Sequence 2 : The farm model

Unit 2.2 : Multi-annual decisions in an annual model

Lesson 16 : Livestock

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Introduction

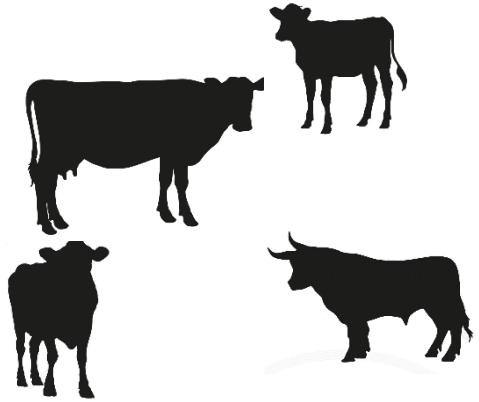
- Modelling livestock
- Necessary knowledge :
  - Zootechnics
- Non-specific constraints, but with integration of livestock activities
- Specific constraints :
  - Herd management
  - Herd diet

Livestock : a multi-annual activity in a static model

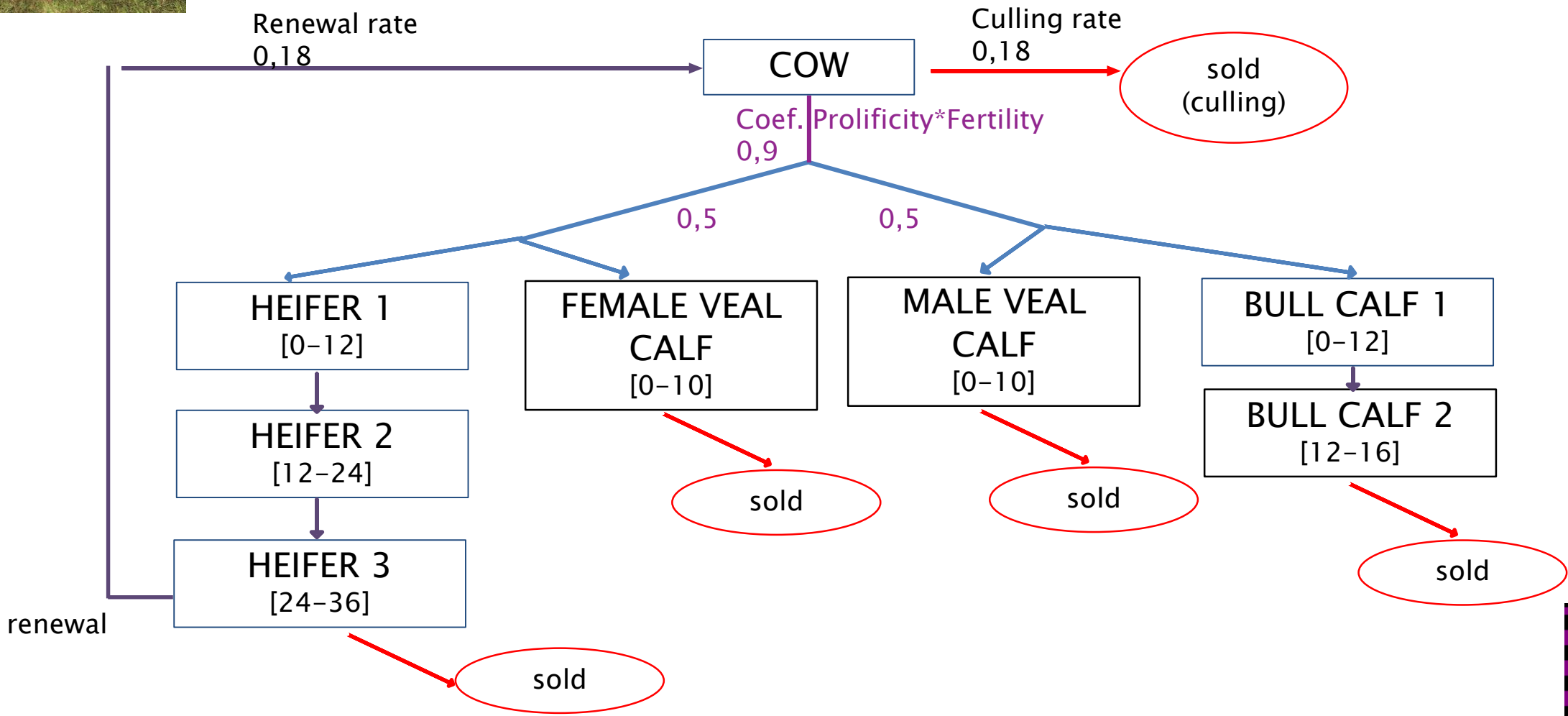
Farm decisions : made for several years

But representation :
Annual static model -> “routine year”

Herd management ?



Example : suckler herd farm
Relations between the animals



- A all animals : cow, mcalf, fcalf, hei1, hei2, hei3, bull1, bull2
- N(A) : animals present
- V(A) : animals sold

Equations	
0,9*0,5*N(cow) = N(fcalf) + N(hei1)	N(mcalf) + N(bull1) = 0,9*0,5*N(cow)
V(fcalf) = N(fcalf)	V(mcalf) = N(mcalf)
N(hei1) = N(hei2) N(hei2) = N(hei3)	N(bull1) = N(bull2)
N(hei3) = V(hei3) + 0,18*N(cow)	V(bull2) = N(bull2)
V(cow) = 0,18*N(cow)	

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Describing animal food needs

Animal food needs can be expressed :

- In terms of diet (kg of hay, of maize, of concentrate, etc. for each category of animal)
