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Short communication

Is agricultural policy promoting a new role for farmers? A case study

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Abstract

European Agenda 2000 considers the integration of environment in CAP and the role farmers can play on natural resources management.

Alternative tillage technologies to seed cereals play an important economic and environmental role on the development of a sustainable agriculture and its adoption may depend on the agricultural policy, particularly policies on income support.

The results obtained clearly show that the use of alternative soil tillage technologies would be promoted by the change of supports from the first to the second pillar of CAP and we can conclude that, in general, this change will encourage a faster technological adoption.

Keywords: Agricultural policy; Natural resources; Tillage technologies

1. Introduction

Common Agricultural Policy (CAP) has been the first common policy of the European Economic Community with the objective, clearly achieved, of promoting the European Agriculture modernization. Nevertheless, until 1992 reform, this modernization has been several times oriented to intensification and as a consequence it had several times prejudicial effects on the environment (APOSOLO, 1999).

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The structural reform of 1992 changed CAP objectives, underlining the environmental character of agricultural sector as the greater land user and promoting the integration of the various agricultural policies—the markets policy, the structural policy and an environmental policy, with the accompanying measures, especially the agri-environmental measures. This difficult task has never been completely carried out—1992 reform has just joint all this policies, instead of making a real integration of them.

Today, it is consensual that rural areas must be the motors of a sustainable rural development and that agriculture must be, as an economical sector, sustainable, competitive and spread all over the European territory. The main difference between European agriculture and its principal competitors lies on its multifunctional nature and on the role it plays on economy and environment, society and rural areas maintenance.

Agriculture and rural development policies should promote a competitive agricultural sector within EU, a sustainable and market oriented agriculture and an effective rural development and it is therefore important to anticipate the policies adjustments, according to what has been established in the Berlin European Council, in order to make the better use of resources.

Alternative soil tillage technologies surely promote a better use of resources. So, we evaluated the impact of different policies on the adoption of alternative soil tillage technologies and simulated some possible policy scenarios that could influence this adoption.

2. The analytical framework

The adverse effects of mobilization on soil structure are well-determined—organic matter oxidation due to surface exposition, mechanical dispersion due to compaction and to the impact of rain on the naked soil. The obvious penalty is wind or water erosion (Azevedo & Cary, 1972).

Alternative soil tillage technologies have an important role to play on a sustainable agriculture development, from environmental and economical points of view, because they reduce compactation and prevent erosion and they also give a relevant contribution to the maintenance of farmers' income in equitative levels. In the short term, they will allow farmers to face price reductions on cereals and sunflower, maintaining their incomes – because of the soil condition due to traffic and the type of machinery used, these technologies have more time to perform the operations in the field and are less exigent in what concerns the time they need to do so, therefore reducing costs – and in the long term they will allow maintaining or even burdening soil productivity, therefore contributing to partially overcome price reduction, allowing farmers to maintain their incomes (APOSOLO, 1999).

Policies that interfere with the income of a particular activity can influence the adoption of one or other technology by farmers. Avillez (2000) refers that CAP is one of the main responsibles by the lack of efficiency on the use of economical resources, since policies contributed to production and technological options that only have entrepreneurial viability as a consequence of income transferences and the production structures maintenance is exclusively due to income support that they benefit from CAP and Hardaker, Huirne, and Anderson (1997 p. 4) stated that agricultural policies in different countries, namely on the EU, have eliminated some sources of risk; nevertheless, the changes agricultural policy has and is still suffering, as a consequence of WTO negotiations, will tend to give farmers a greater exposition to a competitive market, where the consequences of their choices will be less predictable.

Using a farm characteristic of Clay Soils Zone of Beja (Cary, 1985), in the south of Portugal, we simulated the effects of different policies on the adoption of soil tillage technologies, namely direct seeding and reduced mobilization.

