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Ernest Reig Martínez
Vicent Estruch Guitart

The Common Agricultural Policy and Farming in Protected Ecosystems

A Policy Analysis Matrix Approach

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A Policy Analysis Matrix Approach

Ernest Reig Martínez [1,2]
Vicent Estruch Guitart [3]

[1] *INSTITUTO VALENCIANO DE INVESTIGACIONES ECONÓMICAS (Ivie)*
[2] *UNIVERSITY OF VALENCIA*
[3] *POLYTECHNIC UNIVERSITY OF VALENCIA*

Abstract

The Common Agricultural Policy (CAP) of the European Union is currently in a state of evolution, where non-productive functions of agriculture are being increasingly recognised. The growing concern for the environmental consequences of farming activity has led European countries to the development of diverse agro-environmental schemes. This paper reflects on the effect of different policy scenarios, corresponding to old and new regulations of the European Common Agricultural Policy, on the private and social profitability of farming in protected ecosystems. We use as an empirical illustration the case of rice cultivation in the Albufera of Valencia. We use the Policy Analysis Matrix (PAM) to compute private and social profitability indicators, as well as to foresee the effects on rice farms' profitability of the recent CAP reform, which will come into force by 2005-2006. The ability of PAM to integrate environmental aspects into the conventional efficiency analysis of farming systems is also emphasised.

Key words

Environmental effects, sustainability, multifunctionality, Common Agricultural Policy, Policy Analysis Matrix, rice.

Resumen

La Política Agraria Común (PAC) de la Unión Europea se encuentra actualmente en un estado de evolución, en que las funciones no productivas de la agricultura reciben cada vez un mayor reconocimiento. La creciente preocupación por las consecuencias medioambientales de la actividad agraria ha conducido a los países europeos a desarrollar diversos programas agroambientales. Este documento reflexiona sobre el efecto de distintos escenarios de política, correspondientes a reglamentos antiguos y recientes de la Política Agraria Común Europea, sobre la rentabilidad privada y social de la agricultura en ecosistemas protegidos, usando como ilustración empírica el caso del cultivo del arroz en la Albufera de Valencia. En el documento de trabajo se emplea la Matriz de Análisis de Políticas (MAP) para calcular indicadores de rentabilidad privada y social, así como para prever los efectos sobre la rentabilidad de las explotaciones arroceras de la reciente reforma de la PAC, que entró en vigor en 2005-2006. Se pone el énfasis en la habilidad de la MAP para integrar las consideraciones medioambientales en el análisis convencional de la eficiencia de los sistemas agrícolas.

Palabras clave

Efectos medioambientales, sostenibilidad, multifuncionalidad, Política Agraria Común, Matriz de Análisis de Políticas, arroz.

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The Common Agricultural Policy and Farming in Protected Ecosystems: A Policy Analysis Matrix Approach

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CONTENTS

1. Introduction

THE Common Agricultural Policy (CAP) of the European Union is currently facing a legitimacy crisis, fruit of a widening gap between her traditional ways and means and the new aspirations of the European society. Different consecutive agendas for CAP reform have been prompted by a combination of factors, that not only include budgetary constraints but the anticipation of the results of the Doha Round multilateral trade negotiations, the assimilation of the eastward enlargement of the European Union, and the lasting consequences of some health scandals in food and feed markets. But there is also a growing recognition that, beyond its primary function of supplying food and fibre, agricultural activity can provide environmental benefits, and contribute to the sustainable management of renewable natural resources, as well as to the preservation of biodiversity, and the maintenance of the economic viability of less favoured rural areas. All these new concerns are frequently summarised under the heading of *multifunctional agriculture,* and have become an integral part of the so-called *European model of agriculture.* But this *model* offers a considerable conceptual vagueness, and the weight of farm income support in the definition of policy targets remains of paramount importance. *Multifunctionality,* as a key to a new understanding of the role of agriculture in wealthy industrial societies, can only gain scientific substance if referred to empirical evidence, based on site-specific interrelationships between farming activities and non-commercial functions. We wish to contribute to this kind of approach by focusing our attention on a crop that is important for the survival and recreation of wetlands in Europe, and by using a methodology, the Policy Analysis Matrix, that can provide valuable insights with regards to the private and social profitability of farming systems.

