply chain network data, disruption scenarios
20	Data-driven, Knowledge-based	Cattle productivity enhancement	Nutrition, Pasture Management, Farm Business, Management	Elemental status algorithm	(Bolodurina and Akimov 2021)	Assess cow productivity	Elemental status data (e.g. blood tests), productivity records
21	Model-driven	Identification of cows with reproductive issues	Reproduction, Genetics	Boosted classification trees	(Zaborski and Grzesiak 2021)	Detect conception problems	Reproduction records, cow physiological data
22	Model-driven	Aid TB disease control	Animal Health, Welfare	Classification tree analysis	(Romero et al. 2020)	Bovine TB risk factors	Bovine TB case data, farm risk factors

Czech Journal of Animal Science, 71, 2026 (5): 191–207

https://doi.org/10.17221/40/2026-CJAS

Table S1 to be continued

Order	DSS type	Problem solved	Dairy cow sector	Model used	Author	Purpose	Input data
23	Model-driven	Quantification of genotyping returns	Reproduction, Genetics, Farm Business, Management	Deterministic equations	(Newton and Berry 2020)	Genotyping net benefit	Genotyping results, economic parameters, breeding objectives
24	Model-driven	Feed formulation optimisation	Nutrition, Pasture Management	Kernel Extreme Learning Machine (KELM)	(Fu et al. 2020)	Predict diet energy digestion	Diet composition, feed analysis data
25	Data-driven, Model-driven	Farm management optimisation	Farm Business, Management, Milk Production, Quality	Multi-disciplinary approach	(Arcidiacono et al. 2020)	Improve herd productivity	Various farm management data, animal health records, environmental data
26	Knowledge-based	Detection of difficult calvings	Reproduction, Genetics	Rule-based module (decision trees)	(Zaborski and Grzesiak 2021)	Dystocia detection DSS	Animal behavior, physiological indicators (e.g., body temperature)
27	Knowledge-based, Model-driven	Prediction of FMD occurrence	Animal Health, Welfare	GIS-based MCDA	(Sangrat et al. 2020)	FMD risk area identification	GIS data, FMD outbreak history, animal movement data
28	Model-driven	Farm energy and profit optimisation	Farm Business, Management, Environmental Impact, Resource Management	Multi-objective optimisation (Genetic Algorithm)	(Breen et al. 2020)	PV system optimisation	Farm energy consumption, solar irradiance data, economic costs
29	Data-driven, Model-driven	Early warning for weight loss	Animal Health, Welfare, Nutrition, Pasture Management	Random forest model	(Dettmann et al. 2020)	Predict cow body weight change	Milk fatty acid profiles, milk recording data
30	Data-driven, Model-driven	Classify cattle health	Animal Health, Welfare, Farm Business, Management	Artificial Neural Networks	(Pimpa et al. 2019)	Dairy cattle health classification	Health records, physiological data, milk yield
31	Data-driven, Model-driven	Optimising farm energy investments	Farm Business, Management, Environmental Impact, Resource Management	Genetic Algorithm	(Shine et al. 2019a)	Energy investment optimisation	Farm energy data, technology costs, economic parameters
32	Model-driven	Maximising farm ROI	Farm Business, Management, Housing, Infrastructure	Genetic Algorithm	(Shine et al. 2019b)	Optimise farm infrastructure ROI	Farm infrastructure costs, economic data, production metrics

https://doi.org/10.17221/40/2026-CJAS

Table S1 to be continued

Order	DSS type	Problem solved	Dairy cow sector	Model used	Author	Purpose	Input data
33	Data-driven, Model-driven	Improving pasture management	Nutrition, Pasture Management, Environmental Impact, Resource Management	Case-Based Reasoning (CBR)	(Kenny et al. 2019)	Predict grass growth	Climate data, soil data, pasture measurements
34	Knowledge-based, Model-driven	Locating biogas production units	Environmental Impact, Resource Management	GIS-based MCDA, AHP	(Rodrigues et al. 2019)	Biogas plant site selection	GIS data, waste volume, energy demand, environmental regulations
35	Data-driven, Model-driven	Energy impact analysis	Farm Business, Management, Environmental Impact, Resource Management	Support Vector Machine (SVM)	(Shine et al. 2019a)	Predict electricity consumption	Historical electricity consumption data, farm size
36	Model-driven	Evaluating manure treatment	Environmental Impact, Resource Management	Dairy-CropSyst model	(Khalil et al. 2019)	Emissions, nutrient fate modelling	Farm management data, manure characteristics, soil data
37	Data-driven, Model-driven	Planning livestock evacuation	Risk, Disaster Management	BET_VH, TEPHRA2	(Wild et al. 2019)	Volcanic evacuation decision tool	Volcanic hazard data, infrastructure network data, livestock locations
38	Data-driven, Model-driven	Assessing pasture quantity/quality	Nutrition, Pasture Management	SALUS, MDP, UAV	(Insua et al. 2019)	Pasture monitoring, prediction	UAV imagery, weather data, soil data
39	Data-driven, Knowledge-based	Improving herd health decisions	Animal Health, Welfare	Data collection, analysis algorithm	(Alawneh et al. 2018)	Herd health DSS	Herd health records, diagnostic data, treatment history
40	Data-driven, Model-driven	Optimising milk transport fleet	Supply Chain, Logistics	Simulation modelling	(Tryhuba et al. 2018)	Milk harvesting logistics	Milk collection routes, truck parameters, road conditions
41	Data-driven, Model-driven	Analyzing resource consumption	Farm Business, Management, Environmental Impact, Resource Management	Multiple linear regression (MLR)	(Shine et al. 2018)	Predict water/electricity consumption	Farm size, cow numbers, climatic data, consumption records
42	Communication-driven, Data-driven	Pasture management optimisation	Nutrition, Pasture Management	Data-informed decision tool	(Hanrahan et al. 2017)	Grassland management DSS	Pasture measurements, weather data, farm records
43	Data-driven	Real-time physiological info	Reproduction, Genetics, Animal Health, Welfare	Not specified (monitoring system)	(Yu and Maeda 2017)	Inline progesterone monitoring	Inline progesterone levels

