# THE NEW CAP POLICY OF SUBSIDIES AND THE AGRICULTURAL PRODUCTION SYSTEMS OF THE ALENTEJO REGION[1]

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**Abstract**

The implementation of CAP Reform introduces a new way of thinking the choices of the agricultural production systems. According to studies for the Alentejo region, CAP subsidies represent about 50% of the farmers' total income.

The objectives of this paper are to analyze the effects on the traditional agricultural systems of the CAP Reform and of several possible scenarios of agricultural policy after the potential planning horizon of the CAP Reform.

## 1 - INTRODUCTION

Portuguese agricultural policy before the entrance to the Community had a strong impact in the production systems and their profitability. The use of poor soils of the Alentejo for cereals' production was encouraged by higher agricultural product prices and subsidies to production factors. These subsidies to production factors, such as concentrates for animal feeding, had led to the use of intensive technologies on animal production taking the place of the traditional use of pastures and forages.

With the Portuguese entrance to the Community and the compulsory adoption of the CAP, the framework where the Portuguese farmers acted has changed. The low productivity

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of the soils and the full membership with lower prices for cereals, protein crops, oil crops and meat, as well as higher production factors costs, resulted in lower income for the traditional Alentejo producers. In order to avoid such a drastic drop of their income, which could make unprofitable a great percentage of farms, it will be necessary to proceed to adjustments at several levels, namely: technology; resources endowment; and optimal mix of crops and animal activities.

Besides all these specific constraints to the Portuguese agriculture, the CAP reform introduced new rules to the European Union agricultural sector. Thus, the going from a system based on subsidies to the product prices, to a system of direct aids to income - in the products with more weight in the Community agricultural sector - associated with a system which promotes the animal extensification and a compulsory withdraw of arable land (set-aside), introduced a new way of thinking about agricultural production systems selection.

Another question to take in account is that the subsidies resulting from the CAP reform, according to studies made for the Alentejo region, represent 50% of the farmers' total income.

Beef production either by extensive or semi-extensive systems, is an alternative to the cereal production systems. These animal production systems are based on seasonal production of pastures and forages, especially in climates such as the Mediterranean ones.

The seasonally of the pasture and forage production, together with year-to-year yield variability, leads to the necessity of adjustments in livestock feed mix, in certain periods of the year, using hay and cereals' straw as well as concentrates.

Farmers' decisions, such as optimal herd, commercialization strategies for selling beef and adjustments on animal feed mix, are directly dependent on intermediate product availability.

Rational farmer decisions about what, how and how much to produce, need to have information on the availability of resources, on costs and expected productivity and on product prices. These estimates, based on living experience, traduce his perspectives on possible gains or losses, taking in account the technology used. Income variability constitutes the risk that the producer has to consider when taking production decisions, and can be measured as income variance.

In dryland agriculture, namely pastures and forages production, risk is particularly important when the producer has to choose a production technology and the associated risk level, since high levels of risk can constrain the adoption of such technologies. Farmers have, usually, a risk averse behavior (Binswanger, 1980). Thus, they prefer farm plans and production technologies that maintain their income stable, although lower.

Modeling farms without taking in account the producer's risk averse behavior, can lead to farm plans not acceptable by the farmer or without connection with farmers' decisions.

The objectives of this paper are to evaluate the effects on the Alentejo traditional agricultural systems of the CAP reform and of several possible scenarios of agricultural policy after the potential planning horizon of the CAP reform.

After this introduction we will present the description of the methodology and the empirical implementation. Model results are discussed in the third section of the paper, which concludes with CAP reform impacts and their possible evolution on Alentejo agricultural sector.

## 2 - METHODOLOGY AND EMPIRICAL IMPLEMENTATION

In order to achieve the objectives of this paper, we have studied a farm located in Évora county, with 396 hectares of total surface. It has an irrigated area, which guarantees high income and allows, through higher and more stable productions, an animal production almost entirely fed with farm products.

Data used were available from a farm survey, for the base year 1990/91. These data are referred to resource availabilities, technical coefficients and farmer objectives. Other data like product and factor prices, soils and alternative activities were available from official statistics and direct talking to experts.

