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Abstract. In this paper, we discuss the productive and economic implications of several options for the future Common Agricultural Policy (CAP) focusing on French dairy farms (as France includes 16% of the EU milk quota). The options studied follow the proposals made by the European Commission in May 2008 for the "Health Check" of the CAP. We examine the cross effects, on the productive strategy of French dairy farms, of the phasing out of milk quotas and a simplification of the single payment scheme (adoption of a full decoupling and implementation of a regionalization). To do this, a model based on mathematical programming has been developed. This bio-economic model enables us to measure the impact of a change in the CAP on supply behaviour. While respecting the principle of agent rationality (maximization of profit), the model incorporates the economic risk related to the volatility of input and output prices thanks to the "Utility efficient programming" method. Thus, the model maximises the expected utility of income while taking into account a set of constraints: regulatory, structural, zootechnical, agronomic and environmental. The model is applied to four types of dairy farms to reflect the diversity of production systems in the west of France. The model is used to produce quantitative estimations and to evaluate policy changes through the simulation of the CAP Health Check implementation. The results show that with the end of milk quota system, dairy farmers have a high productive potential. The adoption of a full decoupling of the single payment encourages farmers to substitute a part of corn silage by grass. However, rising prices of agricultural production encourage, on the contrary, farmers to intensify their system in order to free up land for growing cereals.

Keywords: dairy farm, CAP Health Check, abolition of milk quotas, price volatility, bio-economic model, Utility efficient programming

JEL classification: Q12 – Q18 – C61

INTRODUCTION

For dairy farmers, the Luxemburg agreement, decided in 2003, marked a new phase in the process of Common Agriculture Policy (CAP) reform. The direct payments were decoupled and the Single Payment Scheme (SPS) was implemented. It was the first time, since the setting up of milk quota in 1984, that the dairy common market organisation was deeply modified. This reform aimed to increase the competitiveness of European agriculture and to promote a market orientated agricultural sector. The Health Check of the CAP maintains these objectives and the European Commission made several proposals in this sense (2008) :

i) Increase of milk quota by 1% annually from 2009 to 2013 to help the sector with gradual transitional measures to prepare to a market without quotas post 2015.
ii) The removal of the set aside: set aside entitlements become normal entitlements;
iii) Full decoupling for vegetal production and animal activities;
iv) These proposals allow Member States to change their decisions on the implementation of the SPS model: Member States applying the historic model are allowed to change over to the regional model.

v) In EU-15, basic modulation, applying to all payments above € 5 000, increases by 2% annually from 2009 until it reaches 13% in 2012.

In France, more than in some others EU member states, these proposals raise questions because the national authorities chose a partial decoupling and the allocation of the single payment based on historical references. Moreover, these authorities have historically favoured a balanced geographical distribution of milk production through an administration of milk quotas. For French dairy farmers, these changes occurred simultaneously with an unprecedented market situation, namely high price fluctuations of agricultural raw materials.

In this context, the aim of this article is to study the implications of CAP Health Check modifications on dairy farmers' behaviour with different hypothetical prices. A Linear Programming (LP) model is used and applied to dairy farms in western regions of France. These regions represent 45% of French milk production and 8% of European (EU-27) milk production (Perrot et al: 2007). Our approach enables a representation of the system with a high level of accuracy. This model pays particular attention to the interactions between the feeding system and the management of land and to the farmer's sensitivity to price changes.

This paper is divided into two parts. In the first part, a description of the mathematical model is presented ; in the second part, some simulations are performed to analyse the impact of the CAP Health Check proposals on dairy farms. These simulations try to resolve these three following questions: i) What would be the productive implications of the abolishment of milk quotas? ii) What would be the consequences of the implementation of a full decoupling, particularly for agricultural productions associated with the dairy activity? iii) What would be the effects of the implementation of a more uniform single payment amount between farms in the same region? For these three issues, the sensitivity of the results is evaluated by taking into account several price options for cereals and livestock.

1. METHODOLOGY

1.1. Linear Programming: a Farm Level Approach

LP is a mathematical technique which enables us to represent the farm functioning in reaction to a set of constraints. LP has long been used as a farm analysis tool because its hypotheses correspond to those of classic micro economics: rationality and the optimising nature of the agent (Hazell and Norton, 1986). This method has several limitations that are inherent to this technique: the yields of the inputs are linear; producers act in a situation of perfect information and adjustments between the inputs are instantaneous. However, the strength of this approach is to represent precisely the productive complexity of the farm. It also allows us to study the threshold effects and to calculate dual values of inputs. Farm-level modelling enables simultaneous consideration of production, price and policy information. LP can: (i) incorporate new production techniques by adding new activities, (ii) agricultural and environmental policy by including new restrictions or by putting levies on undesired outputs.

1.2. One Model for Four Types of Farming

In order to represent the diversity of farms in the West of France, the model integrates four different "types of farming" based on the annual survey of the Institut de l'Elevage (400 dairy producers in this region). The West of France is composed of 42,000 dairy farms: they produce 11 millions of tons of milk per year which is approximately the Netherlands milk production and twice that of Denmark. The average size of farms (243,000 liters of milk quota) is smaller than the other dairy farms in the EU (279,000 liters of milk quota).