Czech Journal of Animal Science, 71, 2026 (5): 191–207

https://doi.org/10.17221/40/2026-CJAS

Table S1 to be continued

Order	DSS type	Problem solved	Dairy cow sector	Model used	Author	Purpose	Input data
44	Data-driven, Model-driven	Improving feedlot efficiency and profit	Farm Business, Management (Feedlot)	Gradient boosting, random forest	(Flores et al. 2017)	Feedlot growth prediction, optimisation	Animal growth data, feed intake, cost data
45	Data-driven, Model-driven	Forecastin g feed intake	Nutrition, Pasture Management	Regression model	(Sivamani et al. 2017)	Predict livestock feed intake	Livestock data, feed characteristics, environmental factors
46	Model-driven	Evaluating pasture intake and yield	Nutrition, Pasture Management, Milk Production, Quality	GrazeIn model	(Roca-Fernandez and Gonzales-Rodrigues 2017)	Pasture intake, milk prediction	Pasture availability, cow characteristics (calving date, stocking rate)
47	Knowledge-based	Classifying reproduction and milk yield	Reproduction, Genetics, Milk Production, Quality	Fuzzy logic	(Akilli et al. 2016)	Dairy cattle management DSS	Farm management data, animal health records
48	Model-driven	Simulating herd properties and diets	Farm Business, Management, Nutrition, Pasture Management	Dairy.js (JavaScript library)	(Vaillant and Baldinger 2016)	Dairy herd simulation library	Animal characteristics, feed composition, growth models
49	Model-driven	Selecting whey processing equipment	Environmental Impact, Resource Management, Farm Business, Management	Facility location problem extension	(Garcia-Flores et al. 2015)	Whey utilisation optimisation	Whey production volume, processing costs, market demand
50	Data-driven, Model-driven	Promoting 24-month calving	Other Livestock Management (Beef)	Empirical model	(Titterington et al. 2015)	Beef heifer growth management	Heifer growth data, feeding strategies, target weights
51	Model-driven, Spatial	Optimising milk collection routes	Supply Chain, Logistics	Heuristic algorithm, GIS	(Amiama et al. 2015)	Milk collection route management	Farm locations, road network data, milk volume
52	Data-driven, Model-driven	Prioritising contamination mitigations	Environmental Impact, Resource Management	Farm-scale risk-index	(Muirhead 2015)	Reduce water faecal contamination	Farm characteristics, weather data, water quality measurements
53	Knowledge-based, Model-driven	Assessing farm environmental impact	Environmental Impact, Resource Management, Farm Business, Management	Life Cycle Assessment (LCA)	(Meul et al. 2014)	Environmental decision support	Farm input/output data (feed, manure, energy), environmental parameters