The model used is a mathematical programming model, which includes the significant features of a profit-maximizing model for an average season, and also season uncertainty and farmer response to such uncertainty. The model represents:

- Rainfall variability and its effects on yields;

- Farmers' decision-making flexibility, because as a season unfolds there are some decisions farmers can make, which favorably alter the impact of that season on production and profits. This flexibility is normally limited by previous decisions and so, in practice, flexibility in decision-making is the modification on adjustment on farm plans - for instance, adjustments in livestock feed mix;

- indirect farmers' aversion to risk.

So, to allow the representation of such factors, the model is one based on discrete stochastic programming (DSP) associated with a MOTAD (minimization of total absolute deviations) framework. This technique deals with season variation by considering a number of discrete states of nature. In effect, season variation is approximated by a number of year

types (states of nature), each represented in the model. DSP also allows for sequential decision-making, which characterizes the flexibility of farmers in modifying strategic decisions as season unfolds. The MOTAD framework captures the effects on farmers' income due to: 1) cash crop yield variability, 2) cost variability from adjustments in livestock feed mix and purchases of feed concentrate, and 3) animal selling variability from adjustments on commercialization strategies.

The model objective function is to maximize expected farmer's income associated with use of farm activities and resources across states of nature. The maximization of the objective function is achieved through selection of an optimal set of farm activities. The activities draw upon the farmer's limited resources of soil areas, machinery and labor, and also feed availability. Included in the set of optimal activities are decisions about the crop rotation selection, livestock feeding in each type of state of nature, machinery and labor use. The activity options available to the farm manager are represented as column entries in a data matrix. The resource and logical limits to activity selection are represented as row entries in the same matrix.

Season variation is approximated by 16 states of nature (Table 1). The criteria for classifying seasons assume that rainfall levels for different periods influence yield production. Each state of nature represents a year type, different from another one depending on the rainfall level for critical periods referred to groups of crops (November-February for cereals in good soils and legumes, October-February for cereals in bad soils, September-December and March-May for pastures and March-May for Spring crops).

Crop activities in the model were based on cereals for grain (wheat, triticale and barley), on legumes (chickpeas, peas and broad beans), on forages (oats*vicia, oats*lupines), and on pastures (fallow, subterranean clover and fertilized fallow). It was also introduced a set

of irrigated activities, since the farmer has the necessary structures and equipment, on an area of 65 hectares. The proposed rotations for the irrigated area are based in corn for grain or for silage, wheat, sunflower and sorghum for grain and for silage.

**TABLE 1 - PRODUCTION TYPE BY STATE OF NATURE**

| STATE OF NATURE | PROB. | CEREALS Good Soils | CEREALS Bad Soils | PASTURES | |
|---|---|---|---|---|---|
| | | | | Autumn | Spring |
| 1 | 0,01 | G | G | G | G |
| 2 | 0,02 | G | G | G | B |
| 3 | 0,04 | B | G | G | G |
| 4 | 0,07 | B | G | G | B |
| 5 | 0,02 | B | B | G | G |
| 6 | 0,05 | B | B | G | B |
| 7 | 0,05 | G | G | B | G |
| 8 | 0,09 | G | G | B | B |
| 9 | 0,08 | B | G | B | G |
| 10 | 0,16 | B | G | B | B |
| 11 | 0,01 | G | B | B | G |
| 12 | 0,02 | G | B | B | B |
| 13 | 0,13 | B | B | B | G |
| 14 | 0,25 | B | B | B | B |
| 15 | 0,00 | G | B | G | G |
| 16 | 0,00 | G | B | G | B |

G - Yield above average
B - Yield below average

Animal activities are based on different production technologies and marketing strategies for cattle. For this type of animals, the activities are distinguished by different breeding periods, races and crossing used. In each one of the livestock activities there are several commercialization alternatives.

The characteristics, productivity and feed production variability determine model selection of animal technology and commercialization alternatives.

A set of optimal farm plans was obtained maximizing the expected farmer's income, subject to a parametric constraint relative to the summation of total negative deviations for all states of nature, weighted by respective probabilities. In each model, different product prices

were considered, taking in account the alignment of the European agricultural prices with the world prices and the different scenarios of agricultural policy.

## 3 - RESULTS

Table 2 shows the main results when the objective is the maximization of expected farm income for maximum risk.