1: *"Grazier farm"* is a 78 ha family farm with 255,000 liters of milk quota. It produces milk with a large part of grass, which provides high food autonomy. The milk yield per cow is low (5,500 liters per year) but the prices of milk and meat are higher thanks to a better milk composition (fat and protein) and heavier carcasses (Normand cow). The age of first calving is 30 months and the calving period is in the spring. Cows are housed for 4 months while they consume corn silage. This system represents 8% of the operations in this area.

2: *"Semi-intensive farm"* is a 50 ha family farm with 290,000 liters of milk quota (18% of the farms in the West of France). The calving period is in the autumn, that's why the use of corn is higher than in the previous case. The cows are more productive: Prim' Holstein with a milk yield of 8,000 liters per year and an age of first calving of 24 months.

3: *"Milk + cereals farm"* is a highly intensive system with 137 ha and 460,000 liters of milk quota. Each cow can produce 8,500 l per year, consequently the use of corn silage in the diet is not limited. Dairy production is the main activity, however cereal crop activity is developed in parallel. It represents 22% of the farms in this region.

4: *"Milk + Young bull farm"* has 100 ha and 400,000 liters of milk quota. It is the most representative system of the area: 30% of dairy farms in the West of France. It has the same characteristics as the previous type of farming but in this one, young bull fattening activity replaces the cereal activity.

1.3. The Model

1.3.1. Optimisation of the Gross Farm Excess

The model optimises the farm plan, which represents the quantities of different outputs produced and inputs used. The economic results follow from the quantities of inputs and outputs and their prices, and give an indication of profitability and farm's income. The model is used to determine the effects of institutional, technical and price changes on the farm plan, economic results and intensification indicators.

The central element in the LP model is the dairy cow. The model represents the functioning of the farm for a one-year period. The duration of lactation is 305 days for all the cows, but the fecundity rate is lower for the most productive cows ("Milk + cereals" and "Milk + Young bulls" farms) decreasing, as a result, the number of calves per cow per year. At the end of the lactation, cull cows are sold and benefit from the female slaughter premium. Regarding the progeny, it is assumed, according to the intensification level of the type of farming, that 25% to 40% of the dairy cows are replaced per year by heifers raised on the farm (Institut de l'Elevage 2008). For the "Milk + Young bulls" farm, the model can choose to fatten (or not) the males calves and buy (or not) other male calves to reach 80 young bulls. These animals are slaughtered when they are 20 months old. Specific costs are considered for each type of animal: artificial insemination, medicines, straw, minerals and other animal costs.

Regarding the vegetal production, the forages produced in the West of France are mainly corn silage, grass silage, hay and pasture. All farmers aim for forage self-sufficiency, the purchase and/or sale of forage are not considered because these are rare activities linked to exceptional events (e.g., drought or exceptional harvest) in this area. For the cereal crops, each type of farming can produce wheat but the "Milk + cereals" type of farming can also produce rape, corn and pea. It is assumed that this production is sold at the harvesting time, there is no stock except for wheat be used to feed the cows. As well as animal production, specific costs are allocated for each type of crop: seed, fertilisers, treatments and harvesting.

Since the setting up of the Luxemburg Agreement, each farm receives a single payment. In France the SFP is granted according to the historic model and the decoupling is partial. The objective function maximizes the Farm Gross Excess (**FGE**). It incorporates neither interest rates nor depreciation. It is therefore not possible with this model to simulate structural changes such as investments or expansion. Thus, the model determines the optimum composition of the herd, the distribution of crops and food intake.

FGE = Output vegetal production – specific vegetal costs + output milk + output meat – specific animal costs + subsidies and single payment (crop, set-aside and animals) – fixed costs (mechanisation, buildings, rent paid for land, farm taxes, interest paid)

1.3.2. The interactions between forage system and animal production

Thornton and Herrero (2001) show that a wide variety of separate crop and livestock models exist, but the nature of crop–livestock interactions, and their importance in farming systems, makes their integration difficult. In order to precisely describe the interactions between forage system and animal production in dairy systems, this model consists of five key components.

1) Particular attention has been paid to the feeding system. The quantity ingested per cow per day is determined by using i) nutritional requirements in energy and protein and ii) the composition of forages and concentrates according to the Unit Feed Lactation system (INRA 2007). Home-produced forages available in the model are pasture, grass silage, hay and corn silage. The purchased feeds are soybean, rapeseed meal, wheat and milk production concentrate. The model has the possibility to use wheat and milk produced on the farm. This model also includes a requirement concerning the structure of the diet, i.e. the equivalent of effective fibre in long roughage is incorporated. At least one-quarter of the dry matter of the diet must consist of structural material to avoid acidosis.

2) The model consider two separate units: the area of production (in hectares) and the volume of production (in kg) that is a function of the yields for each crop, in order to take account of multiple production on the same unit area. Grassland is a specific forage: it can produce grass, hay and silage on the same surface and in the same year.

3) Four periods (spring, summer, autumn and winter) are distinguished in the model. It allows for seasonal specification of grass production and grassland use. Seasonal variations enable us to integrate differences in the growth potential of grass during the growing season as well as the evolution of the nutrient content of grass. The model is more able to reflect temporal conditions thanks to the addition of these parameters.

4) The milk production per cow is not fixed in order to give more flexibility to the model. Farmers have the possibility to reduce or increase milk production by modifying the feeding system. The model can set the milk yield per cow in a range of 1,000 liters. Then the model is calibrated to correspond to the observation for each type of farming.

