

An individual-based model simulating goat response variability and long term herd performance

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Supplementary material online

Appendix A. Events of the herd model

The whole set of events processing within a functional group of the herd model are presented in Table S1. Every year, a specific event updates all the dates of the management plan enabling for the events sequence repetition. The events dedicated to the outputs collection are not presented here.

Table S1 Minimal sequence of discrete events occurring during one dairy year within a function group of the herd model. Events are written in *italics* and input parameters in **bold**; *i* refers to a goat and *j* to a diet

		Event		Condition		Action
Name	Triggered by	Triggered at	Occurrence			
<i>Replacement integration</i>	Date	$t = \text{Start Mating} - 5d$	1	Goat belonging to <i>FG'</i>		Goat moves from <i>FG'</i> to <i>FG</i>
<i>Mating group constitution</i>	Event	<i>Replacement integration</i>	1	NLAC _{<i>i</i>} = 0 NLAC _{<i>i</i>} > 0 and POT _{<i>i</i>} > MeanPOT Else		MG _{<i>i</i>} = 1 MG _{<i>i</i>} = 2 MG _{<i>i</i>} = 3
<i>MG_{<i>i</i>} mating</i>	Period	$t \geq \text{Start Mating}$ and $t \leq \text{Start Mating} + \text{BSL}$	Daily occurrence during BSL	Rand _{<i>i</i>} (0,1) < BreedSuc		$\left\{ \begin{array}{l} \text{PREG}_i = 1 \\ \text{DAT}_{\text{CON}_i} = 1 \end{array} \right.$
<i>Diagnosis</i>	Date	$t = \text{Start Mating} + \text{BSL} + 30d$	1	PREG _{<i>i</i>} = 1		$\text{DAT}_{\text{NXTKID}_i} = \text{DAT}_{\text{CON}_i} + 150d$
<i>Drying off management</i>	Event	<i>Diagnosis</i>	1	PREG _{<i>i</i>} = 1 and NLAC _{<i>i</i>} > 0 PREG _{<i>i</i>} = 0 and NLAC _{<i>i</i>} = 0 PREG _{<i>i</i>} = 0 and NLAC _{<i>i</i>} > 0		$\text{DAT}_{\text{DRY}_i} = \text{DAT}_{\text{NXTKID}_i} - 60d$ Goat culled
<i>Non-pregnant goat management</i>	Event	<i>Diagnosis</i>	1	NPregOption = 0 NPregOption = 1 POT _{<i>i</i>} > MeanPOT Else NPregOption = 2		Goat culled ExtLAC _{<i>i</i>} = 1 Goat culled ExtLAC _{<i>i</i>} = 1

<i>Drying off</i>	Goat	$t = DAT_{DRYi}$	Number of goats to be dried	NA	$LAC_i = 0$ $DAT_{DRYi} = 0$
<i>Kidding</i>	Goat	$Tp_i = 150d$	Number of kidding goats	NA	$PREG_i = 0$ $LAC_i = 1$ $DAT_{PRVKIDi} = DAT_{NXTKIDi}$ $DAT_{NXTKIDi} = 0$
<i>Replacement</i>	Animal level	$SumKID = ReplacSize * 2$	1	NA NA $VolCull_{Size} > 0$ $VolCull_{Num} < \frac{VolCull_{Size}}{2}$	Number of births in FG' $= ReplacSize * ReplacOption$ $VolCull_{Size} = FG_{Num} - 300$
<i>Voluntary Culling</i>	Date	$t = Voluntary\ Culling$	1	$NLAC_i > ThreshLN$ and $POT_i < ThreshProd$ $VolCull_{Num} < VolCull_{Size}$ $NLAC_i > 5$	Goat culled $VolCull_{Num} = VolCull_{Num} + 1$ Goat culled $VolCull_{Num} = VolCull_{Num} + 1$
<i>Diet 1 change</i>	Event	<i>Kidding</i>	Number of kidding goats	NA	$Diet_i = Diet\ 1$
<i>Diet j change</i> (for j=2 to FeedStep)	Date	$t = Start\ Mating + 150d + \frac{BSL}{2} + \sum_1^{j-1} Step_j\ length$	1	NA	$Diet_i = Diet\ j$
<i>Dry diet change</i>	Goat	$t = DAT_{DRYi}$	Number of goats to be dried	NA	$Diet_i = Dry\ Diet$
<i>Extended lactation diet change</i>	Date	$t = Start\ Mating + 150d$	1	$ExtLAC_i = 1$	$Diet_i = Diet\ 1$
<i>Mortality</i>	NA ¹		Daily occurrence	$Rand_i(0,1) < Threshdead_i$	Goat culled

BreedSuc = threshold reflecting the probability of conception associated to mating technique; BSL= breeding season length in days; DAT_{CONi} = date of conception; DAT_{DRYi} = date of drying off; $DAT_{NXTKIDi}$ = date of next kidding; $DAT_{PRVKIDi}$ = date of previous kidding; $ExtLAC_i$ = extended lactation status; $Diet_i$ = input file of goat diet ; $Diet\ j$ = input file for diet (quantity and nutritive values of each feedstuff); Feedstep = number of feed steps within feeding sequence; FG = functional group of productive goats; FG' = functional group of replacement goats; FG_{num} = number of goats present in the FG; LAC_i = lactation status; $MeanPOT$ = mean value (kg) of herd production potential distribution; MG_i = mating group; NA = not applicable; $NLAC_i$ = lactation number; $NPregOption$ = input parameter defining decision rules associated to non-pregnant goats ;

POT_i = production potential; PREG_i = pregnancy status; Rand_i(0,1) = value stochastically triggered between 0 and 1; ReplacOption = input parameter modulating the number of goats kept for replacement; ReplacSize = targeted number of does kept for replacement; Start Mating = date of mating period start; Step_jlength = time (in days) during which the diet j is distributed to the FG; SumKID = counter of kids born; Threshdead_i = threshold used to represent goat's probability of involuntary culling; ThreshLN = value of lactation number used to point goat for culling; ThreshProd = value of production potential (kg) used to point goat for culling; Tp_i = physiological time of pregnancy; Voluntary culling = date of voluntary culling session; VolCullNum = counter of goats being culled; VolCullSize = total number of goats to be culled.

¹Mortality event is daily triggered to perform the stochastic process eventually leading to goat involuntary culling.