For the base model, described on the previous chapter, several scenarios of agricultural policy were simulated. Thus, model 1 represents the situation before CAP reform, where the subsidies were included in the selling price, that is, the present situation for the year 1990/91. Model 2 stands for CAP reform situation, year 2002/03. In this model all the measures of the CAP reform were introduced- set-aside, compensatory payments, extensification premiums - as well as forecast world price for the year 2002/03. Model 3, taking in account the same level of prices, supposes a reduction on 50% of all measures of CAP reform. Model 4 represents the situation where all the measures of CAP reform were taken out and world prices stay for EC prices. On model 5 measures for cattle were not considered, and on model 6 set-aside and compensatory payments were taken out.

**TABLE 2 - RESULTS WITH MAXIMUM RISK**

| | MODEL 1 | MODEL 2 | MODEL 3 | MODEL 4 | MODEL 5 | MODEL 6 |
|---|---|---|---|---|---|---|
| Expected Farmer Income (cts) | 33 589.0 | 19 771.0 | 14 041.8 | 9 327.0 | 13 579.8 | 16 179.0 |
| Total Deviation (cts) | 2 938.0 | 1 673.5 | 1 623.9 | 1 400.4 | 1 577.6 | 1 727.9 |
| Risk Shadow Price (cts) | --- | --- | --- | --- | --- | --- |
| Crop Activities (ha): | | | | | | |
| Triticale 1 - Oats x Vicia (H) - Oats x Vicia (H) | --- | 88.4 | 88.4 | 93.0 | 47.6 | 93.0 |
| Triticale 1 - Oats x Vicia (H) - Barley 1 - Oats x Vicia (H) | --- | --- | --- | --- | 39.7 | --- |
| Triticale 2 - Oats x Vicia (H) - Barley 2 - Oats x Vicia (H) | --- | --- | --- | --- | 34.2 | --- |
| Chick Pea - Wheat 2 - Broad Bean - Barley 2 | 37.0 | --- | --- | --- | --- | --- |
| Chick Pea - Wheat 1 - Oats x Vicia (H) - Barley 1 | 93.0 | --- | --- | --- | --- | --- |
| Subterranean Clover 1 (10 years) | --- | --- | --- | 3.8 | --- | 110.0 |
| Subterranean Clover 2 (10 years) | --- | 37.0 | 37.0 | 37.0 | --- | 37.0 |
| Natural Pasture | 61.0 | 61.0 | 61.0 | 167.2 | 61.0 | 61.0 |
| Subterranean Clover (8 years) - Triticale 2 (G) | 110.0 | 108.2 | 108.2 | --- | 108.2 | --- |
| Wheat (I) x Corn (S) - Sunflower - Wheat (I) x Sorghum (S) - Forage (H) x Corn (G) | 61.0 | 55.2 | 55.2 | 65.0 | 55.2 | 65.0 |
| Wheat (I) x Corn (S) - Sunflower - Wheat (I) x Sorghum (S) - Forage (H) x Corn (G) | 4.0 | --- | --- | --- | --- | --- |
| Forage Area (ha) | 230.6 | 299.0 | 299.0 | 318.8 | 273.4 | 318.8 |
| Livestock Units | 375.0 | 259.4 | 241.4 | 215.3 | 212.2 | 285.2 |
| Animal Activities (heads): | | | | | | |
| Bovines 3 | 242.0 | --- | --- | --- | --- | --- |
| Bovines 4 | --- | 106.0 | 24.0 | --- | --- | 117.0 |
| Bovines 5 | 4.0 | 64.0 | 134.0 | 141.0 | 139.0 | 70.0 |
| Concentrate Weighted Cost (cts) | 18.5 | 177.2 | --- | --- | --- | 186.6 |
| Weighted Income from Animal Selling (cts) | 19 694.0 | 13 338.0 | 11 583.9 | 11 115.8 | 9 960.4 | 14 764.4 |
| Weighted Income from Forage Selling (cts) | 5 680.0 | 7 444.7 | 8 605.3 | 8 794.9 | 10 575.1 | 7 652.0 |

Source: models results

By observing and comparing models 1 and 2, we can evaluate the impacts that the CAP reform will have in Alentejo. Models 3 to 6 will allow evaluating several possible policy scenarios after the year 2003, that is, the planning horizon of the CAP reform and of the specific aids to Portugal.