5) Crop yield depends on the quantities of nitrogen used. Godard et al (2008) formulated an exponential function which satisfies economic requirements for attaining a mathematical optimum (the yield curve has to be concave and strictly increasing) and is consistent with its expected agronomic shape and with parameters with an agronomic interpretation.

$$y = y_{\max} - (y_{\max} - y_{\min}) \times e^{-\sum t_i N_i}$$

where y is crop yield, y_{min} and y_{max} respectively the minimal and maximal yield (different according to the type of farming); t_i represents the rate of increase of the yield response function to a nitrogen source i (e.g. manure, slurry, chemical nitrogen, etc.) the quantity of which is N_i. This enables to take the increasing price of nitrogen into account.

Consequently, milk production, feeding requirements and grass production are assessed for each period. Thanks to the dissociation between surface and quantity for crop production, the model reproduces an optimal production plan which is well fitted to the dairy food system.

1.3.3. The constraints

The set of constraints consists of requirements related to the farm structure, biological rules, production techniques, environmental and political regulations.

Technical and structural constraints. The model takes the demographic equilibrium of the herd into account: the cows give birth to 50% males (sold at the age of 8 days) and 50% females which are reared according to the restocking rate. Buildings are mainly free-stall housing and the only building constraint integrated into the model is the number of places available for the cows. It is assumed that the number of cows can increase by 10%: the application of the Global Monitoring for Environment and Security has motivated many dairy farmers to construct new buildings with more places than required. Regarding crops, the model meets the requirements for the rotation frequency and preceding crop.

Respect for the environment. The CAP reform of 2003 places environmental respect as one of its first objectives with the setting up of cross compliance measures such as water resource management, food safety, animal welfare standards and sustainable development. To avail themselves of various government grants and EU premiums, farmers must operate within codes of good practice. The main environmental measures included in the model are:
i) the European Council directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources which requires that farmers cannot exceed organic nitrogen application rates of 170 kg nitrogen per hectare;
ii) the measure requiring farmers to keep grasslands aged over 5 years;
iii) a premium for the maintenance of extensive livestock systems or ''premium for grassland'' is attributed, provided there is at least 75% of grass in the total farm area and if the stocking rate is below 1.4 "livestock units" per hectare of grass. This premium (75€/ha) finances the "grazier farms" which are less productive but more environmentally friendly.

Seasonal labour. Labour constraints are introduced by allocating labour needs to each activity. Agricultural labour is not regular over the year. Because we distinguish four periods in a year, we can integrate the work peaks. However the difficulty is to quantify the labour needs of each activity. It is assumed that the farmer and his family/associates execute all the work and thus there is no option to hire temporary labour.

The calibration step is very important: the model's results and the empirical observations have to be close. Results were compared to four key points: percentage of cereal crop area, percentage of silage corn area, milk yield per cow per year and the ratio gross farm excess / total output. These data come from a network of 640 French dairy farms (Institut de l'Elevage, 2008) and from the FADN. We consider the solutions to be representative of the cases studied when all four key criteria were close to reality.

1.3.4. Price variations: how to take risk into account?

During the year 2007, prices of agricultural commodities were subject to strong variations. For example, the prices of cereals such as wheat and corn doubled in 2007, from 125 €/t in January to 250 €/t in December. Then the price decreased to reach 180€/t in September 2008. Cereals play a special role in dairy farming: they are both input and output. Increasing prices are favourable to crop production but, on the other hand, are negative for the production of downstream products. Many studies have demonstrated that farmers typically behave in a risk-averse way (Hardaker et al, 2008). As such, farmers often prefer farm plans that provide a satisfactory level of security even if this means sacrificing some income.

Many methods have been developed to include risk in mathematical programming farm models. The E-V, quadratic risk programming and its linear approximations MOTAD models (Hazell, 1971) and Target MOTAD (Tauer, 1983) are the most commonly used methods. But these approaches require that the decision maker must have a quadratic utility function or an income distribution that is normal. An assumption of normally distributed income can be both unrealistic and unsatisfactory for risk-averse farmers who are not indifferent between symmetrical and skewed distributions (Patten et al, 1988). Lambert and McCarl (1985) presented a mathematical programming formulation that allows identification of the expected utility function. Their approach which does not require an assumption of normally distributed income, can accommodate the assumption that the utility function is monotonically increasing and concave (risk-averse). Patten et al (1988) and then Hardaker et al (2004) reformulated this approach as Utility efficient programming (UEP): $U_k = 1 - \exp(-r_a \times z_k)$

where z is the net farm income for state k and r is a non-negative parameter representing the coefficient of absolute risk aversion: $r_a = (1 - \lambda)r_{min} + \lambda r_{max}$, for $0 \leq \lambda \leq 1$

where λ is a parameter reflecting variation in risk preference, and r_{max} and r_{min} are upper and lower bounds of the coefficient of absolute risk aversion (r_a).In the model the input prices (concentrates) and the output prices (meat, milk and cereals) are subject to variation.

2. SIMULATIONS, RESULTS AND DISCUSSION

The proposals of the Health Check have two main objectives: removing the supply controls of the CAP (milk quota and set-aside) and simplification of the SPS (full decoupling and regionalization). In order to identify the effect of each measure on the economic performance of farmers and their productive choices, we proceed to the simulation setup.

