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Animal mobility helps optimizing forage systems. Case of the relationship between Burgundy and Northern Italy.

Animal mobility is a common theme among zootechnicians. It concerns the use of space by animals and also breeding system management. This theme, particularly developed in the case of both nomad and transhumant systems, can be studied in the grassland systems of temperate areas, regarding cattle exchanges between areas, based on the principle of getting the greatest value from the rarest elements, or as regards herd moving, to exploit a remote resource within a sedentary system. The present work lies on the assumption that bovine mobility brings some flexibility to suckler herd management by shortening the production cycle of male cattle which helps to increase the number of female livestock, conditioning income, (Veysset *et al.*, 2005) or by use of fields at a certain distance.

I- The evolution of the suckler herd in Burgundy depends upon Northern Italy

Evolution of forage areas and herbivorous livestock in Burgundy

The forage area in Burgundy dropped by 9.4 % between 1989 and 2005 *i.e.* more than the Utilized Farm Area which decreased by 3.3 %. The number of herbivorous livestock decreased by 2.1 % and consequently the herbivorous stocking rate increased by 8.2 % because of the reduction of forage area (table 1).

Table 1: Evolution of herbivorous livestock and surface area in Burgundy between 1989 and 2005

Source: agreste on Internet

	2005	1989	Variation from 1989 to 2005	Variation from 1989 to 2005 (%)
Utilized Farm Area (ha)	1,860,908	1,923,092	-62,184	**-3.3**
Forage Area (ha)	927,089	1,023,510	- 96,421	**-9.4**
LU (Livestock Unit) total[1]	958,003	978,402	- 20,399	**- 2.1**
LU dairy cows	62,300	89,700	-27,400	**-30**
LU suckler cows	387,175	360,740	+26,435	**+7**
LU other bovines	288,030	299,180	-11,150	**-4**
LU goats	4,352	6,613	-2,261	**-34**
LU ewes	30,495	49,995	-19,500	**-39**
LU saddle horses	11,732	8,238	+3,494	**+42.4**
LU Draught horses	2,530	3,163	-633	**-20.0**
Stocking rate (LU /ha forage)[2]	1.03	0.95	+0.078	**+8.2**
Dairy cows (head)	62,300	89,700	- 27,400	**-30**
Suckler cows (head)	455,500	424,400	+31,100	**+7**
Ewes (head)	203,300	333,300	- 130,000	**-39**
Store cattle output (head)	335,136	320,800	+14,336	**+4.5**
Store cattle + 1 year (head)	182,178	232,800	-50,622	**-22**
Store cattle –1 year (head)	152,958	88,000	+ 64,958	**+74**

The herbivorous livestock evolution was due to the dairy cow decrease which amounted to minus 27,400 Livestock Units (LU). The 130,000-ewe decrease was equivalent to minus 19,500 LU. Both decreases were partly offset by the suckler cow increase which amounted to plus 26,300 LU. The number of suckler cows reached its maximum in 2001. This was caused partly by a marked disruption of the markets in 2000 linked to BSE cases and foot-and-mouth disease. The second hypothesis was the compulsory introduction of 15 % of heifers among premium cows since 2001 which has slowed down the growth of livestock (more non-premium cows) (Jambon e*t al*., 2001).

[1] The coefficients used are those of agricultural statistics for herbivores LU.
[2] Total Herbivorous LU in Burgundy / Forage Area

Nevertheless the herbivorous herd evolution covers two phenomena which are worth dissociating :

- an intensification effect corresponding to 8.1 % of LU,
- a particular effect of increase or decrease in each herbivorous category corresponding to 7.1 % of LU (calculation in appendix 1).

The contribution for each herbivorous category has been calculated apart from the intensification effect (table 2).