https://doi.org/10.17221/40/2026-CJAS

Table S1 to be continued

Order	DSS type	Problem solved	Dairy cow sector	Model used	Author	Purpose	Input data
54	Model-driven, Spatial, Web-based	Assessing farm sustainability	Environmental Impact, Resource Management	GIS, ELECTRE TRI (MCDA)	(Silva et al. 2014)	Environmental sustainability assessment	GIS data, environmental indicators, farm attributes
55	Data-driven, Model-driven	Improving reproduction decisions	Reproduction, Genetics	ML algorithms	(Shahinfar et al. 2014)	Predict insemination outcomes	Insemination records, cow reproductive history, physiological data
56	Data-driven, Model-driven	Reducing business risk	Farm Business, Management	Stochastic budgeting	(Farina et al. 2013)	Assess farm business risk	Financial data, pasture production data, market prices
57	Data-driven, Knowledge-based	Enhancing raw milk safety	Supply Chain, Logistics, Milk Production, Quality	Not specified (DSS elements)	(van der Spiegel et al. 2013)	Raw milk safety control	Raw milk testing results, processing data, hazard identification
58	Model-driven	Optimising cow replacement	Reproduction, Genetics, Farm Business, Management	Markov chain algorithm	(Cabrera 2012)	Cow replacement economics	Cow age, milk yield, reproduction status, economic parameters
59	Integrated assessment tool	Reducing the environmental impact	Farm Business, Management, Environmental Impact, Resource Management	Biophysical model, N budgets	(Moreau et al. 2012)	Farming system sustainability	Farm system data, environmental indicators, economic performance
60	Model-driven	Estimating feed intake and milk yield	Nutrition, Pasture Management, Milk Production, Quality	INRA fill unit system	(Faverdin et al. 2011)	Predict intake, milk production	Pasture characteristics, cow body weight, milk yield
61	Model-driven, Spatial	Promoting safe manure reuse	Environmental Impact, Resource Management	Environmental Risk Assessment Model	(Rio et al. 2011)	Organic waste management	Waste characteristics, soil data, environmental regulations
62	Model-driven	Predicting intake, milk yield	Nutrition, Pasture Management, Milk Production, Quality	GrazeIn model	(Delagarde et al. 2011b)	Herbage intake, milk production	Pasture data, cow characteristics, grazing management
63	Model-driven	Predicting herbage intake	Nutrition, Pasture Management	GrazeIn model	(Delagarde et al. 2011a)	Grazing intake prediction	Grazing management type, pasture availability, cow data
64	Model-driven	Optimising reproductive programs	Reproduction, Genetics, Farm Business, Management	Markov chain simulation, budgeting	(Giordano et al. 2011)	Reproductive management economics	Reproductive program costs, success rates, cow data

Czech Journal of Animal Science, 71, 2026 (5): 191–207

https://doi.org/10.17221/40/2026-CJAS

Table S1 to be continued

Order	DSS type	Problem solved	Dairy cow sector	Model used	Author	Purpose	Input data
65	Model-driven	Predicting herbage mass	Nutrition, Pasture Management	Climate-driven pasture model (PGSUS)	(Romera et al. 2010)	Pasture mass estimation	Climate data, soil data, pasture measurements
66	Model-driven	Evaluating finishing strategies	Farm Business, Management	Stochastic budgeting model	(Minchin et al. 2010)	Cull cow finishing economics	Cull cow characteristics, feed costs, market prices
67	Knowledge-based, Model-driven	Anticipating food security future	Supply Chain, Logistics	Modelling, simulation	(Omran et al. 2010)	National food security	Food production data, consumption data, market prices
68	Model-driven	Assessing mastitis cost	Animal Health, Welfare, Farm Business, Management	SimHerd (simulation model)	(Hagnestam-Nielsen and Ostergaard 2009)	Mastitis economic impact	Mastitis incidence, treatment costs, milk yield losses
69	Model-driven	Classifying dairy farms	Farm Business, Management	Discriminant analysis	(Riveiro-Valino et al. 2009)	Farm classification validation	Farm structural data, production data, financial data
70	Data-driven, Knowledge-based	Automating records, breeding values	Other Livestock Management (Small Ruminants)	Software (SURPRO V1.0)	(Onder et al. 2009)	Flock management automation	Animal records, breeding values, performance data
71	Model-driven (dynamic simulation)	Evaluating farm sustainability	Farm Business, Management, Environmental Impact, Resource Management	GAMEDE (stock-flow model)	(Vayssieres et al. 2009)	Dairy farm sustainability	Farm activity data, environmental parameters, economic data
72	Model-driven	Decreasing nitrogen leaching	Environmental Impact, Resource Management	DyNoFlo (whole-farm model)	(Cabrera et al. 2007)	Environmental sustainability modelling	Farm data, climate forecasts (seasonal)
73	Knowledge-based, Model-driven	Managing water resources	Environmental Impact, Resource Management	Hydraulic, chemical, agricultural models	(Dentinho et al. 2008)	Groundwater quality preservation	Geological data, hydrological data, agricultural practices
74	Model-driven	Early detection of mastitis	Animal Health, Welfare	Mixture of four time-series models based on Kalman filter	(Norberg et al. 2008)	In-line detection of mastitis	Somatic cell count (SCC) time-series data
75	Model-driven	Optimising silage production, cultivar selection, and sowing date	Nutrition, Pasture Management	CERES-Maize crop model	(Braga et al. 2008)	Maize silage production optimisation	Climate data, soil data, maize cultivar characteristics