Rice cultivation in the European Mediterranean area constitutes a good example of a *multifunctional agricultural system,* given its important landscape and ecological value, which may be added to its directly productive function. This paper aims to calculate the private and social profitability of rice farming in the proximity of the Albufera Natural Park of Valencia (Spain), one of the most valuable coastline wetland sites of

South Europe [1]. The analysis is made under different policy scenarios, and considering two alternative farming technologies, which we call *sustainable* and *unsustainable.* The policy scenarios are based on the rice Common Market Organisation (CMO) before and after the 2003 reform of the Common Agricultural Policy (CAP), known as the *Mid-Term Review,* and on the application of a site-specific agro-environmental program. Our target is twofold: first we wish to assess the private and social costs of compliance with the environmental regulations that define the criteria for *sustainable* farming. Second, we wish to compute the threshold of social benefits arising from public — i.e., environmental — goods jointly produced with rice, which would justify the permanence of rice farming, even if it appears uncompetitive at world prices.

We use the *Policy Analysis Matrix* (PAM) approach to compute private and social profits under the different policy scenarios and technologies. This methodology was initially developed by Monke and Pearson (1989). The PAM framework displays a high potential for fruitful empirical applications. In this paper we show its usefulness in dealing with real world situations in policy contexts that value the ability of agriculture to conform to sustainability.

The surface covered by the rice fields in the areas adjoining the Albufera lake is 14,350 hectares (CAPA, 2001), with an average farm size of approximately 4 hectares. Cultivation is completely mechanized, and the crop is irrigated through flooding, using waters of the basin of the river Turia, administered by a public agency, the *Confederación Hidrográfica del Júcar.* Rice has been a traditional monoculture in this area.

Since the CAP reform of 1992, rice farmers have benefited from a support system based on three elements: commercial protection and export subsidies, public intervention purchases, and direct aid per hectare. Nonetheless, the Uruguay Round Agricultural Agreement established restrictions on the use of export subsidies, and opened a future of free import access to the European domestic market, in accordance with the *Everything But Arms Initiative,* adopted in favour of less developed countries. On the other hand, the direct aid per hectare was subject to a progressive penalty should the *Basic Designated Areas* for rice cultivation be exceeded, something which has of-

1. The Natural Park of the Albufera protects 21,120 hectares of wetland complex, and is placed in the vicinity of the Metropolitan Area of Valencia, with some 1.5 million inhabitants. This semi-urban character is a circumstance which enhances its value as a natural resort of great recreational interest, but also increases the risk of water pollution, as a result of effluents from urban and industrial activities, and to a lesser degree from farming ones.

ten occurred in Spain during recent seasons. In 2003, following the *Mid-Term Review* of the European Common Agricultural Policy, policy tools changed, and a decoupled system of payments was introduced.

The effects of the aforementioned support instruments on the private profitability of rice farms are supplemented by the environmental payments being applied in cultivation areas included in the Ramsar [2] list, as is the case of the Albufera of Valencia. These payments compensate for the restrictions on the use of specific farming techniques, imposed for the sake of ecosystem protection.

After this *Introduction,* the second section develops the notion of rice as a *multifunctional* crop, and the third section describes the basic tenets of the chosen methodological approach. Section four calculates the private and social profitability of this farming system, while section five describes the main findings. Finally, section six concludes.

2. The *Convention on Wetlands of International Importance especially as Waterfowl Habitat,* signed in Ramsar (Iran) in 1971 is an intergovernmental treaty for the conservation and wise use of wetlands, primarily oriented to provide habitat for waterbirds, but increasingly concerned with biodiversity conservation in general. The Albufera of Valencia was declared a Ramsar site in May 1990.

2. Rice: A Multifunctional Crop

BY considering agriculture as a multifunctional activity, its role of producing food stuffs and raw materials is linked with other equally important functions regarding the defence of landscape and environmental values, the safeguarding of biodiversity, the creation of conditions for food security, and contributing to the viability of rural areas. The explicit acknowledgment of the multifunctional character of agriculture is seen as an essential element of the so-called European agricultural model (European Commission 1999, 2000*a*, 2000*b*). Multifunctionality played an important role in the discourse of the European agricultural authorities at the beginning of the current Doha Round of international trade negotiations. On the domestic European front *multifunctionality* has also served to legitimise agricultural policy changes, gradually shifting farm support to the second pillar of the CAP (Garzon, 2005). In this sense *multifunctionality* was instrumental in conceptualizing the CAP reform of 1999, but by the time of the 2003 reform it seemed to have lost part of its appeal in favour of the wider notion of sustainability. In any case the growing or declining popularity of *multifunctionality* does not reflect only the dialectics between domestic policy reform and international trade negotiations. Among the European Union Member States there is also a wide range of political and academic conceptions of MFA, which can be organised around different axes, and not only *positive* versus *normative* (Perraud, 2004).