Table 2: Contribution of the various herbivorous categories to the evolution of herbivorous Livestock Units in Burgundy between 1989 and 2005

Fewer LU		More LU	
Dairy cows	25,530	Suckler cows	33,956
Ewes	18,459	Bovines <1 year of age	16,622
Other bovines	12,044	Suckler heifers	11,829
Milk heifers	5,037	Saddle horses	3,666
Goats	2,123	Bulls	340
Female lambs	2,042	Donkeys	331
Other ovines	928		
Draught horses	567		
Other caprines	14		
Total (1)	66,744	Total	66,744

(1) In 2005 the herbivorous Livestock Unit sum resulted from the fall of forage areas and an intensification effect which we regard conventionally as equivalent for all herbivores. Consequently, the specific dynamic sum of the various herbivorous categories must be null. So the sum of positive or negative effects shows the significance of substitutions between each herbivorous category.

In between the 1988 and 2000 censuses, the OTEX "beef cattle", "large-scale cultivation and herbivores" and "large-scale farming industry" benefited from the growth of the suckler herd conversely to other OTEX, in particular "sheep, caprines and other herbivores" and "milk-meat cattle". This went along with a trend towards suckler cow specialization and concentration (Dussol, 2002).

Evolution of animal output

As regards bovine output, the number of store cattle from the farm increases by 4.5% with the rejuvenation trend (table 1). This rejuvenation imparts to the system a greater flexibility for increasing the herd (part 2) by removing wintering (GEB, 2003). In addition, the adjustment made to reach the extensive level is more worthwhile than the fall in cow numbers [3]. From a marketed male cattle observatory (breeders' cooperative representing half of the cattle trade) in the Charolais region, we can observe that the share of the store cattle increased from 67.1 % to 78.4 % between 1998 and 2005 (table 3).

The number of baby beef decreases (29.5 % to 18.4 %). Among the store cattle, heavy grazing calves and back grazing calf increase (32.4 to 59.4 %) whereas both grazing calves and store young bull decrease. As for the Charolais cows and heifers, the share of finished cows and finished heifers were respectively 68.6 % and 42.8 % in 2005 (table 4).These finishing rates, which reached their maximum in 2001, have tended to drop significantly as far as cows are concerned.

[3] 0,6 LU between 6 months and 2 years proportionally to the length of presence since the year 2000, 6 months for 0,6 LU make it possible to gain 0,3 LU. It just needs having 3 younger males to have one more cow with equivalent stocking rate.

[4] A geographical area larger than Burgundy but more representative of Charolais systems.

Table 3: Marketing of Chorolais male cattle by breeders' cooperatives in the Charolais area, in the years 1998, 2001 and 2005 (%)

Source :stockbreeders' network, from 1999 to 2006

Years	1998	2001	2005	Years	1998	2001	2005
Grazing calves (%)	21.6	14.8	12.1	Store males (%)	67.1	70.1	78.4
Heavy grazing calf or back grazing calf (%)	32.4	44 .0	59.4				
Store young bull (%)	13,1	11,4	6,8				
Baby beef (%)	29.5	25.0	18.4	Finished males (%)	32.9	29.9	21.6
Steers (%)	3.4	4.9	3.2				
Total male	100	100	100	Total male	100	100	100

Table 4: Marketing of Charolais females by the stockbreeders' cooperatives in the Charolais area in 1998, 2001 and 2005 (%)

	2005	2001	1998
% finished cows	68.6	83.2	76.9
% finished herfers	42.8	45.9	31.3

We lack reference before 1998 but according to our research, the finishing rates were lower in the previous years. On the other hand, the lowering of this finishing rate raises some questions, it is probably linked to back grounding. Thus complementarily the fall in the number of store young bull vacates grass area which can be used for rearing more cows and the maize silage allows to increase the back grounding of grazing calves.
One can observe a concentration of the heavy grazing calves category with back grounding and the finishing rate of the females somehow constitutes the adjustment variable to increase back grounding.

Export to Italy

Whereas the number of store cattle imported by the Italians decreased, the French share in the number of store cattle imported by Italy increased between 1999 and 2004 (see table 5), it currently represents 83 %.

Table 5 : Store cattle import by Italy

	1999	2000	2001	2002	2003	2004
Total import store cattle in Italy (head x 1000)	1,093	930	803	910	942	881
From France (head x 1000)	792	700	663	762	789	730
Part from France %	72.5	75.3	82.6	83.7	83.8	82.9

In 2005, Burgundy exported 280,000 bovines made up of 170,000 *grazing calves*, 80,000 heifers and 30,000 cows. Two thirds of bovines are exported towards Italy (132,000 males and 44,000 females). This flow accounted for 22% of French exports.