https://doi.org/10.17221/40/2026-CJAS

Table S1 to be continued

Order	DSS type	Problem solved	Dairy cow sector	Model used	Author	Purpose	Input data
76	Model-driven	Supporting decisions on treating chronic subclinical mastitis	Animal Health, Welfare, Farm Business, Management	Stochastic Monte Carlo simulation model	(Steeneveld et al. 2007)	Economic assessment of chronic subclinical mastitis treatment	Mastitis treatment protocols, economic costs, milk prices
77	Model-driven	Reducing N leaching and devising forage and manure application strategies	Environmental Impact, Resource Management, Farm Business, Management	Decision Support System for Agrotechnology Transfer (DSSAT)	(Cabrera et al. 2007)	Limiting nitrogen leaching	Climate forecasts, farm management data, soil data
78	Web-based	Providing information and technology for dairy business planning	Farm Business, Management	Not specified (information and technology platform)	(Savilionis et al. 2007)	General dairy farm information and planning	Farm records, financial data, production goals
79	Model-driven, Multicriteria	Assessing the impact of land management on water quality and quantitying and evaluate alternatives	Environmental Impact, Resource Management	Semidistributed hydrological model (SWAT), multicriteria decision support system	(Cau and Paniconi 2007)	Impact of land use on water supply and quality	Land use data, hydrological data, water quality parameters
80	Knowledge-based (protocol for decision support)	Supporting on-farm welfare assessment	Animal Health, Welfare	Welfare indicator protocol (38 measures from 4 sources)	(Rousing et al. 2007)	Animal welfare assessment in Automatic Milking System (AMS) herds	Welfare indicator observations, AMS data
81	Knowledge-based	Promoting sustainable Integrated Parasite Management (sIPM) and reducing anthelmintic resistance	Other Livestock Management (Small Ruminants)	FAMACHA© system, milk yields as indicators	(van Wyk et al. 2006)	Targeted selective treatment for worm management	Animal health indicators (e.g., FAMACHA© scores, milk yields)
82	Model-driven	Determining the costs of lameness and defining economically feasible strategies	Animal Health, Welfare, Farm Business, Management	SimHerd (dynamic, stochastic, mechanistic Monte Carlo model)	(Ettema and Ostergaard 2006)	Economic decision-making for lameness prevention and control	Lameness incidence data, treatment costs, prevention costs

https://doi.org/10.17221/40/2026-CJAS

Table S1 to be continued

Order	DSS type	Problem solved	Dairy cow sector	Model used	Author	Purpose	Input data
83	Data-driven, Model-driven	Assessing N leaching and economic impacts of reduction and evaluating economic/ ecologic sustainability	Environmental Impact, Resource Management, Farm Business, Management	DyNoFlo Dairy model (integrates nutrient budgeting, crop, and optimisation models; Markov-chain simulation)	(Cabrera et al. 2005)	Increasing profits and minimising nitrogen leaching	Climate data, farm management practices, soil data, nutrient budgets
84	Model-driven	Predicting pasture production to aid on-farm decision-making	Nutrition, Pasture Management	GrazeGro model (based on LINGRA)	(Barrett et al. 2005)	Herbage growth prediction for pasture production	Weather data, soil data, pasture measurements

REFERENCES

Akilli A, Atil H, Takma C, Ayyilmaz T. Fuzzy logic-based decision support system for dairy cattle. Kafkas Univ Vet Fak Derg. 2016;22(1):13-9.

Akkose M, Polat Y. Multi-criteria decision analysis for supporting the selection of subclinical mastitis screening tests to use in large- and small-scale dairy farms in Türkiye. Trop Anim Health Prod. 2023 Dec 7;56(1):6.

Alawneh JI, Henning J, Olchowy TWJ. Functionality and interfaces of a herd health Decision Support System for practising dairy cattle veterinarians in New Zealand. Front Vet Sci. 2018 Feb 23;5:21.

Alwadi M, Alwadi A, Chetty G, Alnaimi J. Smart dairy farming for predicting milk production yield based on deep machine learning. Int J Inf Technol. 2024 Oct;16(7): 4181-90.

Amiama C, Pereira JM, Carpente L, Salgado J. Spatial decision support system for the route management for milk collection from dairy farms. Transp Lett. 2015;7(5): 279-88.

Amon B, Dragoni F, Diaz de Otalora Aguirre X, Cinar G, Anestis V, Bartzanas T. "MilKey" and "MELS": Zhe role of information and communication technologies in mitigating emissions and increasing sustainability of livestock systems. In: VDI Wissensforum GmbH, editors. AgEng-LAND.TECHNIK 2022. VDI Berichte. Dusseldorf: VDI Verlag; 2022. p. 299-304.

Arcidiacono C, Barbari M, Benni S, Carfagna E, Cascone G, Conti L, Di Stefano L, Guarino M, Leso L, Lovarelli D, Mancino M, Mattoccia S, Minozzi G, Porto SMC, Provolo G, Rossi G, Sandrucci A, Tamburini A, Tassinari P, Tomasello N, Torreggiani D, Valenti F. Smart dairy farming: innovative solutions to improve herd productivity. In: Coppola A, Di Renzo G, Altieri G, D'Antonio P, editors. Innovative biosystems engineering for sustainable agriculture, forestry and food production. Lecture Notes in Civil Engineering, vol. 67. Cham: Springer; 2020. p. 65-70.