Looking at Table 2, we can see that the biggest impacts, on the expected farm income, happen when we go from the year 1990/91 to the year 2002/2003, that is, when we introduce the CAP reform. Expected farmer's income will decrease by 41.12% in this situation. This decrease is mainly due to the alignment of the world and Community prices, bearing in mind that the production factor prices will remain stable.

Comparing the expected farm income of the several models, we can see that the highest value is achieved in model 1, as has been already referred, and the lowest in model 4. This model is the one where there are not any aids either to crop or animal activities. This value is about 50% of the expected farm income in model 2, which confirms that the direct aids to the farmer's income are around 50% of the expected farm income. This result also confirms the conclusions of other studies done for the Alentejo region. The intermediate situation will be the model where we only consider 50% of the direct payments to the farmer.

It is also interesting to see that the expected farm income in model 6, which considers only subsidy to animal production, is higher than the one obtained in model 5, which has subsidies only for crop activities. This translates the more important role of the animal activity, as well as the associated subsidies, for this farm.

In what concerns the total negative deviation, it achieves its higher value on model 1, where expected farm income is also the highest. Model 4 has the lowest total negative deviation as well as the lowest expected farm income. As expected, income variability is reduced when the expected farm income is also reduced. Although, in relative terms, total

deviation is as greater as lower is the weight of subsidies and aids to the expected farm income. Thus, before and after the CAP reform, the income total deviation from expected farm income goes from 8.7% (model 1) to 8.5% (model 2), which traduces the greater stability provided by the subsidies introduced with the CAP reform. This stability induced by the direct payments to the producers, being independent of the yields, is extremely important, as can be understood when we withdraw also subsidies (model 4). As a result, the total deviation represents 15% of the expected farmer's income. In model 6, total deviation stands for a minor percentage of the expected farm income (10.6%) than in models 3 and 5 (11.6%). Again, this traduces the more important role of the subsidies to animal activities in comparison to crop activities.

When comparing the results of models 1 and 2, concerning selected activities, we see that long rotations with protein crops disappear and that the cattle production is reduced (from 246 to 170 heads), giving place to an increase on the forage area.

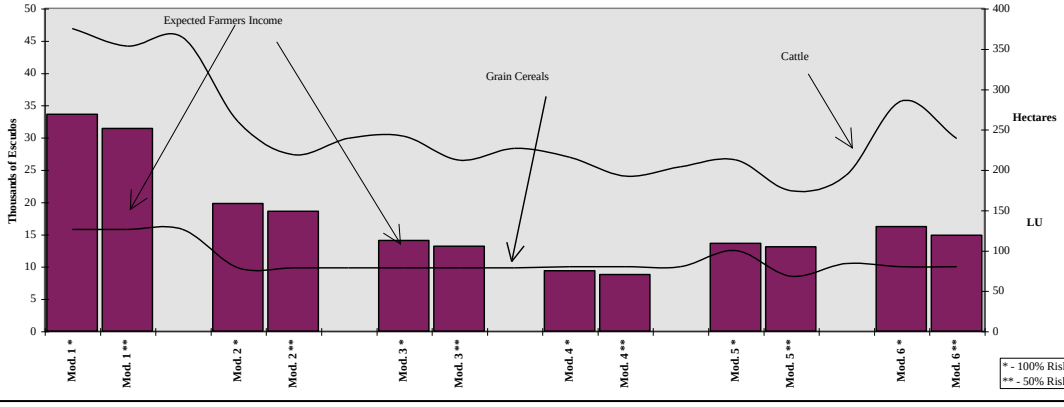
In models 2, 3 and 5 large areas of the subterranean clover (8 years) - triticale 2 (G) rotations appear. In model 6, where the area of subterranean clover increases, only the animal activities are subsidized, meanwhile, in model 4, without any subsidies, we can find a great area of natural pasture. In what concerns the irrigated area, it decreases (from 65 to 55.2 hectares), whenever we have subsidies to crop activities with the implementation of set-aside (models 2, 3 and 5).