Bovine flow between Burgundy and Italy and forage area

If we consider a 2-ton consumption of dry matter forage by head for fattening (for instance maize silage), we can evaluate 352,000 tons of dry matter necessary in Italy to fatten store cattle from Burgundy. With a high output in maize silage of 18 tons of dry matter per hectare (figure from l'Institut de l'Elevage, 2005), we can estimate that fattening the store cattle in Italy requires approximately 20,000 ha. The same mode of fattening-up applied in Burgundy would require twice the area, which means 40,000 ha (output of 9 tons dry matter per ha). It is equivalent to 37,600 LU in Burgundy.
The externalisation of the fattening-up function allows a theoretical gain of 22,000 more suckler cows in Burgundy. At the same time, to obtain this 132,000-male-bovine flow, Italy should maintain a herd of 287,000 suckler cows which implies 500 to 600,000 ha of permanent grass area which are not easily available in this country. We mustn't forget that the Utilized Farm Area in Italy is only 13 million ha.

II – Plasticity of the Charolais breeding systems

The mobility of male bovines from Burgundy towards Italy is linked with a great plasticity (adaptability to changes**,** flexibility). Back grounding or fattening-up of male bovines have a cost in fodder (hay or maize silage) or in grazed area (table 6).

Table 6 : Necessary forage to different cattle output of charolais suckler breed

Source :from Réseau d'Elevage Charolais 1999 a et b

	Grazing calf	Back grazing calf		Store young bull	Baby beef	Steers
	No specific area	Back grounding with hay	Back grounding with maize silage	Back grounding with hay and pasture year 2	Fattening with maize silage	Hay, maize silage, pasture year 2 et year 3
Hay (kg DM)	0	200 à 500		700	0	320+1750
Maize silage (kg DM)	0		400 à 700		1,200 à 2000	1,000
Pasture (ha)	0		0	0.30	0	0.70
Hay area (ha/head)	0	0.04 à 0.1		0.14	0	0.4
Maize silage area (ha/hea)	0		0.04 à 0.07	0	0.12 à 0.2	0.10

On principle, grazing calves do not graze on fodder areas except for the pastures which they share with their mothers.
Back grounding needs hay (from 200 to 500 kg of dry matter) or maize silage (400 to 700 kg of dry matter). The store young bulls require hay and grazing ground. The baby beef which are usually fattened up with maize silage do not need grazed area after weaning. Finally, the steers require hay over two consecutive years, both grazing ground and maize silage.
On this basis, we can evaluate a cow equivalent for each substitution of a grazing calf by a bovine with a longer cycle (see parameters in appendix 2). Steers have a very large impact on the need for fodder area to cows'detriment. The calving potential drops by 0.45 per fattened steer which implies 45 fewer calvings for a 100- suckler cow herd. Fattening–up baby beef with maize silage brings about a drop of 6 calvings for 100 cows and back grounding a drop by 3 calvings for 100 cows. Thus with the same quantity of maize silage, it is possible to do back grounding for 3 grazing calves or to fatten one baby beef. As regards the zootechnical aspect, back grounding is practiced with one-year-old Charolais bovines just before puberty which places them in a maximum growth zone with a moderate feed efficiency and a maximum average daily gain.

Table 7: Substitution between bovine types and impact on calving number

Baby beef Production with 1500 kg DM maize silage in replacing of :	**Calving decrease per male**	**Calving decrease 100 cows**
Grazing calf	0.13	6.0
Back grazing calf with 250 kg /or 500 kg hay	0.08/0.04	3.7/1.8
Back grazing calf w. 400 kg /or 800 kg maize silage	0.09/0.06	4.1/2.8
Steer production in replacing of :		
Grazing calf	1.05	48.3
Back grazing calf with 250 kg /or 500 kg hay	1.01/0.97	46.5/44.6
Back grazing calf w. 400 kg /or 800 kg maize silage	1.02/0.98	46.9/45.1
Replacing grazing calf by :		
Back grazing calf with 500 kg hay	0.08	3.68
Back grazing calf with 800 kg de maize silage	0.07	3.22
Replacing store young bull by steer	0.41	18.9
Replacing grazing calf by store young bull	0.34	15.6
	Fewer calvings per female	Fewer calvings e by 100 ?
Replacing grazing calf (female) by heifer	0.97	22.3