Payments partially decoupled from production and agri-environmental measures from 1992 reform were the first attempt to correct the negative impact of production oriented policies, valuing the farmers' role as landscape and rural space keepers. In 1997, the base year of the study, the political reference framework to cereals production was based, mainly, on partially decoupled payments. Agri-environmental measures, within the Rural Development Plan (RURIS) for Portugal (2000–2006), preview a subsidy to farmers who use direct seeding or reduced mobilization techniques in their farms (DGDRural, 2000), since these technologies contribute to the conservation of the soil. Seeing that, we also study a situation where farmer can benefit from these agri-environmental measures, which means that, in this case, the subsidy is eco-conditioned. The agreement reached in Brussels, in October 2002, give us a more or less clear idea on the agricultural budget to the future, which means we have the opportunity to try to guarantee the long term safety of our agriculture (Fischler, 2002). According to Swinbank (personal communication, 2002), the last agreement on CAP reform establishes the decoupled payments, which agricultural economists advice since 1960, to really reform CAP—the aim is to guarantee a sustainable utilization of rural space and the change from a productivist to a multifunctional agriculture. For this reason, the adoption of alternative soil tillage technologies as also been studied in a situation where subsidies, with the same amount farmers receive now, are totally decoupled from production.

3. Methodology

The methodology to assign this problem must consider on one hand the economic evaluation of soil tillage technologies and on the other hand the way risk and risk aversion behaviours interfere with technological choice. Farmer entrepreneur must decide knowing the time needed to establish the cereals, depending on the technology used, and the investment costs each technology implies. Its decision has an income risk due to production risk—different cereal productions, depending on the technology and the type of year – and resources risk – differences in each type of year availability of days to operate on the field establishing the seed bed for the cereals, caused by the influence of technology on the soil condition.

Farm modelling, representing a system full of interactions at product and use of resources levels, allows the analysis of farmer's decision problem, admitting that such a decision is rational and conditioned by the scarce resources he has (Knipscheer, Menz, & Verinumbe, 1983).

The model must consider the aspects focused before and account their influence on the economic evaluation of technologies. This evaluation is influenced by stochastic parameters which values are only known after investment but which probability distribution of occurrence is known.

Linear Programming Model solution optimizes farmer's decision, indicating the best investment alternative, considering the different type of year's probability of occurrence and the best farming plan for each type of year.

Assuming the farmer's objective is income maximization, which means he is neutral to risk, its decision problem can be stated as (Martins, 2006):

$$\text{Max}Z = \sum_{s} P_s \left[\left(\sum_{j} (r_j f_{js} \left(k_{js}\right) - c_j k_{js}) x_{js} \right) - (c_t x_t) \right]$$

s.t.

$$\sum_j x_{js} \leq S$$

$$\sum_j x_{js} - x_t \leq 0$$

$$x_{js} \geq 0; \quad x_t \geq 0; \quad k_{js} \geq 0;$$

where Z is the objective function, representing the long term economic result, P_s the occurrence probability of each state of nature s; r_j the income of product j; f_{js} the continuous production function by production unit of product j in the s state of nature; k_{js} the vector of variable production factors amount used in the j activity on the s state of nature by unit of production; c_j the unitary cost of the variable production factors used in the short term activity j; c_t the unitary cost of the long term activities t; S the available land at the farm; x_{js} the number of units of j activity on the s state of nature; and x_t is the dimension of the long term activities t.

Decision making is often not neutral to risk and neglecting risk aversion on agricultural farm models can lead to important overestimations of production levels and may significantly influence the farmer behaviour in what concerns the proposed new technologies.

Specifically, in the context of decision making about the utilization of soil conservation practices, as alternative soil tillage technologies, Kramer, McSweeny and Stavros (1983) refer Nowak and Wagener (personal communication, 1981) which pointed that risk aversion attitudes may affect farmer decision and that investigation of the relation between risk and farmer behaviour in what concerns alternative soil tillage technologies would be very useful to the design and implementation of a soil conservation policy.

The subjective utility hypothesis shows how we can integrate the two components of utility (preference) and probability (degree of belief) to rationalize a risky choice (Hardaker, Huirne and Anderson, 1997).

Many methods have been used to elicit the required information from decision makers to be able to encode their preferences into a suitable utility function (Hardaker, Huirne and Anderson, 1997).