Barrett PD, Laidlaw AS, Mayne CS. GrazeGro: A European herbage growth model to predict pasture production in perennial ryegrass swards for decision support. Eur J Agron. 2005 Jul;23(1):37-56.

Bolodurina IP, Akimov SS. Intelligent methods for assessing the productivity of dairy cattle based on a comprehensive study of elemental status. IOP Conf Ser Earth Environ Sci. 2021;624(1):012020.

Bradhurst R, Garner G, Hovari M, de la Puente M, Mintiens K, Yadav S, Federici T, Kopacka I, Stockreiter S, Kuzmanova I, Paunov S, Cacinovic V, Rubin M, Szilagyi J, Kokany ZS, Santi A, Sordilli M, Sighinas L, Spiridon M,

https://doi.org/10.17221/40/2026-CJAS

Potocnik M, Sumption K. Development of a transboundary model of livestock disease in Europe. Transbound Emerg Dis. 2022 Jul;69(4):1963-82.

Braga RP, Cardoso MJ, Coelho JP. Crop model based decision support for maize (Zea mays L.) silage production in Portugal. Eur J Agron. 2008;28(3):224-33.

Breen M, Upton J, Murphy MD. Photovoltaic systems on dairy farms: Financial and renewable multi-objective optimization (FARMOO) analysis. Appl Energy. 2020;278: 115534.

Cabrera VE, Breuer NE, Hildebrand PE, Letson D. The dynamic North Florida dairy farm model: A user-friendly computerized tool for increasing profits while minimizing N leaching under varying climatic conditions. Comput Electron Agric. 2005;49(3):286-308.

Cabrera VE, Jagtap SS, Hildebrand PE. Strategies to limit (minimize) nitrogen leaching on dairy farms driven by seasonal climate forecasts. Agric Ecosyst Environ. 2007 Dec;122(4):479-89.

Cabrera VE. A simple formulation and solution to the replacement problem: A practical tool to assess the economic cow value, the value of a new pregnancy, and the cost of a pregnancy loss. J Dairy Sci. 2012 Aug;95(8):4683-98. Erratum in: J Dairy Sci. 2026 Apr;109(4):4660.

Chegini H, Naha RK, Mahanti A, Gong M, Passi K. An agriprecision decision support system for weed management in pastures. IEEE Access. 2023;11:93366-79.

Cau P, Paniconi C. Assessment of alternative land management practices using hydrological simulation and a decision support tool: Arborea agricultural region, Sardinia. Hydrol Earth Syst Sci. 2007;11(6):1811-23.

Delagarde R, Faverdin P, Baratte C, Peyraud JL. GrazeIn: A model of herbage intake and milk production for grazing dairy cows. 2. Prediction of intake under rotational and continuously stocked grazing management. Grass Forage Sci. 2011a;66(1):45-60.

Delagarde R, Valk H, Mayne CS, Rook AJ, Gonzalez-Rodriguez A, Baratte C, Faverdin P, Peyraud JL. GrazeIn: A model of herbage intake and milk production for grazing dairy cows. 3. Simulations and external validation of the model. Grass Forage Sci. 2011b;66(1):61-77.

Dentinho TP, Minciardi R, Robba M, Sacile R, Silva V. The architecture of a decision support system (DSS) for groundwater quality preservation in Terceira Island (Azores). In: Meire P, Coenen M, Lombardo C, Robba M, Sacile R, editors. Integrated water management: practical experiences and case studies. NATO Science Series IV: Earth and Environmental Sciences, Vol. 80. Dordrecht: Springer; 2008.

Dettmann F, Warner D, Buitenhuis B, Kargo M, Kjeldsen AMH, Nielsen NH, Lefebvre DM, Santschi DE. Fatty acid profiles from routine milk recording as a decision tool for body weight change of dairy cows after calving. Animals (Basel). 2020 Oct 23;10(11):1958.

Ettema JF, Ostergaard S. Economic decision making on prevention and control of clinical lameness in Danish dairy herds. Livest Sci. 2006;102(1-2):92-106.

Farina SR, Alford A, Garcia SC, Fulkerson WJ. An integrated assessment of business risk for pasture-based dairy farm systems intensification. Agric Syst. 2013;115:10-20.

Faverdin P, Delagarde R, Baratte C, Peyraud JL. GrazeIn: A model of herbage intake and milk production for grazing dairy cows. 1. Prediction of intake capacity, voluntary intake and milk production during lactation. Grass Forage Sci. 2011;66(1):29-44.

Flores H, Meneses C, Villalobos JR, Sanchez O. Improvement of feedlot operations through statistical learning and business analytics tools. Comput Electron Agric. 2017;143:273-85.