As regards female bovines, a similar calculation can be performed. Each heifer which is breeded and fattened beyond the necessary cow renewal reduces the output by about one calving.

Discussion et conclusion

In a context in which the maintenance of income is linked to herd size, priority is given to the increasing of livestock per farm as shown by the regional statistics (93 heads by farm in 1988 and 150 heads by farm in 2000 ;

Dussol, 2003). Leaving aside economic comparisons of systems (which usually enhance the limited advantages of fattening-up), today the stockbreeders' strategy is in favour of larger livestock numbers which can increase with more flexibility and less risk.
There are few maize silage areas in Burgundy, therefore stockbreeders keep this forage for back grounding or the finishing of female bovines. They privilege cattle using a maximum amount of grass. The complementarity with Italy supports this tendency. Bovine mobility via export to Italy is in favour of the female livestock but not in favour of meat output [4] .In Italy the rare factor is the land and its high price which first and foremost must be made profitable. In Burgundy the suckler livestock systems enjoy large dimensions and allow a moderate intensification to obtain sufficient income.
As regards sustainability, the transport cost might be a weak point : the livestock transport from Burgundy towards Northern Italy costs 0.10 € per kg of live cattle (2,200 € for 22 tons).The transport conditions of the cattle must be considered as well because of the duration of the journey (from 8 to 10 hours). Lastly, the problem of cattle effluents must be considered too, because of groundwater pollution in Italy. According to the 'Institut de l'Elevage' (2005), 15 to 20 % of land in the 4 major fattening areas in Northern Italy are in vulnerable zones. According to the new calculation standards (34 nitrogen units per young bull), the allowed rate is 5 baby beef per ha in vulnerable zones and 10 baby beef in non-vulnerable zones. Problems seem densely located in some areas but this does not call into question the cattle flow towards Italy.

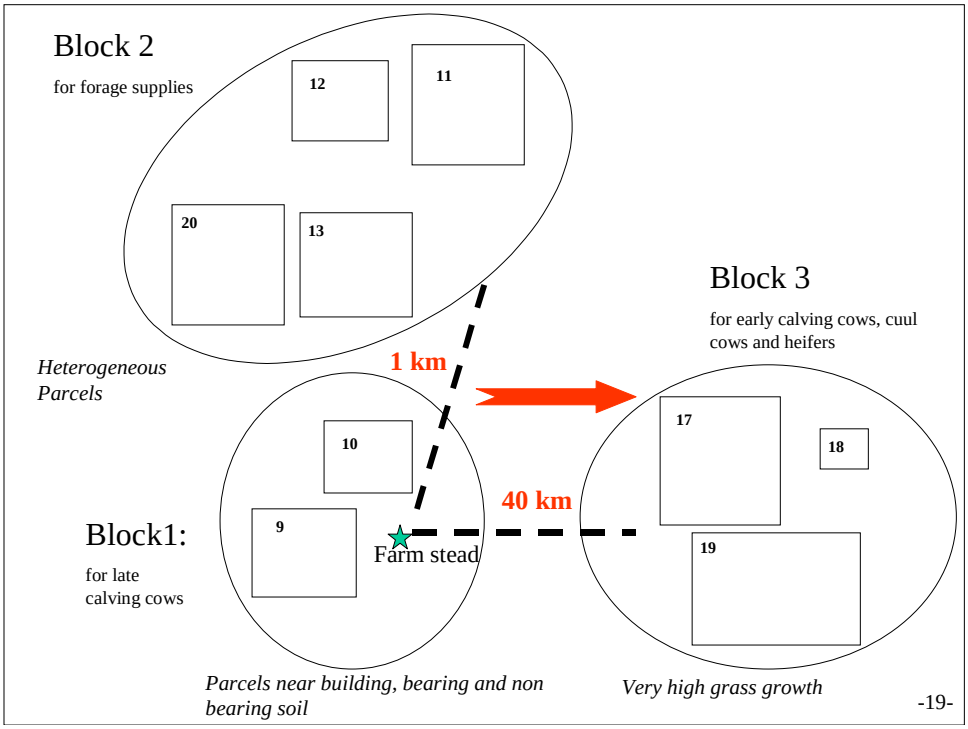
III - Animal mobility gives flexibility to a cattle-breeding farm faced with the constraint of distant fields