Cattle are present in the optimal solution of all models, with an higher value in model 1, reaching minimum values in models 4 and 5 (without subsidies to animal activities). In the other models, the livestock unity will be greater when there are only subsidies to the animal activities, lower when we consider 50% of subsidies and there will have an intermediate value when subsidies to animal and crop activities are present.

Concentrate weighted cost has similar values in the solutions of models 1, 2 and 6, having zero cost in models 3, 4 and 5, that is, with 50% of subsidies, without subsidies, and no subsidies to animal activities.

The weighted income from animal selling is higher in model 1, reaching its lowest value, as expected, in model 5, where no subsidies to animal activities were considered.

**Figure 1 - Optimal Solutions**




Source: Model results

When comparing the results with maximum risk and with 50% of maximum risk (Figure 1), we can see that the expected farm income decreases in all models, being this decrease of 6.5%, 6.1%, 6.2%, 6.0%, 3.7% and 8.2%, respectively. Thus, the decrease of the expected farmer's income is minimum when compared with the reduction of the total deviation. This lead to the conclusion that farmers will choose plans with lower risk because they will achieve great variability reductions at the cost of small changes in the expected farm income.

**TABLE 3 - RESULTS WITH 50% OF MAXIMUM RISK**

| | MODEL 1 | MODEL 2 | MODEL 3 | MODEL 4 | MODEL 5 | MODEL 6 |
|---|---|---|---|---|---|---|
| Expected Farmers Income (cts) | 31 411.7 | 18 569.2 | 13 164.3 | 8 768.5 | 13 076.8 | 14 849.6 |
| Total Deviation (cts) | 1 469.0 | 836.8 | 811.9 | 700.2 | 788.8 | 863.9 |
| Risk Shadow Price (cts) | 1.7 | 2.1 | 1.7 | 1.3 | 1.0 | 2.1 |
| Crop Activities (ha): | | | | | | |
| Triticale 1 - Oats x Vicia (H) - Oats x Vicia (H) | --- | 88.4 | 88.4 | 93.0 | 88.4 | 93.0 |
| Chick Pea - Wheat 1 - Oats x Vicia (H) - Barley 1 | 95.0 | --- | --- | --- | --- | --- |
| Chick Pea - Wheat 2 - Broad Bean - Barley 2 | 35.0 | --- | --- | --- | --- | --- |
| Subterranean Clover 1 (10 years) | --- | --- | --- | --- | --- | 110.0 |
| Subterranean Clover 2 (10 years) | --- | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 |
| Natural Pasture | 61.0 | 61.0 | 61.0 | 171.0 | 171.0 | 61.0 |
| Subterranean Clover (8 years) - Triticale 2 (G) | 110.0 | 108.2 | 108.2 | --- | --- | --- |
| Wheat (I) x Corn (S) - Sunflower - Wheat (I) x Sorghum (S) - Forage (H) x Corn (G) | --- | 55.2 | 55.2 | 65.0 | 55.2 | 65.0 |
| Wheat (I) x Corn (S) - Sunflower - Wheat (I) x Sorghum (S) - Forage (S) x Corn (G) | 65.0 | --- | --- | --- | --- | --- |
| Forage Area (ha) | 231.1 | 299.0 | 299.0 | 318.8 | 311.4 | 318.8 |
| Livestosk Units | 353.0 | 218.5 | 211.7 | 192.0 | 174.0 | 238.8 |
| Animal Activities (heads): | | | | | | |
| Bovines 3 | 231.0 | --- | --- | --- | --- | |
| Bovines 4 | --- | 89.3 | 54.0 | --- | --- | 98.0 |
| Bovines 5 | --- | 53.7 | 85.0 | 126.0 | 114.0 | 59.0 |
| Concentrate Weighted Cost (cts) | 4 050.0 | 741.5 | --- | --- | --- | 615.0 |
| Weighted Income from Animal Selling (cts) | 20 801.5 | 11 913.2 | 11 044.8 | 10 256.9 | 8 280.0 | 13 145.3 |
| Weighted Income from Forage Selling (cts) | 6 375.6 | 8 605.3 | 8 525.1 | 8 794.9 | 9 239.7 | 8 795.0 |

Source: models results

In model 5, expected farm income decrease is minimum. This happens because in this model animal activities have the lowest weight, being the greater part of the income obtained from crop activities, where the subsidies do not depend directly on produced quantities.