Ballestero and Romero (1991) proposed a combination of compromise programming (CP) with the models of risk programming (such as the well-known MOTAD), leading to the compromise risk programming (CRP). This method avoids the problem of determining the farmer utility function, establishing the compromise set as being that portion of the feasible boundary where the tangency with the iso-utility curves will occur.

The basic idea in CP is the identification of an ideal solution as a point where each attribute under consideration achieves is optimum value. When a conflict between the different attributes exists the ideal point is just used as a reference point. CP assumes that any decision-maker seeks a solution that is as close as possible to the ideal point (Zeleny's axiom of choice). The ideal point coordinates are given by the optimal values of farmer's objectives. The ideal point is infeasible, revealing the conflict among objectives (for example, maximum income and minimum risk). To measure the proximity of an efficient point to the ideal point, compromise programming uses distance functions.

This means that to incorporate farmer behaviour, we use compromise programming, incorporating in the model the distance functions L_1 and L_∞, which are those that limit the compromise set (Romero, Rehman, & Domingo, 1988). To calculate L_1, the model structure will be modified as follows (Martins, 2006):

$$\mathrm{Min} L_1 = W_1 \frac{Z^* - Z}{Z^* - Z_*} + W_2 \frac{D^* - D}{D^* - D_*}$$

s.t.

$$Z = \sum_s P_s \left[\left(\sum_j (r_j f_{js}(k_{js}) - c_j k_{js}) x_{js} \right) - (c_t x_t) \right]$$

$$\sum_j x_{js} \leq S$$

$$\sum_j x_{js} \leq 0$$

$$\left[\left(\sum_j (r_j f_{js}(k_{js}) - c_j k_{js}) x_{js} \right) - (c_t x_t) \right] - Z + D_s \geq 0$$

$$\sum_s D_s = D$$

$$x_{js} \geq 0; \quad x_t \geq 0; \quad k_{js} \geq 0;$$

where the variables has the same meaning as before, D_s is the deviation of income Z_s from the average income Z, each year s, and D is total absolute deviation. Z^*, D^*, Z^* and D^*, represent, respectively, the best and worse values for long term economic result and total absolute deviation and W_1 and W_2 represent the weight or importance attached by the decision-maker to each objective – best economic result and less total absolute deviation – in the objective function.

To calculate L_∞ the model will be modified as follows (Martins, 2006):

$$\mathrm{Min} L_\infty = d$$

s.t.

$$Z = \sum_s P_s \left[\left(\sum_j (r_j f_{js} \left(k_{js} \right) - c_j k_{js}) x_{js} \right) - (c_t x_t) \right]$$

$$W_1 \frac{Z^* - Z}{Z^* - Z_*} \leq d$$

$$W_2 \frac{D^* - D}{D^* - D_*} \leq d$$

$$\sum_j x_{js} \leq S$$

$$x_{js} \geq 0; \quad x_t \geq 0; \quad k_{js} \geq 0;$$

where variables have the same meaning as before, and d is the maximum deviation, among all the individual deviations.

With this model, we can evaluate the farmer's decision on the technology utilization for different policy situations. Particularly, this model can analyse the effect of intra-annual production variability with the different technologies and the effect of available days to mobilize soil with each technology, i.e., the effect of production and resources risk.

The model development is available elsewhere (Martins, 2006). In general, we considered vegetable and animal activities – which need land (vegetable activities), work and traction – permanent and seasonal work activities and machinery investment activities. Vegetable and animal activities complement each other – the vegetable activities are rotations and give some by-products used by animal activities – which is important in what concerns the productive orientation of the farm and the machinery required. The vegetable production activities' products are sold, stored and given to animals as food. Animal activities' products are sold. The limiting factor is only the available land, which means that all the other production factors can change or do not limit production activities.

On the problem stated, it is critical to consider the different production for vegetable activities on each year and the necessity of dimensioning the machinery needed considering the difference of available days to perform the different cultural operations each technology has and the different machinery each technology uses. To model these aspects, the model considers investment activities including a tractor and all the machinery needed to each technology. The number of these sets is estimated considering the farmer will adopt each year the production plan that optimizes his long term decision.