The suckler cattle system without daily milking allows a remote management of animal batches with the possibility of delegating monitoring. This aspect of animal mobility is also worth describing**.** We refer to a case study carried out by students of ENESAD[5].
Mr G. farms 180 ha including 118 ha of permanent grass and 87 charolais suckler cows ; besides he sells *thin grazing calves*.
The farm characteristic is to manage two sites 40 km away from each other :

- site 1 with 72 ha of grass in "Plateau de Langres", cold area in winter which dries out in summer,
- site 2 with 46 ha of grass in the "Bassigny" area with clayey soils, explosive grass growth in springtime.

The farmstead and the livestock buildings are located on site 1 (figure1). These buildings are too small to accommodate cattle.

Figure 1: Field pattern schematization of Mr. G.



[4] The potential of male bovines fattened in Burgundy amounts to 176,000 heads which represents 120,000 tons of livestock (680 kg per head). 21,000 cows produce 11,550 tons of live cattle (550 kg alive/cow) which implies a difference of around 100,000 tons of alive cattle 'lost' for Burgundy. The productivity of grassland systems varies from 350 to 400 alive kg per ha whereas maize silage in Italy makes it possible to rear 9 bull-calves/ha which means 2,500 alive kg (each head grows by 280kg).

[5] Etablissement National d'Enseignement Supérieur Agronomique de Dijon

The management difficulty is the supplies of grass which does not grow very long near the farmstead. Conversely, on site 2, the explosive grass growth must be managed. The alternative is either to constitute important fodder stock to be brought back from site 2 towards site 1 or to move cattle to site 2 to favour grazing and constitute forage stocks on site 1. The latter solution has been adopted.
The general rule is to not produce hay on site 2 which is far away. All the hay is then harvested on site 1, and if need be, the pasture area is reduced. During drought periods, the stockbreeder can buy grass in complement. With these major constraints, the general rule of cattle management is to split the herd into two batches:

- a first batch of suckler cows which calve before Christmast in order to use the livestock building ; cows are artificially inseminated.
- a second batch made up of suckler cows - with reproduction by natural service - which calve in February-March. These cows stay as long as possible outdoors to limit cattle in the building.

The schematized field pattern shows the general logic of this farm's management (figure 1). We can see three blocks of land.

1 - A first block with 2 parcels near the buildings (9 & 10) used for the pasture of late calving cows and for hay. One of the 2 parcels has bearing soil (9) whereas the other has non-bearing soil. So when it rains heavily, the cattle can move onto the first parcel. The fodder stock on these parcels can be adjusted by reducing the pasture area.

2- A second block with 4 parcels (11, 12, 13 and 20) is very heterogeneous for agricultural capabilities with drying slopes and a wet bottom**.** On 2 parcels (12 and 11 partly), the farmer produces grass silage. On the other parcels (remains of parcel 11, 20 and 13), he harvests hay. At the end of the season, the cattle from parcel 2 move here. Parcel 13 is used as winter pasture.

3- Finally, block 2 is used as grazing for suckler cows and heifers (parcels 17 and 19) or cull cows (piece 18). Between May 15th and June15th a field closed to grazing animals (10 ha) is used as grass reserve to avoid wastage.

This example enhances the interest of the mobility of cattle batches to overcome a important constraint linked to distance. The choice of maximum pasture system enables the farmer to make the best use of grass for grazing. It is characteristic of this suckler cow system. The grazed grass valorization is optimal since it accounts for 2/3 of the annual feed ration in this system.