Risk shadow prices (Table 3), are greater in models 2 and 6 (2.1 thousand escudos), followed by the models 1 and 3 (1.7 thousand escudos). With these plans, at the cost of some increase of risk, the farmer will obtain greater values for the expected farm income.

Comparing the models with maximum risk and 50% of risk, we can see that, in general, cash crop activities decrease. This is the case of protein crops and cereals, which are replaced by pastures and forages. It can be also seen that the forage area is stable and that the number of livestock units decreases, showing the tendency for animal extensification. However, the concentrate quantities bought increases with the diminution of risk, since that the pasture yield variability must be compensated.

In what concerns buying concentrates, we have already seen that these only take place on models 1, 2 and 6, that is, without and with CAP reform and with subsidies to animal production only, respectively. In the models where the animal activities have greater weight, the biggest quantities of concentrates are bought in the states of nature that represent the worst production years for pastures and forages. On the contrary, the quantity of sold forages is greater in models 3, 4 and 5, where livestock units are lower.

As referred, the selected cattle activities are 3, 4 and 5, that stands, respectively, for race crossing between Mertolengo and Charolês with Winter and Autumn breeding periods, race crossing between Alentejano and Charolês with Winter breeding periods. We can see (Table 2 and 3) that, in general, model solutions include two cattle activities

with different breeding periods, exception being the models without subsidies for animal activities where the breedings are concentrated in only one season (Winter).

Concerning commercialization alternatives, although livestock units decrease when risk diminishes, the number of male bovines (animals sold with an higher weight) increases with the risk decrease. To make this possible, and because this is a stable and assured income, it is necessary to buy more concentrate.

The only exceptions made to this situation happen in models 3, 4 and 5, where the male bovine premiums do not exist or are very low. So, in the more favorable states of nature for crop activities, it is preferable to sell forages than fat more animals. In the same way, in the majority of cases, the model chooses to sell animals with higher weight, having the male bovines a significant value only in the states of nature less favorable for pasture and forage production.

In short, independently of the agricultural policy scenario and of the beef prices, animal fattening in semi-extensive systems is profitable, except in the case of farms with reduced production of animal feeds or the absence of animal premiums.

## 4 - CONCLUSIONS

On this farm the CAP reform impacts are very strong, because production systems are deeply changed, in the sense that are given a greater weight to bovines and diminishing cereals' area. However, these adjustments do not avoid decreases on expected farm income.

Model results show different optimum activity combinations, as well as give information about the kind of animals to sell in each state of nature. Animal weight for sale and concentrates bought and forages sold vary from state of nature to state of nature, and are dependent of intermediate products' yields. This variability between

states of nature is the main source of adjustments in beef selling periods and feeding choices.

According to Marques (1993), new CAP will have deep economic and social implications for Alentejo agriculture. Even though with more competitive and less distorted markets and having in mind to be close to market, farmers and farms will be more distant from the market and from a competitive typical resource allocation. The reason for this is very simple. The great part of farm income of the Alentejo farmers will not be coming from market but from public institutional power. Decreases on product prices will lead, in short term, to the diminishing of variable resources use. Consequently, there will be decreases on production, and on the medium/long run it will be necessary to adjust farm's structure. Lower variable resource allocation will lead to production systems extensification, resulting in decreasing investments with negative impacts in an already low technological development level of those systems. These social and economic impacts will spread either in the factor supplier sector or in the processing sector.

Prices decrease and income transferences based in regional productivity classes will lead to the abandonment of intensive production technologies. In this context, farmers will only maintain competitive, in the great majority, if they proceed to the extensification of their production systems.

Finally, the subsidies' weight on expected farm income is extremely high (around 50%), and works like a buffer of income. Forcing no subsidies, deep decreases on expected farm income will appear, compromising the profitability of farm.

On the other hand, CAP reform allows for behaviors closer to the market, since taking out the entire CAP reform measures for the year 2003, we do not verify changes on agricultural systems. Livestock activities share the biggest part of income and beef production is profitable.

Probably, this situation, close to market rules, will only be sustainable if farmers be helped. Otherwise, our farms will go away with the end of CAP reform measures and Alentejo will be a desert.....!!!!

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