Fu Q, Shen W, Wei X, Zhang Y, Xin H, Su Z, Zhao C. Prediction of the diet energy digestion using kernel extreme learning machine: A case study with Holstein dry cows. Comput Electron Agric. 2020;169:105231.

Garcia-Flores R, Martins R, de Souza Filho OV, Gonzalez M, Mattos C, Rosenthal A, Juliano P. A novel facility and equipment selection model for whey utilisation: A Brazilian case study. Comput Electron Agric. 2015;117:181-7.

Giordano JO, Fricke PM, Wiltbank MC, Cabrera VE. An economic decision-making support system for selection of reproductive management programs on dairy farms. J Dairy Sci. 2011 Dec;94(12):6216-32.

Hagnestam-Nielsen C, Ostergaard S. Economic impact of clinical mastitis in a dairy herd assessed by stochastic simulation using different methods to model yield losses. Animal. 2009 Feb;3(2):315-28.

Hanrahan L, Geoghegan A, O'Donovan M, Griffith V, Ruelle E, Wallace M, Shalloo L. PastureBase Ireland: A grassland decision support system and national database. Comput Electron Agric. 2017;136:193-201.

Innes DJ, Pot LJ, Seymour DJ, France J, Dijkstra J, Doelman J, Cant JP. Fitting mathematical functions to extended lactation curves and forecasting late-lactation milk yields of dairy cows. J Dairy Sci. 2024 Jan;107(1):342-58.

Insua JR, Utsumi SA, Basso B. Estimation of spatial and temporal variability of pasture growth and digestibility in grazing rotations coupling unmanned aerial vehicle (UAV) with crop simulation models. PLoS One. 2019 Mar 13;14(3):e0212773.

Kenny EM, Ruelle E, Geoghegan A, Shalloo L, O'Leary M, O'Donovan M, Keane MT. Predicting grass growth for sustainable dairy farming: A CBR system using Bayesian case-exclusion and post-hoc, personalized explanation-by-example (XAI). In: Bach K, Marling C, editors. Case-

https://doi.org/10.17221/40/2026-CJAS

based reasoning research and development. ICCBR 2019. Lecture Notes in Computer Science (LNAI), vol. 11680. Cham: Springer; 2019. p. 172-86.

Khalil TM, Stockle CO, Carlson BR, Uslar-Valle N, Nelson RL, Frear CS, Ma J, Higgins SS, Leytem AB, Dungan RS. Dairy-CropSyst: Gaseous emissions and nutrient fate modeling tool. Comput Electron Agric. 2019;162:495-507.

Khan MF, Thorup VM, Luo Z. Delineating mastitis cases in dairy cows: development of an IoT-enabled intelligent decision support system for dairy farms. IEEE Trans Ind Inform. 2024;20(7):9508-17.

Meul M, van Middelaar CE, de Boer IJM, van Passel S, Fremaut D, Haesaert G. Potential of life cycle assessment to support environmental decision making at commercial dairy farms. Agric Syst. 2014;131:105-15.

Minchin W, O'Donovan M, Buckley F, Kenny DA, Shalloo L. Development of a decision support tool to evaluate the financial implications of cull cow finishing under different feeding strategies. J Agric Sci. 2010;148(6):739-48.

Moreau P, Ruiz L, Mabon F, Raimbault T, Durand P, Delaby L, Devienne S, Vertes F. Reconciling technical, economic and environmental efficiency of farming systems in vulnerable areas. Agric Ecosyst Environ. 2012 Jan;147:89-99.

Muirhead R. A farm-scale risk-index for reducing fecal contamination of surface waters. J Environ Qual. 2015 Jan;44(1):248-55.

Newton JE, Berry DP. On-farm net benefit of genotyping candidate female replacement cattle and sheep. Animal. 2020;14(8):1565-75.

Nogoy KMC, Park J, Chon SI, Sivamani S, Park MJ, Cho JP, Hong HK, Lee DH, Choi SH. Precision detection of real-time conditions of dairy cows using an advanced artificial intelligence hub. Appl Sci (Basel). 2021;11(24):12043.

Norberg E, Korsgaard IR, Sloth KHMN, Lovendahl P. Time-series models on somatic cell score improve detection of mastitis. Acta Agric Scand A Anim Sci. 2008;58(4): 165-9.

Omran A, Saleh M, Khorshid M. Intelligent decision support system for the Egyptian food security. In: Proceedings of the 10th International Conference on Intelligent Systems Design and Applications (ISDA 2010); 2010 Nov 29–Dec 1; Cairo, Egypt. Piscataway (NJ): IEEE; 2010.

Onder H, Cam MA, Soydan E. Automation of flock management and establishment of decision support systems for small ruminant production. Asian J Anim Vet Adv. 2009; 4(6):314-9.

Perov I. Robotic dairy systems – Change in management paradigm. In: Ronzhin A, Berns K, Kostyaev A, editors. Agriculture digitalization and organic production. Smart Innovation, Systems and Technologies, vol. 245. Singapore: Springer; 2022.