2.1. Simulations

Base year: The year of reference is 2007, and the results of the 2007 survey of the Institut de l'Elevage are used to calibrate the model. It is the first year in France with the full implementation of the Luxembourg Agreement. So, the decoupling is partial: crop premium is partially decoupled (75%) as well as the slaughter premium (60%) and other animal premiums (suckler cow, ewe: 0%) ; but direct subsidies based on the milk quota, special premiums for bovine male (SPBM) and set aside premiums are totally decoupled. We use the 2007 average prices for milk, meat and cereal products.

S1: The first item to be analysed concerns the impact of the set-aside removal. Set-aside was instituted in 1992 as a supply control mechanism in order to limit crop production. However, according to the Luxemburg agreement's objectives (agriculture competitiveness) and due to the 2007 situation on the cereal market, the European Commission proposes to remove the set-aside obligation. We compare this simulation to the base year.

S2: Then, starting with the S1 situation (set-aside removal), we study the implication of the end of milk quotas. We allow a transition of the management of milk sector from public regulation to the private sector. The relationship between farmers and processors will evolve and it is likely that a contractualization system will be set up on three points: quantity, price and term. Thus, we simulate an authorized production volume increase up to 20% in relation to the 2007 reference. We consider that, with the reorganization of the productive dairy sector, dairies have expanded opportunities and these will benefit the more efficient farmers.

S3: Thirdly, we discuss the impact of full decoupling. Theoretically the decoupling of aid has no effects on income because it does not affect the amount of subsidies, only the method of assigning is different. However, decoupling can change production activity by making some products less attractive than before. Starting with the *S2* situation we incorporate full decoupling (for the crop premium and the slaughter premium).

S4: Finally, we simulate the implementation of flatter payment rates per entitlement received by farmers in each region. The regionalization allocates the same amount of direct aid per hectare to all farmers in a region. We apply this flat rate model to the S3 situation (without distinction between arable and grazing lands). The amount is allocated by administrative region. It is an important question because in the French dairy sector the allocation of aid based on a historical reference economically promotes farms with an intensive production system. Farms using a system based on grass, often seen as more environmentally friendly, receive a lower amount of aid (for the same level of production).

2.2. Set-aside removal: increase of cereal crops area

Set-aside represents 3.8% of the agricultural usable area in the West of France, the impact of such a measure is therefore minor but it masks difference between types of farming (especially with crop production). The simulation of this proposal leads to an increase of income: the FGE rises by 3% to 8% according to the type of farming (except for the grazier farm which had no set-aside). Farmers put back in cultivation the total area previously in set-aside (see Table 1 *S1*). The "Semi-intensive", "Milk + cereals" and "Milk + Young bull" farms use the free lands to increase the surface devoted to cereals. They do not use this opportunity to extensify the dairy production by substituting corn silage with grassland. Therefore, there is no improvement of the environmental indicators (nitrogen pressure/ha, Livestock Unit/ha and milk/ha). We also must note that the nitrate directive (maximum of 170 kg of nitrogen/ha) is not a constraint for any farm studied in the *base year* and *S1*. Nevertheless, set-aside has a positive impact on the environment (biodiversity) and the Commission proposes several measures to the Member states to maintain the present environmental benefits of set aside.

2.3. Abolition of milk quota system: a high production potential

The second simulation deals with the abolition of milk quotas. They were introduced in 1984 as a response to overproduction. Colman (2002) shows that the milk quota system is source of inefficiencies with a non-optimal allocation of quota among producers: "a high number of vulnerable and inefficient producers remain in milk production". Even if milk quotas are tradable as in several countries (UK, Netherlands and Denmark) there are lags in adjustment and imperfections such that the theoretical optimum has not been achieved. Moreover, the European Commission (2008) estimates that: "The current market outlook situation indicates that the conditions for which milk quotas were introduced in 1984 are no longer relevant."

Several studies estimate the impact of a quota abolition. Bouamra-Mechemache and Requillart (2002) and Kleinhanss et al (2002) who use partial equilibrium models show that, at the EU level, an abolition of the milk quota system leads to a milk production increase of 7 to 10% to reach the market equilibrium, and causes a 21 to 26% price diminution.

In comparison with the S1 situation, the implementation of a contractualization system (with a constant farm structure) leads to significant changes (see Table 1 *S2*). First of all, the dairy farms studied have a high production potential since they produce from +13% to +20% more milk. This rise in volume is permitted by the intensification of production system: increasing the number of cows and the milk yield per animal (with more concentrate feed). Therefore the milk quantity per ha of forage, the nitrogen pressure per ha and the working time increase except for the "Milk + Young bull" farm which replaces bulls by dairy cows.

