Development of a Model Simulating the Impact of Management Strategies on Production From Beef Cattle Farming Systems Based on Permanent Pasture

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Introduction Grazing systems in Europe increasingly have to meet environmental objectives, which influence management strategies. A deterministic model describing farming system dynamics is being developed in order to elucidate interactions between nature-friendly management practices, as for example late (after flowering) hay harvest or moderate stocking rate, and agricultural output.

Model presentation The model predicts, with a daily time step, farm system operation and agricultural output from a given farm structure and management strategy. It is built and calibrated for non-intensive French beef cattle farming systems based on permanent pasture. The model is made up of four interacting sub-models. A grassland resource sub-model adapted from Carrère *et al*. (2002) predicts grass growth and quality at the paddock level, from soil quality, vegetation functional traits and climatic data. A herd performance sub-model based on INRA (1989) calculates weight gain and milk production from energy intake, for an average cow and calf. A feeding sub-model predicts selective intake at pasture for an average cow and calf, and herd feeding indoors. A management sub-model decides on herd movements, concentrate supplementation to achieve intermediate objectives (calf weight at sale, cow body condition score at calving) and day of hay harvest. The whole model and individual sub-models are undergoing sensitivity analysis and validation.

Simulation example The effects of stocking rate and proportion of late hay harvest were examined in a 2x2 factorial design. The model was run for 6 climatic years, with stocking rate (SR) 1.4 or 1.2 LSU/ha, half the surface planned for hay harvest (half for 1 cut, half for 2 cuts), with 50% or 100% late 1st cut, and calves sold at 9 months, 320 kg. SR change was performed by altering the number of animals. Simulation results are given in Table 1; the model being deterministic, standard deviations refer to discrepancies between climatic years.

Table 1 Simulated annual agricultural output (mean ± SD); DOM=digestible organic matter

Management strategy	Days at pasture	Grazed DOM (t/calf)	Grazed DOM (t/cow)	Harvested DOM(t/cow)	Concentrate consumption at pasture (kg/calf)	Concentrate consumption housed (kg/cow)
SR 1.4 – 50% late	172 ± 7	0.35 ± 0.08	1.69 ± 0.07	1.27 ± 0.12	180 ± 13	36 ± 33
SR 1.2 – 50% late	178 ± 10	0.34 ± 0.03	1.75 ± 0.10	1.47 ± 0.13	184 ± 13	20 ± 23
SR 1.4 – 100% late	170 ± 7	0.32 ± 0.02	1.68 ± 0.07	1.15 ± 0.16	204 ± 57	64 ± 40
SR 1.2 – 100% late	177 ± 10	0.34 ± 0.03	1.74 ± 0.09	1.30 ± 0.19	204 ± 50	53 ± 49

Lowering SR increases grass availability at pasture, and thus lengthens grazing season (+7 days); consequently, grazed DOM per cow is higher (1.75 vs 1.69 t/cow), even though grazed DOM per day is unchanged (9.86 kg/cow). Lowering SR also increases harvested DOM per cow (1.39 vs 1.21 t/cow); therefore, winter concentrate consumption per cow tends to be reduced (37 vs 50 kg/cow). 100% late 1st cut has little effect on grazed DOM at pasture, but reduces harvested DOM per cow (1.23 vs 1.37 t/cow) via a decrease in mean hay digestibility (0.59 vs 0.63) that is not compensated by an increase in dry matter yields (2.01 vs 2.02 t/cow). Thus, concentrate consumption for cows is higher for 100% late 1st cut (59 vs 28 kg/cow). Overall, whatever the management strategy, calves performance remains unchanged. Simulated agricultural output varies widely with climatic years, as in a real farm.

Conclusions This model may offer a useful tool to support discussion between research, advisory and environmental services. It can be enriched by new management rules and a biodiversity score sub-model.

References

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