Conclusion

The suckler farming systems of Burgundy, mostly Charolais systems, remain basically grassland systems. Similarly, at the turn of the twentieth century the arrival of the railway brought opportunities in the specialized meat systems. The livestock road transport has opened up new prospects for these breeding systems. The development of trade with the Italian market has contributed to improve farming systems in Burgundy. The void created by the departure of male bovines generates, by communicating vessels, the production of finished females adapted to the French market. Gradually the breeding systems have adapted to the system of premiums : back grounding to have the first male premium bovine and shortening the cycle to decrease the stocking rate. As regards the zootechnical aspect, back grounding near one-year-old Charolais bovines places them in a maximum growth zone with a moderate feed efficiency and a maximum average daily gain. As a consequence, mobility decisively favours flexibility in the farming system. The fattening function is delegated to the Italians, somehow share maize silage areas of Italy are integrated into the fodder system of Burgundy and conversely the stockmen of Burgundy are the cattle breeders of the Italians.
Basically, there should be no problem as long as the relationship is balanced. The possible question is sustainability : environmental problems linked to the concentration of cattle-breeding farms on the Italian side, the fragility of slaughterhouse system on the French side, or even a sanitary crisis (?).

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Internet site

AGRESTE : http://agreste.maapar.lbn.fr/TableViewer/dimView.aspx Consulted on May 22nd 2007

Appendix 1 : Calculation of the specific dynamics of different herbivorous types in Burgundy between 1989 and 2005

In absolute variation of L.U. number, we can dissociate 2 effects :
an effect due to the intensification of livestock production on forage area and a specific effect of dynamics of each animal type (increase or decrease). In order to dissociate these 2 effects, firstly we reason about the intensification effect which can be estimated with the LU total. On the assumption that all herbivorous types have the same stocking rate, the reasoning is as follows:
- There were 978,402 LU in 1989, if the stocking rate were identical in 2005, we would have 978,402 * (927,089 / 1,023,510) = 886,230 LU (ratio to fodder surface).
- Actually, the number of LU in 2005 was 958,003, thus the intensification effect of fodder surface is 958,003-886230 = 71,713 LU that is to say 8.1 % LU more (71,773 / 886,230 * 100). The intensification increases the number of LU by 8.1 % per ha.

Specific dynamics of different herbivorous types

The average fall of herbivorous L.U. represents 2.1 % (978,402-958,003)/958,003)

Suckler cow specific dynamics**:**
If we apply the fall of 2.08 %, we should have 353,219 LU suckler cows. Actually there are 387,175 LU which means a specific dynamic of +33,956 LU. Thus the current number (387175) results from :
- numbers if identical stocking rate (360,740*927,089/1023510): 326,756 LU
- intensification effect (326756*0.0809868) (8.1 %): +26,463 LU
- specific effect: + 33,956 LU

An identical calculation is used for all types of cattle.

Appendix 2 **: Assumptions for calculating the substitution between herbivorous types**

Numerical productivity 92 % which means 46 males and 46 females per 100 cows.
Steers : Selected areas:
- 2,070 kg hay, 5,000 kg/ha are 0.41 ha
- 1,000 kg maize silage are 0.1 ha
- pasture:

2 generations with 0.4 and 0.8 LU which represents 1.2 LU per year with 60 ares by LU = 0.72 ha
Baby beef :
- 1500 kg dry matter maize silage that is to say 0.15 ha

store young bull *:*
- 700 kg of hay = 0.14 ha
- pasture 0.4 LU is 0.24 ha

Back grazing calves
- 250 kg hay = 0.05 ha
- - 500 kg hay = 0.1 ha
- - 400 kg maize silage = 0.04 ha
- - 800 kg f maize silage = 0.08 ha

The areas used for the lengthening of the cycle are deducted from grass areas. It allows to calculate fewer LU corresponding to less grass areas on the basis of an average stocking rate of 1.2 LU/ha. On an average there are 1.4 LU per calving in the cattle-breeding system, which enables us to evaluate the number of fewer calvings.