Looking at how each type of farming adapts to the abolition of the milk quota, we note that the "Semi-intensive farm" and the "Milk + cereal farm" cannot attain the production cap of 20%. The "Semi-intensive farm" is constrained by building space whereas the "Milk + cereal farm" is constrained by the available working time. The model is then modified to lift these constraints: possibility to enlarge the cowshed (the cost of one place in the building is about 4000€ per cow: 330€ with a 12 year amortization) and to hire workers· (the cost of one hour of salaried work is about 15€ all taxes include). The "Semi-intensive farm" needs 3 additional places to reach the threshold of a +20% increase (+1% FGE) and the "Milk + cereal farm" needs 240 hours of supplementary working time (+5% FGE) (Table 2 scenario *S2 without constraint*). About the economic results, an additional 20% milk volume leads to an increase of 10% FGE (for Semi-intensive and Milk + cereals). The marginal yield of an additional liter of milk is about the half paid price as shown by Moro et al (2005). The FGE increases proportionally less than the milk quantity because of the additional variable costs and crop – forage mix (cereal crops replaced by forage production).

These results show that dairy farmers have great potential to increase their milk production, perhaps by more than the 20% we allow (with a constant structure or with some investment). The main reason for this productive potential is that the agricultural area of dairy farms in west of France increased by 52% during the last 10 years while the quota per farm increased by only 28%. Therefore, to use this land, farmers developed alternative activities such as feedlots or cereals, which they can reduce or remove in case of quota abolition. The situation on dairy markets during the end of 2007 and the beginning of 2008 confirms these impressions.

Indeed, in France, the price of milk during this period has risen to encourage farmers to increase their production. They have shown a strong capacity to respond to these incentives since the production in the west of France increased by 15% in only five months (comparison between 2007 and 2008, Office de l'Elevage, 2008).

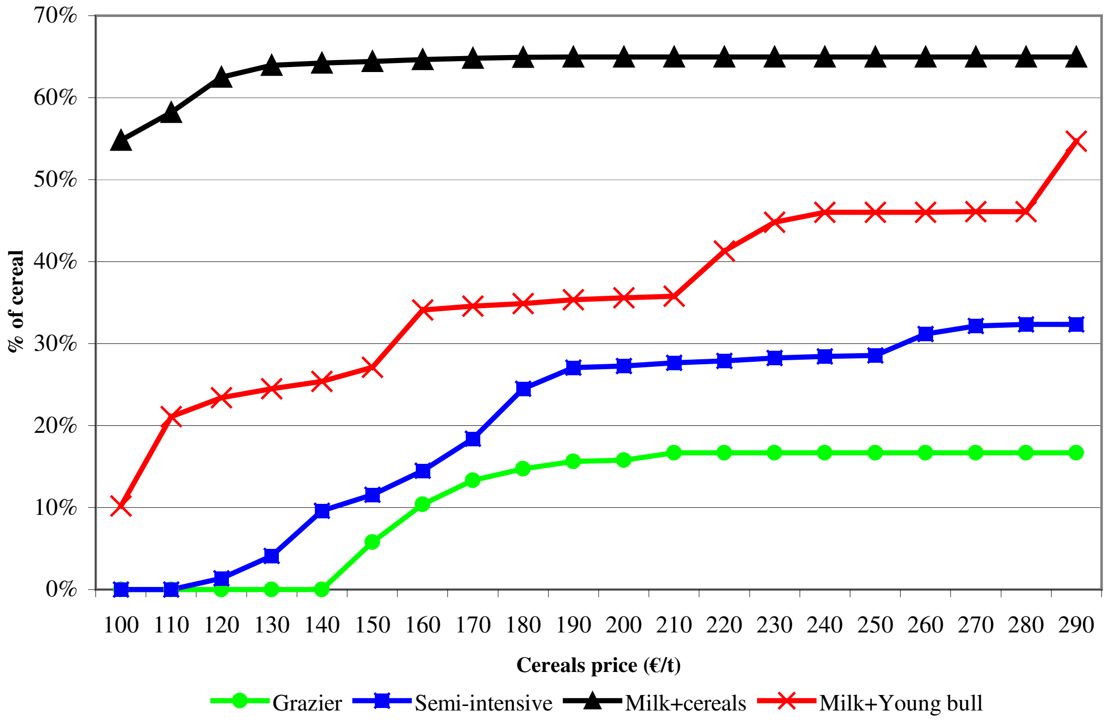
Table 1. Implementation of the Health Check proposals: simplification of the SPS and removal of supply control mechanism (quota and setaside)