  - Several types of rations can be indicated

OR

- In terms of energy contents (for example in Fodder Units, FU)
  - The model chooses the food categories

Example : describing animal food needs

Animals produced	Live weight	Growth rate	FU needs	Diet (in FU)	Diet
Cow	600 kg		2205 FU	661 FU cereal crops 772 FU hay 772 FU grass	661 kg grain 1543 kg DM hay 1187 kg DM grass
Veal calf	40kg at birth 227kg sold at 10 months old	600 g/d	600 FU milk and 594 FU	600 FU milk and 119 FU cereal crops 237 FU hay 237 FU grass	1000 L milk 119 kg grain 474 kg DM hay 365 kg DM grass
Heifer 1	40kg at birth 260kg at the end of the year	600 g/d	600 FU milk and 713 FU	600 FU milk 143 FU cereal crops 285 FU hay 285 FU grass	1000 L milk 143 kg grain 570 kg DM hay 438 kg DM grass

calves

In our calculations, we considered :
- 1 kg of cereal crops = 1 FU ;
- 1 kg of hay dm = 0.5 FU ;
- 1kg of grass dm = 0.65 FU
- grassland productivity : 5 tonnes of dry matter per ha (mowed or grazed)

MILK :
- The calves are initially fed milk from their mothers.
- One litre of milk provides 0,6 FU and makes them gain 100g in terms of growth.
- In order to produce 1 litre of milk, the cow needs 0,45 FU.