Pimpa A, Eiamkanitchat N, Phatsara C, Moonmanee T. Decision support system for dairy cattle management using computational intelligence technique. In: Proceedings of the 7th International Conference on Computer and Communications Management (ICCCM 2019); 2019 Jul 27; Bangkok, Thailand. New York (NY): ACM; 2019. p. 181-5.

Rio M, Franco-Uria A, Abad E, Roca E. A risk-based decision tool for the management of organic waste in agriculture and farming activities (FARMERS). J Hazard Mater. 2011 Jan 30;185(2-3):792-800.

Riveiro-Valino JA, Alvarez-Lopez CJ, Marey-Perez MF. The use of discriminant analysis to validate a methodology for classifying farms based on a combinatorial algorithm. Comput Electron Agric. 2009 May;66(2):182-90.

Roca-Fernandez AI, Gonzalez-Rodriguez A. External validation of the GrazeIn model of pasture dry matter intake and milk yield prediction for cows managed at different calving dates and stocking rates. Span J Agric Res. 2017; 15(4):e0608.

Rodrigues C, Rodrigues AC, Vilarinho C, Alves M, Alonso JM. Spatial multicriteria GIS-based analysis to anaerobic biogas plant location for dairy waste and wastewater treatment and energy recovery (Barcelos, NW Portugal). In: Machado J, Soares F, Veiga G, editors. Innovation, engineering and entrepreneurship. HELIX 2018. Lecture Notes in Electrical Engineering, vol. 505. Cham: Springer; 2019. p. 626-32.

Romera AJ, Beukes PC, Clark CEF, Clark DA, Levy H, Tait A. Use of a pasture growth model to estimate herbage mass at a paddock scale and assist management on dairy farms. Comput Electron Agric. 2010;74(1):66-72.

Romero MP, Chang YM, Brunton LA, Parry J, Prosser A, Upton P, Rees E, Tearne O, Arnold M, Stevens K, Drewe JA. Decision tree machine learning applied to bovine tuberculosis risk factors to aid disease control decision making. Prev Vet Med. 2020 Feb;175:104860.

Rousing T, Jakobsen IA, Hindhede J, Klaas IC, Bonde M, Sorensen JT. Evaluation of a welfare indicator protocol for assessing animal welfare in AMS herds: Researcher, production advisor and veterinary practitioner opinion. Anim Welf. 2007;16(2):213-6.

Sangrat W, Thanapongtharm W, Poolkhet C. Identification of risk areas for foot and mouth disease in Thailand using a geographic information system-based multi-criteria decision analysis. Prev Vet Med. 2020 Dec;185:105183.

Saro J, Stadnik L, Blahova P, Huguet S, Brozova H, Duchacek J. A decision support system based on disease scoring enables dairy farmers to proactively improve herd health. Czech J Anim Sci. 2024a May;69(5):165-77.

Saro J, Subrt T, Brozova H, Hlavaty R, Rydval J, Duchacek J, Stadnik L. A decision support system for herd health

https://doi.org/10.17221/40/2026-CJAS

management for dairy farms. Czech J Anim Sci. 2024b Dec;69(12):502-15.

Savilionis A, Zajanckauskas A, Petrauskas V, Juknevicius S. Online decision support system for dairy farm. In: Elleithy K, editor. Advances and innovations in systems, computing sciences and software engineering. Dordrecht: Springer; 2007.

Shahinfar S, Page D, Guenther J, Cabrera V, Fricke P, Weigel K. Prediction of insemination outcomes in Holstein dairy cattle using alternative machine learning algorithms. J Dairy Sci. 2014 Feb;97(2):731-42.

Shahinfar S, Khansefid M, Haile-Mariam M, Pryce JE. Machine learning approaches for the prediction of lameness in dairy cows. Animal. 2021 Nov;15(11):100391.

Shine P, Breen M, Upton J, O'Donovan A, Murphy MD. A decision support and optimization platform for energy technology investments on dairy farms. In: 2019 ASABE Annual International Meeting; 2019 Jul 7–10; Boston, MA. St. Joseph (MI): ASABE; 2019a. Paper No. 1901055.

Shine P, Scully T, Upton J, Murphy MD. Annual electricity consumption prediction and future expansion analysis on dairy farms using a support vector machine. Appl Energy. 2019b;250:1110-9.

Shine P, Upton J, Murphy MD. The development of a national-level energy assessment tool for the dairy industry. In: 2022 ASABE Annual International Meeting; 2022 Jul 17–20; Houston, TX. St. Joseph (MI): ASABE; 2022. Paper No. 2200539.

Shine P, Upton J, Scully T, Shalloo L, Murphy MD. Comparing multiple linear regression and support vector machine models for predicting electricity consumption on pasture based dairy farms. In: 2018 ASABE Annual International Meeting; 2018 Jul 29 – Aug 1; Detroit, MI. St. Joseph (MI): ASABE; 2018. Paper No. 1801140.