	Grazier Farm			**Semi-intensive Farm**			**Milk+cereals Farm**			**Milk+Young bull Farm**		
	Base year	S1[1]	S2[2]	Base year	S1	S2	Base year	S1	S2	Base year	S1	S2
FGE (€)	66 600	66 600	79 300	67 100	69 300	75 400	156 900	169 000	183 400	156 600	163 700	174 400
Crop area												
Grain price (€/t)	180	180	180	180	180	180	180	180	180	180	180	180
Cereals	13.0	13.0	12.3	15.3	18.2	15.2	77.9	89.0	89.0	35.4	43.5	35.1
Silage maize	6.5	6.5	6.2	13.7	13.7	15.0	24.0	24.0	22.9	46.4	46.4	45.5
Grassland	58.5	58.5	59.5	18.0	18.1	19.8	24.0	24.0	25.1	10.0	10.1	19.4
Set-aside	0.0	0.0	0.0	2.9	0.0	0.0	11.2	0.0	0.0	8.2	0.0	0.0
Premium for grassland	yes	yes	yes	no	no	no	no	no	no	no	no	no
Animal activity												
Milk price (€/t)	350	350	350	350	350	350	350	350	350	350	350	350
Total produced milk (l)	285 000	285 000	342 000	290 000	290 500	325 520	460 000	460 000	537 970	400 000	400 000	480 000
Dairy cows (nb.)	56	56	57	35	35	38	60	60	64	47	47	55
Young bull (nb.)										75	75	59
Milk yield (l/year)	5 350	5 350	6 000	8 500	8 500	8 500	7 900	7 900	8 500	9 000	9 000	9 000
Milk l/ha forage area	4 380	4 380	5 210	8 140	8 120	9 350	9 590	9 590	11 220	7 090	7 080	7 400
Concentrates (kg/year)	440	440	610	1 470	1 470	1 470	810	810	1 180	1 440	1 440	1 160
Nitrogen pressure (kg/ha)	130	130	132	127	127	139	78	78	79	147	147	146
Working time (h/awu/year)	2 000	2 000	2 030	1 590	1 620	1 730	1 970	2 060	2 140	2 030	2 070	2 040
Economic results												
Total output (€)	167 600	167 600	191 300	158 500	162 600	172 100	346 900	366 000	391 400	354 800	366 900	367 700
Milk output (€)	97 900	97 900	117 500	99 600	99 600	111 800	158 000	158 000	184 800	137 400	137 400	164 900
Meat output (€)	33 600	33 600	34 000	16 100	16 100	17 600	25 100	25 100	23 5000	99 800	99 800	86 100
Crop output (€)	13 300	13 300	12 700	20 300	24 100	20 100	105 600	123 600	123 900	50 300	61 700	49 900
Total subsidies (€)	22 700	22 700	22 700	22 500	22 800	22 700	58 300	59 300	59 200	67 300	68 000	69 500
Variable costs (€)	40 100	40 100	45 200	43 400	45 000	47 800	90 900	96 400	105 600	104 300	108 400	98 500
Fixed costs (€)	60 900	60 900	62 400	48 000	48 300	49 100	99 100	100 500	102 300	93 900	94 800	94 800
Marginal yields												
Additional milk quota (€/t)	304	304	42	230	238	0	263	263	0	240	252	156
Additional milk yield (€/l)	n.c.[3]	n.c.	4198	332	317	3225	n.c.	n.c.	5156	187.8	158.6	1721
Additional area (€/ha)	393	393	388	903	897	967	898	898	834	948	949	843
Additional building place (€/pl)	n.c.	n.c.	n.c.	n.c.	n.c.	2037	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.
Additional work hour (€/h)	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	104	n.c.	n.c.	33

[1] S1: 2007 situation with set aside removal ; [2] S2: S1 situation with milk quota abolishment ; [3] n.c.: not a constraint

We can also note that, one additional liter of milk productivity per cow per day causes income to rise by 5 000€ (for the *milk+cereal farm).* It is the economic gain permitted by the genetic level of animals. Indeed, cows which have a greater productive potential may produce a higher quantity of milk at a lower cost. Naturally, such conclusions depend on the relative prices of milk, cereals and meat. The next section discusses how dairy farmers respond to the evolution of those prices.

Figure 1. Proportion of cereals in the usable agricultural area according to the cereals price



The Figure 1 shows the evolution of the cereal component in the total farm area according to the cereals price (with a fixed milk price: 350€/t). The main point is that whatever the cereal price, all the farms produce all the authorized milk quantity. Farmers increase cereal production when cereal prices increase: they intensify milk production to free up land for cereal crops (more corn silage with concentrate instead of grass). The "Milk + Young bull farm" has larger possibilities to increase the cereal production because it can reduce the fattening activity. We also observe that with a price below than 140€ per ton, that was the price for the year before 2006, cereal production strongly decreases (two farms totally remove this production). The soaring price of fertilizers during the year 2008 (1.25€ per nitrogen kg in May 2008) plays a crucial role by diminishing the gross margin.

We also test the adaptation of farmer's strategy by varying milk price (from 200 to 400 €/t) and cereal price (form 100 €/t to 300€/t). We note that the milk price variation has no impact on land use because farmers always produce their available quota. To see cereal production become more profitable than milk, cereal price must be higher than 250€/t with a milk price lower than 230 €/t: these are very extreme prices.

2.4. Full decoupling: a stable income

The WTO requires that subsidies granted to farmers shall not be related to the factors of production employed. Theoretically the decoupling has no effects on income because it does not affect the amount of subsidies, but it can change production activity by making some products less attractive than before.

The implementation of full decoupling has very little influence on economic performance (see Table 2 *S2*) and productive strategies for one main reason: the initial rate of decoupling was high for dairy production. Indeed the greatest change stemmed from the implementation of the Luxembourg Agreement with the decoupling of a major part of the subsidies dedicated to dairy farmers. Lelyon et al (2008) show that this measure leads to a substitution of cereal and corn silage by grasslands. Moreover, it encourages farmers to stop the fattening activity (the profitability of which is discussed with the full decoupling of the SPBM). Nevertheless, some issues balance this conclusion: most farmers do not consider not using their buildings to their full capacity even if it's more advantageous from a business point of view ; and many of them produce under contract with a slaughterhouse. For the year 2007, the report of the Office de l'Elevage (2008) shows that the number of young bulls did not decrease in France.