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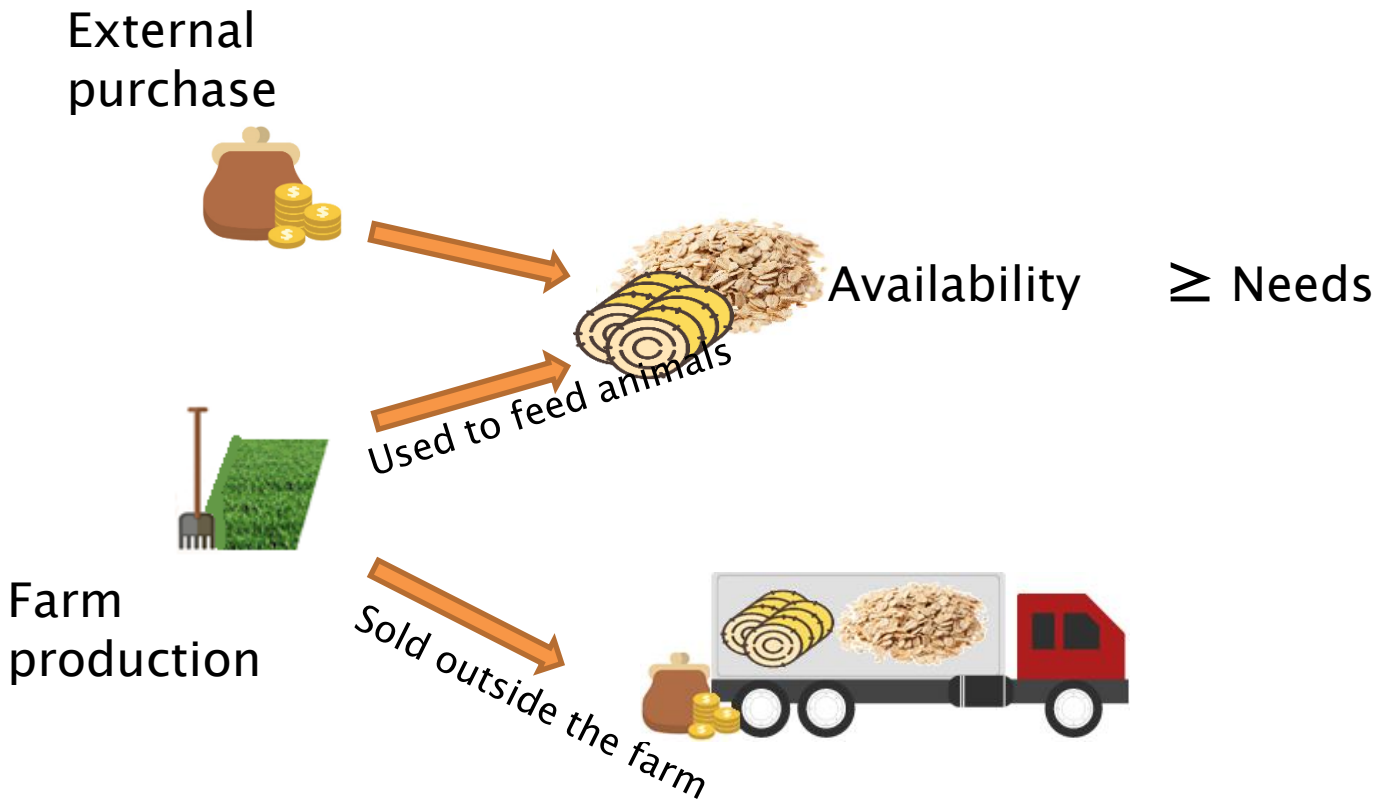
Meeting needs



In GAMS :

```
FOOD(C).. sum(A, BES(A,C)*NB(A)) =l= RDT(C)*S(C)-V(C) ;
```

Objective function

Global gross margin = gross margin plant-based activity + gross margin animal-based activity

MB_{plant} :[PC(C)*YLD(C)-COST(C)]*X(C)

MB_{animal} : AV(A)*PXA(A)- food - other costs

What is written in GAMS :

```
sum(A,AV(A)*PXA(A))
+ sum(C,V(C)*PC(C)) -sum(C,X(C)*COST(C)) =e= Z
```

Example : suckler herd farm

- UAA : 100 ha
- Hours of labour per year : 2000 h

- Culling/renewal rates : 18%
- Prolificity rate : 90%
- Sex ratio : 50%

- Three crops : barley, grass, hay
- Barley selling price : 100€/tonne

	Yield (kg/ha)	Cost (€/ha)	Hours of labour needed (h/ha/an)
Barley	6000	380	20
Grass	2000	50	8
Hay	3000	100	10

	Diet	Hours of labour needed (h/ha/an)	Selling price (in €)
Cow	661 kg grain 1543 kg DM hay 1187 kg DM grass	10	1000
Veal calf	119 kg grain 474 kg DM hay 365 kg DM grass	4	Female : 695 Male : 650
Heifer 1	143 kg grain 570 kg MS foin 438 kg MS herbe	6	

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