Silva LC, Alcada-Almeida L, Dias J. Development of a web-based multi-criteria spatial decision support system for the assessment of environmental sustainability of dairy farms. Comput Electron Agric. 2014;105:74-81.

Sivamani S, Shin C, Park J, Cho K, Cho Y. A regression analysis for the prediction of the food supply in livestock. Adv Sci Lett. 2017;23(12):12717–12720.

Steeneveld W, Swinkels J, Hogeveen H. Stochastic modelling to assess economic effects of treatment of chronic subclinical mastitis caused by Streptococcus uberis. J Dairy Res. 2007 Nov;74(4):459-67.

Titterington FM, Morrison SJ, Lively FO, Wylie ARG, Gordon AW, Browne MR. An analysis of Northern Ireland farmers' experiences of using a target-driven beef heifer growth management plan and development of an empirical model leading to the launch of a decision support tool to promote first calving of beef heifers at 24 months. Agric Syst. 2015 Jan;132:107-20.

Tomasello N, Valenti F, Cascone G, Porto SMC. Improving natural ventilation in renovated free-stall barns for dairy cows: Optimized building solutions by using a validated computational fluid dynamics model. J Agric Eng. 2021 Mar;52(1):1135.

Tryhuba A, Zachko O, Grabovets V, Berladyn O, Pavlova I, Rudynets M. Examining the effect of production conditions at territorial logistic systems of milk harvesting on the parameters of a fleet of specialized road tanks. East Eur J Enterp Technol. 2018;5(3):59-70.

Tsiamas K, Rahimifard S. A simulation-based decision support system to improve the resilience of the food supply chain. Int J Comput Integr Manuf. 2021 Aug 31;34(10): 996-1010.

Um MM, Dufour S, Bergeron L, Gauthier ML, Paradis ME, Roy JP, Falcon M, Molgat E, Ravel A. Development of a decision support tool to compare diagnostic strategies for establishing the herd status for infectious diseases: An example with Salmonella Dublin infection in dairies. Prev Vet Med. 2024 Jul;228:106234.

Vaillant J, Baldinger L. Application note: An open-source JavaScript library to simulate dairy cows and young stock, their growth, requirements and diets. Comput Electron Agric. 2016 Jan;120:7-9.

van der Spiegel M, Sterrenburg P, Haasnoot W, van der Fels-Klerx HJ. Towards a decision support system for control of multiple food safety hazards in raw milk production. Trends Food Sci Technol. 2013;34(2):111-20.

van Wyk JA, Hoste H, Kaplan RM, Besier RB. Targeted selective treatment for worm management – How do we sell rational programs to farmers? Vet Parasitol. 2006 Jul 31; 139(4):336-46.

Vayssieres J, Bocquier F, Lecomte P. GAMEDE: A global activity model for evaluating the sustainability of dairy enterprises. Part II – interactive simulation of various management strategies with diverse stakeholders. Agric Syst. 2009 Jul;101(3):139-51.

Wang H, Guo T, Wang Z, Xiao J, Gao L, Gao X, Wang H. PreCowKetosis: A Shiny web application for predicting the risk of ketosis in dairy cows using prenatal indicators. Comput Electron Agric. 2023;206:107697.

Wild AJ, Wilson TM, Bebbington MS, Cole JW, Craig HM. Probabilistic volcanic impact assessment and cost-benefit analysis on network infrastructure for secondary evacuation of farm livestock: a case study from the dairy industry, Taranaki, New Zealand. J Volcanol Geotherm Res. 2019;387:106670.

Wilfart A, Baillet V, Balaine L, Diaz de Otalora X, Dragoni F, Krol DJ, Fratczak-Muller J, Rychla A, Rodriguez DGP,

https://doi.org/10.17221/40/2026-CJAS

Breen J, Anestis V, Buckley C, Alem H, Winiwarter W, Akkal-Corfini N, Amon B. DEXi-Dairy: an ex post multicriteria tool to assess the sustainability of dairy production systems in various European regions. Agron Sustain Dev. 2023;43(6):82.

Yu GM, Maeda T. Inline progesterone monitoring in the dairy industry. Trends Biotechnol. 2017 Jul;35(7):579-82.

Zaborski D, Grzesiak W, Wojcik J. The use of a rule-based module as a decision support system for dystocia detection in dairy cows. Indian J Anim Res. 2020;54(1):128-30.

Zaborski D, Grzesiak W. Utilization of boosted classification trees for the detection of cows with conception difficulties. Indian J Anim Res. 2021;55(3):359-63.

Zhou X, Xu C, Wang H, Xu W, Zhao Z, Chen M, Jia B, Huang B. The early prediction of common disorders in dairy cows monitored by automatic systems with machine learning algorithms. Animals (Basel). 2022 May 12; 12(10):1251.