The general structure of the basic model (Martins, 2006), without the calculus of L_1 and L_∞ is shown in Appendix A. It indicates that there is a set of activities that represent the short-term decisions, which change with the year. There is another set of activities that represent the structural decisions, which do not change with the year, thus representing the long-term decisions of the farmer.

4. Results

The production plans that optimize the farmer's decision on the different types of years, in what concerns vegetable activities are shown in Table 1. On the base situation, the model only can choose the traditional technology, while on the technological alternatives situation the model can choose among all the technologies those that best fit the farmer's objectives.

Table 1
Production plans for different types of soil–rotations and areas (ha) on base and with alternative technologies situations

Type of year	1	2	3	4	5	6
Base situation						
Clay soils	Rotations: sunflower–durum wheat–wheat					
	201.5	201.5	201.5	170.1	201.5	201.5
Sandy loam soils	Rotations: Triticale–oat–fallow–fallow					
	185.0	185.0	185.0	123.0	134.9	185.0
Technological alternatives situation						
Clay soils	Rotations: (1) sunflower–durum wheat–wheat; (2) sunflower–barley–wheat					
Direct seeding	57.5	72.8	57.1	51.5	53.2	55.7
Reduced mobilization	144.0	128.6	144.4	112.2	106.4	145.5
Sandy loam soils	Rotations: Triticale–oat–fallow–fallow					
Direct seeding	185.0	185.0	185.0	184.4	184.4	185.0

Source: model results.

Table 2
Machinery (no. of tractors), tractor drivers (no.) and sheep (no. of type heads) on base and with alternative technologies situations

Base situation	
Tractors 120 hp	3
Harvest machines	1
Tractor drivers	3
Sheep	416
Technological alternatives situation	
Tractors 80 hp	1
Tractors 105 hp	1
Harvest machines	1
Tractor drivers	2
Sheep	403

Source: model results.

For the activities that do not change with the year, i.e., the long-term activities, which are the machinery, the permanent workers and the animals, the results are shown in Table 2.

The economical results of the cultural occupation and farm structure, for each type of year, are presented in Table 3.

From the analysis of these tables, we must point out that for the technological alternatives situation the seeded area is, on average, higher, although there are fewer tractors (two instead of three), less powered, which also implies fewer tractor drivers. This conjunction leads to a higher expected income for technological alternatives situation that corresponds also to a higher total absolute deviation. The evaluation of income risk for the efficient plans of production allows us to determine the set of admitted farm plans that give a maximum expected income for each standard deviation level.

With the objective of determining this set, we parameterized the restriction referring to the sum of total absolute deviations, at 25% steps. The results obtained, as well as the optimum activities levels, are shown in Table 4.

To use the compromise programming with this problem, we can obtain, from Table 4, the ideal and the anti-ideal vectors. The ideal vector includes the best expected income, €49675 and the

Table 3
Expected income, total absolute deviation of that income and each year's negative deviations, for base situation and with alternative technologies situation (€)

Type of year	1	2	3	4	5	6
Base situation						
Negative deviation in each state of nature.	–	–	–	16849	22521	18456
Expected income	27950					
Total absolute deviation	57965					
Technological alternatives situation						
Negative deviation in each state of nature.	–	–	–	27753	31260	39774
Expected income	49675					
Total absolute deviation	99025					

Source: model results.