2.5. Regionalization of the subsidies: significant redistributions

Finally, we study the impact of the regionalization of the Single Payment on the dairy farmer's behaviour. The decoupling of subsidies poses the problem of the legitimacy of this support with the increasing time in relation to the historic reference. France (such as Spain) chose to define the value of the SP based on the farm's historical references as opposed to England and Germany which decided to apply the principle of regionalization. The SFP per hectare for the western region is 370 €/ha, which is slightly higher than the national level (345 €/ha). Nonetheless, this figure hides disparities between types of production: 420 € / ha for intensive dairy farms and 330 € / ha for the extensive one (Chatellier, 2006).

We compared the *S3* situation (with full decoupling) to a regional flat rate payment (*S4*). The simulation indicates (see Table 2) an income transfer between farms: the Milk + Young bulls farm sees its FGE decrease by 16% while the FGE of the grazier farm increases by 8%. The extensive farms with large surfaces benefit from this transfer: they receive subsidies which originally were intended for beef-cattle and crop farms. Furthermore, the model shows that the crop area, the number of animals, or the milk yield per cow are identical to *S3*. When the subsidies are totally decoupled, the farmer chooses the more efficient production, considering price and performance of each activity. The model suggests that there is no relationship between the amount of aid given and the production system chosen. However the model does not take into account the investments: a farmer receiving a significant amount of aid can modernize his production equipment to make it more efficient and increase his income (either through an increase in the product or lower expense), or he may also expand his farm.

Table 2. Implementation of the Health Check proposals: simplification of the single payment scheme (full decoupling and regionalization)

	Grazier Farm			Semi-intensive Farm			Milk+cereals Farm			Milk+Young bull Farm		
	[1] S2 without constraint	S3[2]	S4[3]	S2 without constraint	S3	S4	S2 without constraint	S3	S4	S2 without constraint	S3	S4
FGE (€)	79 300	79 300	85 800	78 400	74 900	71 700	185 400	182 300	174 700	174 400	174 200	146 200
Crop area												
Cereals	12.3	10.6	10.6	12.8	12.9	12.9	89.0	89.0	89.0	35.1	34.9	34.9
Silage maize	6.2	5.3	5.3	16.1	15.0	15.0	24.0	22.5	22.5	45.5	45.5	45.5
Grassland	59.5	62.1	62.1	21.1	22.1	22.1	24.0	25.5	25.5	19.4	19.6	19.6
Premium for grassland	yes	yes	yes	no	no	no	no	no	No	no	no	no
Animal activity												
Total produced milk (l)	342 000	342 000	342 000	348 000	325 520	325 520	552 000	538 000	538 000	480 000	480 000	480 000
Dairy cows (nb.)	57	57	57	41	38	38	65	64	64	55	55	55
Young bull (nb.)										59	59	59
Milk yield (l/year)	6 000	6 000	6 000	8 500	8 500	8 500	8 500	8 500	8 500	9 000	9 000	9 000
Milk l/ha forage area	5 210	5 070	5 070	9 360	8 760	8 760	11 500	11 230	11 230	7 400	7 370	7 370
Concentrates (kg/cow/year)	610	620	620	1 470	1 360	1 360	1 170	1 180	1 180	1 160	1 150	1 150
Nitrogen pressure (kg/ha)	132	133	133	149	139	139	81	79	79	146	146	146
Working time (h/awu/year)	2 030	2 030	2 030	1 830	1 720	1 720	2 190	2 140	2 140	2 040	2 040	2 040
Economic results												
Total output (€)	191 300	185 700	192 800	178 000	168 900	165 400	396 500	390 500	382 300	367 700	367 200	337 100
Milk output (€)	117 500	117 500	117 500	119 500	111 800	111 800	189 600	185 000	185 000	164 900	164 900	164 900
Meat output (€)	34 000	34 500	34 500	18 800	17 600	17 600	24 100	23 500	23 500	86 100	86 200	86 200
Crop output (€)	12 700	10 900	10 900	17 000	17 100	17 100	123 500	124 000	124 000	49 900	49 500	49 500
Total subsidies (€)	22 700	22 800	29 900	22 600	22 400	18 900	59 300	58 000	58 000	69 500	66 600	66 600
Variable costs (€)	45 200	44 100	44 100	50 000	45 200	45 200	108 400	105 900	105 900	98 500	98 200	98 200
Fixed costs (€)	62 400	62 300	62 900	49 600	48 800	48 500	102 700	102 200	101 700	94 800	94 800	92 600
Marginal yields												
Additional milk quota (€/t)	42	172	139	183	0	0	79	0	0	156	164	164
Additional milk yield (€/l)	4 198	2 734	2 250	1 222	3 200	3 200	3 789	5154	5154	1721	1584	1584
Additional area (€/ha)	388	430	360	1 023	846	846	1 050	806	806	843	747	747
Additional building place (€/pl)	n.c.[4]	n.c.	n.c.	n.c.	2 020	2 020	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.
Additional work hour (€/h)	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	97	97	33	30	30

[1] S2 without constraint: S2 situation without production constraint ; [2] S3: S2 situation with full decoupling ; [3] S4: S3 situation with regionalization of the SP
[4] n.c.: not a constrain

CONCLUSION

This model, based on the linear programming methodology, shows its ability to analyse the impact of the CAP Health Check on dairy farms in West of France. In order to represent realistic behaviour, we place the technical, biological, structural, environmental and regulatory realities at the heart of the producer's choice. However, keep in mind the limitations of the method which is based on instantaneous adjustments, constant yields and the idea that the actors are primarily guided by a desire to maximize their income. Some improvements are possible such as using a multi objective function to take into account other considerations which may play an important role (like, for example, the time of work). Other types of farming can also be integrated into the study. A "*Milk + Pigs*" farm could allow detailed analysis of the environmental topic, especially with regard to nitrogen surplus. Finally, the increasing volatility of prices puts risk at the heart of farmers' consideration. The UEP method takes into account the risk of price variation but no attention is paid to the upward or downward expectations made by the farmers. Indeed, the techniques for taking the risk into account incorporate the amplitude of price variation but not the path of their evolution. Integrating this element in linear programming models is an important issue in a context of increasing price volatility.

