***Supplementary Material S1.*** *Detailed presentation of the model*

The model links ecological and production dynamics at field and farm levels. We first present the decision sub-system at farm scale and then the biotechnical sub-system at field scale.

*The decision sub-system*

The relative proportions of the three grassland land uses in the farm are fixed at the start of each year, as described by the vector, ***pt***:

 (1)

At the beginning of each month, a decision is made on the stocking rate (in livestock units per hectare, LU.ha-1), ***ut****=( utMOW,utEOG, utPOG)’* allocated to the different land uses (the symbol ‘ indicates transposition). Values of ***ut*** are limited by an upper threshold, *utot*, which reflects the stocking rate at farm level. Two farm types were compared, intensive and extensive farms. They differed in two characteristics, the stocking rate at the farm level *utot* and the maximum stocking rate in *POG*. When the whole herd could not be fed with grazed biomass, fodder from mown fields was used for supplementation.

*The biotechnical sub-system*

*Grass dynamics.* Grass dynamics is an adaptation of the model developed by Tichit et al. (2007). The dynamics of grass growth and death are simulated using a monthly time step. For each land use, *j*, grass biomass, ***Btj*,** is partitioned into live and standing dead grass (i.e. ***Btj*** *= (BjL,t , BjD,t)’*) expressed as organic matter (*g.OM.m-²*), which grows, senesces, and/or decays. ***Btj*** is also affected by grazing and mowing:

 (2)

In equation (2), H represents biomass harvest by mowing *(j=MOW)* or grazing *(j=EOG,POG)* in *g*.*OM.m-2: HMOW=C(****Btj****)* and *HPOG,EOG=Gt(****Btj****).* Matrix *A* describes the rates of increase and decrease of living and dead standing grass. *A* encompasses the transition rates defining grass dynamics: growth, senescence, and decay rates. It is specified as follows:

 (S1.5)

*r2,t* and *r3,t* (month-1) represent senescence and decay rate coefficients.

Growth rate, *r1,t(****Bt****)* (month−1), accounts for live biomass remaining after senescence, (1-r2,t), and growth of live biomass that is the product of a time dependent potential growth rate under ideal environmental conditions (i.e. without nitrogen or water limitation), ***γ1,t*** (g.m−2.month−1). and the relative light interception by live mass based on Beer’s law:

 (S1.6)

Where *rs,t* represents senescence, and *β* is an attenuation coefficient.

Harvest due to grazing ***Gt***=(*GL,t; GD,t*) is comprised of grazing of living, *GL,t*, and standing dead grass, *GD,t*. Following Tichit *et al.* (2007), we assume that grazing cattle has a preference for living grass and would only consume dead grass if no living grass was available:

 (S1.7)

In mown fields, harvest occurs only once a year at time *tC*. A residual grass biomass, *BR*, is present after mowing. Biomass off-take due to mowing is:

 (S1.8)

with k=0,1,...,K-1, where K is the number of years in the temporal horizon

*Bird dynamics.* The bird dynamics model is a spatial adaptation of the Sabatier et al. (2010) model. Population dynamics of each wader species are represented as staged structured matrix models (Caswell, 1989) with three classes: juveniles, sub-adults, and adults (suffixes 0, 1 and 2). Each population is divided into three sub-populations corresponding to the three land uses (*MOW*, *POG*, and *EOG*). The population of each species is described by a (9x1) vector, ***Nt*** :

 (S1.9)

with ***Njt,i***the density of birds of age class, *i*, and subject to land use, *j*, at time, *t*, and the symbol, ’, indicates transposition.

Wader dynamics from time, *t*, to time, *t+1*, is described by:

 (S1.10)

where *Mt* is the demographic matrix, *Rt* is the habitat selection matrix, and *ht=(htMOW, htEOG, htPOG)* is grass height at time, *t*, expressed as:

 (S1.11)

The two matrixes, *Mt* and *Rt*, account for class and spatial fluxes, respectively.

Habitat selection matrix, *Rt*, addresses selection of nesting sites by adults and selection of foraging habitat by juveniles. Matrix, *Mt*, describes life traits of the bird species and the direct and indirect effects of grassland management regime.

*Bird demography.* The life cycles of the two species are marked by four demographic events: reproduction, juvenile survival, sub-adult survival, and adult survival. Focusing on migratory birds, we consider that grassland management only affects reproduction and juvenile survival, and define adult and sub-adult survival as constants *s2* and *s1*, respectively. Demographic parameters are included in the Leslie matrix, *Mt*: clutch size parameters are on the first row, and survival parameters are on the sub diagonal.

Clutch size (reproduction), *f*, depends on the number of eggs per bird without trampling, *αi*, and on the effect of nest trampling by cattle (Beintema and Muskens 1987) or mechanical destruction of nests by mowing (Labisky, 1957; Berg *et al.,* 1992).

In grazed fields (*EOG* and *POG*), clutch size is calculated as:

 *t=t\*+k, k=1,...,K-1* (S1.12)

where *η* is the effect of trampling on eggs at a stocking rate of 1 LU.ha-1 during one day, *τ* is the incubation length of eggs for the species considered, *t\** is the month of reproduction and *j=EOG,POG*.

In mowed field, the clutch size is calculated as:

 (S1.13)

were *m* is the mortality induced by mowing, and k=1,...K-1.

Juvenile survival depends on grass height and a density dependence effect. Grass height, *htj*, is a good proxy for wader habitat quality because it reflects predation risk and food availability (Durant *et al.,* 2008). Similar to Tichit *et al.* (2007) and Sabatier *et al.* (2010), the effect of grass height on juvenile survival is included in the model using a threshold function, *φ(htj)*. A Beverton-Holt function with a coefficient of intra-specific competition, *c*, is used to include the effect of density dependence in the model. Juvenile survival is:

 (S1.14)

*Habitat selection.* There are two stages during which habitat selection is important. First, adult lapwing and redshank select nesting sites at the start of the breeding season (Galbraith, 1989; Berg *et al.,* 1992). Second, soon after hatching, juveniles leave the nest and start foraging in the surrounding area, accompanied by their parents (Blomqvist and Johansson, 1995). In this study, we only modelled movements at these two stages, implicitly assuming that the birds were able to use the whole farm as soon as they were able to fly. Habitat selection appeared to depend on habitat characteristics, which we summarized using grass height, *ht*. More precisely, we assumed that habitat selection depended on expected survival (a function of habitat quality) and reflected an ideal free distribution of the birds in space (Houston, 2008). Mathematically, we define *rjj’(h,p)* as the probability that a bird of a given life stage would shift from the habitat of land use, *j*, to the habitat of land use *j’*. For adults and sub-adults in land use *j,* *rjj’(h,p)* represents the probability that they would reproduce in land use *j’* at the next nesting event. For juveniles hatched in land use *j,* *rjj’(h,p)* represents the probability that they would forage in land use *j’*:

 (S1.15)

The probability of shift to another habitat depends on the expected survival in the target habitat, *φ*(*hj’*). Each *rjj’(h,p)* constitutes an element of the habitat selection matrix, *R*.

Juvenile mortality can be important during movement to the foraging site (Blomqvist and Johansson, 1995). Thus, in the case of habitat shift from one management regime to another, juvenile survival is affected by a coefficient, *(1-d)*, and *d* is the fraction of mortality due to juvenile movement.

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