Table 4
Model results, with parameterization of total absolute deviation—total absolute deviation (€), expected income (€) and optimum activities levels

Solutions	Type of year	θ (A)	0.75 θ (B)	0.50 θ (C)	0.25 θ (D)	0 (E)
Total absolute deviation		99025	74091	49396	24695	0
Expecyed income		49675	42597	34367	26137	10076
Ha seeded with alternative technologies	1	286	204	271	191	53
	2	286	286	214	129	85
	3	286	201	239	256	286
	4	248	229	229	229	194
	5	244	219	219	219	239
	6	286	197	197	197	197
	Average	270	223	225	206	185
Ha seeded with traditional technologies	1	0	45	0	13	106
	2	0	0	50	59	1
	3	0	85	48	30	0
	4	0	58	58	58	57
	5	0	67	67	67	47
	6	0	90	90	90	90
	Average	0	60	57	57	50
Traction sets						
80 hp ds		1	1	1	1	1
105 hp rm		1	1	1	1	1
120 hp td			1	1	1	1
Number of sheep heads (th)		403	405	405	405	405

Source: model results.

minimum standard deviation, 0. The anti-ideal vector includes the minimum expected income €10076, and the maximum standard deviation €99025.

Assuming the farmer weights both his objectives in the same way (to obtain the best expected income and the lower deviation of that income), the L_1 and L_∞ points, for our model, are shown in Table 5.

These results correspond to the use of alternative soil tillage technologies in most of the farm, but the farmer will still use, in part of his farm, traditional technology. On average, we can say that he will prepare 211 ha of his farm with alternative technologies and only 57 ha with traditional technology.

At this point we can state that is not the income risk, coming from the production and resources risks, which influences the non-adoption of alternative soil tillage technologies by farmers. Our results clearly show that the farmer will prefer the alternative technologies in spite of continuing

Table 5
L_1 and L_∞ for the studied model—total absolute deviation and expected income (€)

Extreme points	Objective function	
	Total absolute deviation	Expected income
L_1	22356	25354
L_∞	43186	32297

Source: model results.

Table 6
Expected income, total absolute deviation of that income and each year's negative deviations, for base situation and with alternative technologies situation (€)

Type of year	1	2	3	4	5	6
Base situation						
Negative deviation in each state of nature	–	–	–	16851	22519	18457
Expected income	27882					
Total absolute deviation	57826					
Technological alternatives situation						
Negative deviation in each state of nature	–	–	–	23828	26197	27519
Expected income	71702					
Total absolute deviation	101381					

Source: model results.

to use traditional technology in part of its farm–thus, the substitution of machinery will surely be only partial. In other words, the results show that the farmer have clear advantages on renewing immediately some of his traditional equipment but also on maintaining a part of it, at least until it is completely depreciated.

Even if it is the structural component of CAP, giving support to the investment, that specially promotes modernization and restructuring of farms and if the effect of this support depends on the way they privilege a specific orientation or support all the orientations on the same way we have defined that in the long-term the farmer will adopt the alternative soil tillage technologies. The issue is now to know if the political short term measures, especially the agri-environmental measures, will contribute to a faster adoption of these technologies.

In a short-term horizon, we are now interested on other forms of support (as income support) which subsidize the use of some cultural practices, promoting their adoption by the farmers. It is important to state that its efficiency may depend on the magnitude of other income supports that eventually contradict the reconversion and adoption of soil tillage technologies, especially if we consider also the risk effect that we are trying to analyse.

The Portuguese government supports the introduction or maintenance of direct seeding and reduced mobilization techniques with income support, among the Portuguese specific agri-environmental measures which are particularly important on the context of actual development of CAP, because they are part of the second pillar. They give income support, linked with the eco-functionality of the farm. Then it is particularly important to study the model results considering this agricultural policy measures that are supposed to improve the farmers' use of alternative soil tillage technologies. We will then consider that the farmers who use direct seeding or reduced mobilization will benefit from the supports to the introduction or maintenance of these technologies.

Accordingly to the legislation, the subsidies are (Ministry of Agriculture, Fisheries and Food 2003):

	Subsidy to the culture	Subsidy to the conservation of stubble
Direct seeding or line/zone mobilization techniques	€44	€38

Table 7
Model results, with parameterization of total absolute deviation—total absolute deviation (€), expected income (€) and optimum activities levels

Solutions	Type of year	Ω	θ	0.75 θ	0.50 θ	0 25 θ	0
Total absolute deviation		101381	99025	74091	49396	24695	0
Expected income		71702	70839	62604	54374	46144	33265
Ha seeded with alternative technologies	1	286	286	232	180	174	153
	2	286	286	264	214	178	98
	3	286	281	273	243	221	205
	4	248	248	248	248	248	248
	5	244	244	244	244	244	244
	6	286	286	286	286	286	286
	Average	270	270	259	241	232	216
Traction sets							
80 hp ds		1	1	1	1	1	1
105 hp rm		1	1	1	1	1	1
120 hp td							
Number of sheep head (th)		399	399	399	399	399	399

Source: model results.