In terms of public policy, according to our simulations, the full decoupling of direct supports (compared to a situation with a partial decoupling) would not have a strong impact on the western French dairy farms' strategies. This is due to the fact that the direct payments which are granted to these farms have been largely decoupled since 2005. As to the implementation of a SFP regionalization, we estimate that the impacts concern the distribution of incomes between types of farm: the extensive farms benefit from a transfer of aid from the more intensive ones. However, the productive choices are not affected by this scenario. The removal of the set-aside will have just a little influence, both on income and production plan. For dairy farms in the West of France, the most important measure of the CAP "health check" is, of course, the abolition of the milk quota. Our simulations show that farmers of this region have a strong potential to expand milk production, even with constant structure of the land. All things being equal, and whatever the prices, dairy farmers always try to reach the maximum quantity of milk allowed by our model. Nevertheless, the fluctuations of cereal prices have an impact on crop rotation and the intensification level. It is important to note that the current situation prevailing in agricultural markets is unprecedented and changes the balance between inputs and outputs.

The future of dairy production will be also closely connected to the strategies developed by dairy companies (whether private or cooperative), especially because they will have more power in the milk market regulation. Without the milk quota, the strategies of the firms will influence the milk production model in France (concentration, enlargement, intensification) and therefore the location of dairy farms on the French territory.

REFERENCES

Bouamra-Mechemache, Z., and Réquillart, V. (2002). Policy Reform and the EU 15 Dairy Industry. *In* "Phasing out milk quota in the UE" (D. Colman, ed.). Manchester.

Chatellier, V. (2006). Le découplage et les droits à paiement unique dans les exploitations laitières et bovins-viande en France. *Cahiers d'Economie et Sociologie Rurales*, 2-28.

Colman, D. (2000). Inefficiencies in the UK milk quota system. *Food Policy* **25**, 1-16.

Commission of the European Communities (2008). Proposal for a Council Regulation establishing common rules for direct support schemes for farmers under the common agricultural policy and establishing certain support schemes for farmers. pp. 161.

Godard, C., Roger-Estrade, J., Jayet, P. A., Brisson, N., and Le Bas, C. (2008). Use of available information at a European level to construct crop nitrogen response curves for the regions of the EU. *Agricultural Systems* **97**, 68-82.

Hardaker, J. B., Richardson, J. W., Lien, G., and Schumann, K. D. (2004). Stochastic efficiency analysis with risk aversion bounds: a simplified approach. *The Australian Journal of Agricultural and Resource Economics* **48**, 253-270.

Hazell, P. B. R., and Norton, R. D. (1986). "Mathematical Programming for Economic Analysis in Agriculture," MacMillan, New York.

INRA (2007). "Alimentation des bovins, ovins et caprins : Besoins des animaux - Valeurs des aliments," Editions Quae, Versailles.

Institut de l'Elevage (2008). "Les systèmes bovins laitiers en France : Repères techniques et économiques," Institut de l'Elevage, Paris.

Kleinhanss, W., Bertelsmeier, M., and Offermann, F. (2002). "Phasing Out Milk Quotas: Possible Impacts on German Agriculture," Inst. of Farm Economics and Rural Studies.

Lambert, D. McCarl, B. (1985). Risk modeling using direct solution of nonlinear approximations of the Utility Function. *American Journal of Agricultural Economics* 67, 846-852.

Lelyon B, Daniel K, Chatellier V. (2008) Decoupling and prices: determinant of dairy farmers choices? A model to analyse impacts of the 2003 CAP reform. EAAE Congress, Ghent.

Moro, D., Nardella, M., and Sckokai, P. (2005). Regional distribution of short-run, medium-run and long-run quota rents across EU-15 milk producers. EAAE Congress, Copenhagen.

Office de l'Elevage (2008). " Le marché des produits laitiers, carnés et avicoles en 2007," Office de l'élevage, Paris.

Patten, L. H., Hardaker, J. B., and Pannell, D. J. (1988). Utility Efficient Programming for whole-farm planning. *Australian Journal of Agricultural Economics* 32, 88-97.

Perrot, C., Coulomb, C., You, G., and Chatellier, V. (2007). Labour productivity and income in North-European dairy farms. *Le dossier économie de l'élevage* 364, 1-61.

Tauer, L. (1983). Target MOTAD. *American Journal of Agricultural Economics* 65, 606-610.

Thornton, P. K., and Herrero, M. (2001). Integrated crop-livestock simulation models for scenario analysis and impact assessment. *Agricultural Systems* 70, 581-602.