The results obtained for the base and alternatives technology situation were given in Table 6 and solutions obtained with parameterization, for the same levels of standard deviation as before, are shown in Table 7.

The agri-environmental income support measures are supposed to at least maintain – to support – the farmers' income while they promote environmental friendly practices, such as the use of direct seeding or reduced mobilization.

The results clearly show that in this case agri-environmental measures do achieve these two objectives. On one hand, they contribute to raise farmers' income—to a total absolute deviation of €99025, the maximum obtained without the agri-environmental subsidies, the farmer can now obtain an income of €70839, while he could only obtain €49675 before. On the other hand, they incentive the adoption of alternative soil tillage technologies by promoting the abandonment of traditional technology and the raise on the areas seeded with alternative technologies. The main point is that they give to farmers an amount that compensates the loss of subsidies given by prices and markets policy even if it is still rentable to produce with only traditional technology.

Still, in the actual context of CAP, there is a question that should be answered: What would be the consequences, in terms of incomes and technologies adoption, of a change on agri-environmental amounts given by transference of supports from the first to the second CAP pillar, i.e., a transfer between pillars?

To test this hypothesis, we redistributed the subsidies farmer's have in this moment through market and prices policy, conditioning half of the amount received to the use of alternative technologies. As this means a substantial change on the supports to traditional technology, it is now particularly important to see the results for the base situation and for the technological alternatives situation. The results are presented in Table 8.

The first interesting result from this analysis is that traditional technology would no longer be an economically sustainable alternative. More important is that, for the technological alternatives situation, the risk, measured by total absolute deviation, would significantly decrease while expected income would rise.

Table 8
Expected income, total absolute deviation of that income and each year's negative deviations, for base situation and with alternative technologies situation (€)

Type of year	1	2	3	4	5	6
Base situation						
Negative deviation in each state of nature.	–	–	–	–	–	–
Expected income	–					
Total absolute deviation	–					
Technological alternatives situation						
Negative deviation in each state of nature.	–	–	–	23828	26197	27519
Expected income	60070					
Total absolute deviation	77735					

Source: model results.

Table 9
Model results—total absolute deviation (€), expected income (€) and optimum activities levels

Solutions		Type of year	ψ
Total absolute deviation			77735
Expected income			60070
Ha seeded with alternative technologies		1	286
		2	286
		3	286
		4	248
		5	245
		6	286
		Average	270
Traction sets	80 hp ds		1
	105 hp rm		1
Number of sheep heads (th)			399

Source: model results.

In what concerns seeded hectares, traction sets and number of type heads, model results on technological alternatives situation are shown in Table 9.

As far as technology adoption is concerned, it is important to notice that transferring supports from the first to the second pillar of CAP would make farmers less vulnerable to the type of year they have to face, each year, certainly contributing to accelerate the adoption rhythm by farmers.

5. Conclusions

Agenda 2000 proclaims a model for European agriculture which takes into account that it should be, as an economical sector, sustainable, competitive and spread all over the European territory. In this context, member countries should seek to promote the adoption of agricultural practices that allow the profitability of farmer resources, burden the agricultural competitiveness on rural zones and allow the development of the role farmer must and should play on natural resources administration.

From our point of view, this clearly points to a new emphasis on agricultural policy. The European Union does not pay just to maintain incomes – such as in 1992 reform – but pays for farmers to play a new role. Many times, this role is linked with a non-commodity and therefore is not easy to value and additionally it is strictly linked with farmer's previous role—to produce. Without production, soil maintenance, landscape maintenance, etc., would have surely another value.

The higher profitability of cereals established with alternative soil tillage technologies, due to a raise on the available days to operate and to an adjustment on the structure of farm, namely the number of tractors, implements and drivers, and the conservation of soil, for which destruction mobilization is the principal responsible, seem to be able to join this two objectives together. The policy should then be able to promote the use of these technologies.

Market and prices policies are not! The results for the first simulations allow us to conclude that for the base year, with subsidies partially untied to production but not eco-conditioned, a farmer that weights equally both his objectives maximizes his expected utility using on his farm both alternative technologies and traditional technology, which indicates that having on his farm an apparatus prepared for traditional technology, the farmer will mobilize part of the farm with this technology. Therefore, in the Portuguese case, market and prices policies could not, on there own, guarantee the new farmer's role.

The introduction of agri-environmental measures, with its actual values, apparently promotes this new farmer's role—but we have to ensure that the amount given compensates the loss of some of the subsidies the farmer has from markets and prices policy.

According to C. Marques (personal communication 2003), agricultural policy financing will be more and more contested without a clear perception, by a consumer highly exigent on what concerns food security and quality, that the farmer is serving him with a contribution to the production of safe food and to the maintenance of natural resources that are the production base. The consumers pressure, the enlargement and the perception that CAP first pillar has no justification from agricultural producer competitiveness point of view and is hardly justifiable as a destination of Europeans citizens' taxes led to new policy developments.

The Brussels European Council of October 2002 has reinforced the importance of CAP second pillar. On the document presented the 21st of January 2003, the European Commission refers the necessity of a new reform effort, seeing a better equilibrium of supports and the reinforcement of rural development. After the budget decisions of Brussels' that can only be made by savings on the first pillar expenses. The reform additional effort demands savings on the expenses with markets and prices and actual direct payments, transferring those savings to the second pillar.

These adjustments go on the same direction then our last scenario which show that the use of alternative soil tillage technologies would be promoted with a change of supports from the first to the second pillar. This fact would anticipate a more stable and sustainable agriculture, from an economical and environmental point of view. We can than conclude that, in general, the promotion of a faster technological adoption should be clearly encouraged. The agri-environmental measures are an important first step, but the change of supports from the first to the second pillar of CAP ensures that European Union can establish a sustainable and predictable model for the agricultural development on the coming years.

We have to be aware that underlining agricultural policy is the fact that the reinforcement of the weaker rural areas will contribute to the economic cohesion of the European Union. For a country such as Portugal, with an agricultural model that difficultly suits the CAP market and prices policies, these changes are very important and would probably be a real opportunity. For the European Union as a whole they allow the maintenance of a stable agricultural policy for the future, a fair distribution of income supports and a better answer to consumers and contributors wishes under the new budgetary scenario.

Appendix A. General structure of the model

	Short term Activities (Year 1)	Dev. (Year 1)	…	Short term Activities (Year 6)	Dev. (Year 6)	Long term Activities	Resources Availability
Objective function	$\alpha 1 C_{cp} 1$			$\alpha 6 C_{cp} 6$		$-C_{lp}$	MAX
Year 1 restrictions: **Land** **Work** **Traction** **Extra hours** **Animal feeding** **Stocks** **Transferences from storage** **Animal Premium**	A_{1cp}					$-A_{lp}$	≤ 0
⋮			⋮				⋮
Year 6 restrictions: **Land** **Work** **Traction** **Extra hours** **Animal feeding** **Stocks** **Transferences from storage** **Animal Premium**				A_{6cp}		$-A_{lp}$	≤ 0
Current result year 1	$+C_{cp}1$					$-C_{lp}$	$=C1$
⋮							⋮
Current result year 6				$+C_{cp}6$		$-C_{lp}$	$=C6$
Deviation year 1	$+C_{cp}1$	-D1				$-C_{lp}$	$=\Sigma a_n C_n$
⋮							⋮
Deviation year 6				$+C_{cp}6$	-D6	$-C_{lp}$	$=\Sigma a_n C_n$
Total absolute deviation		-D1			-D6		= -D

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