From an analytical point of view, the jointness between commercial and non-commercial outputs is a central aspect in any definition of agricultural multifunctionality (MFA), as well as the fact that some of those non-commercial outputs can be considered as externalities or public goods (OECD, 2000). The research work undertaken under the OECD was primarily inspired by the need to clarify a term that meant different things to its different Member countries. Three distinct sets of issues formed the nucleus of the research programme: production relationships linking together the multiple goods produced by agriculture, the measurement of the demand for non-commodity outputs, and the implications of MFA for policy reform and the trade liberalisation process promoted by the World Trade Organisation (WTO). Contributions from OECD-sponsored research work and different empirical studies from agronomists and ecologists (Brouwer and Crabtree, 1999) have substantially clarified the characteristics of joint production of commodity and non-commodity outputs. It has been noticed that the relationship between the production of agricultural goods and the generation of positive or negative externalities does not take place in the real world in the form of a set of fixed coefficients, rather it is contingent on the type of production techniques used, the prevailing environmental conditions — climate, soil type — and farmers' technical skills concerning the management of natural resources. The importance of agriculture as a supplier of non-commodity outputs is not necessarily linked to the level of farm output produced. Most of the multifunctional outputs of agriculture can be contemplated as associated with the use of land. Therefore, how land is used by agriculture, how much land is used, and how agricultural activity is spatially structured are very important issues with regards to the role of agriculture as a multifunctional activity (Burrell, 2003).

Rice cultivation, besides helping to shape a highly valued traditional landscape, performs an important non-marketable function linked to the protection of biodiversity and the environment. Along with the flooding technique, it contributes to mitigating the damage caused by the draining of former natural wetland sites in the Iberian Peninsula throughout the last century, in fact according to the Spanish White Book of Agriculture and Rural Development (MAPA, 2003), 60% of Spanish wetlands have been dried out or seriously damaged. Wetlands are important in Spain, not only for the wealth of animal life that dwells in these sites, or for representing a wide variety of ecosystems that are poorly represented in other European countries, but also because of their function in regulating the water cycle and detecting the problems that affect it, as well as in the treatment, by natural decantation, of polluted waters (Montes, 1995).

The rice fields act as seasonal aquatic ecosystems, given that they are flooded during Summer, a season in which the Mediterranean wetland areas undergo drought conditions, and also during part of Winter, for ecological reasons. A wide variety of waterbirds feed off the fish and insects that inhabit them, and for certain species, such as herons, the rice fields supply between 50% and 100% of the food that these birds need during the breeding season. It has been estimated that at least 25 bird species of European conservationist concern use the rice fields in Spain to either pass the Winter, or as a place to rest and feed during their migrations (Fasola and Ruiz, 1997). Flooded rice fields around the Albufera lake provide the predominant regional feeding area for some bird species like ducks, common cranes and egrets, because the eutrophication of the waters of the Albufera prevents the lake itself from supplying enough food to cover birds' needs. On the other hand, in the specific case of the Albufera of Valencia, it is worth mentioning the function of purification by decantation of the urban residual waters that are emptied into it, as well as the important public health function that is performed by preventing a marsh land area developing into a source for transmitting diseases (e.g. malaria), all of which feature among the environmental services that this cultivation provides (Estruch *et al.,* 2003). Rice fields were mentioned as a source of positive environmental externalities in the review of Spanish literature on agricultural multifunctionality commissioned by the OECD (Tió and Atance, 2001).

In 1986 the Regional Government of Valencia declared the Albufera and its vicinity a Nature Reserve, implying that rice cultivation is subject to this Reserve's regulations. Chemical products implying a major risk for the ecosystem have been prohibited. This has reduced most of the *negative externalities* previously generated, such as water pollution by phytosanitary products or nitrates, the reduction of algae and the lacustrine vegetation through the use of herbicides, and also the loss of biodiversity that takes place when the vegetation of the irrigation channels and boundaries are eliminated by chemical means. The unease generated among farmers because of the restrictions imposed by the Reserve regulations led to the approval of an agro-environmental program, *Protection of the Flora and Fauna in Coastline Wetland Sites: the Albufera of Valencia,* by the Government of the Region (september, 1995), which established compensation payments for farmers.

Various programs with an environmental purpose have targeted this area since 1995 (Estruch and Vallés, 2001). The last one was passed in the year 2001, and related to the 2001-2006 period, and is expected to be prorogued to 2007. Its main mandatory managerial prescriptions were the following: maintenance of a farming logbook; four-month maintenance of flooded plots during Autumn-Winter; a maximum amount of 110 Units of Nitrogen Fertilizer to be applied per hectare; biological control of the *Chilo Suppresalis;* mechanical control of weeds by means of the slime technique through premature flooding; prohibition of burning of stubble; care and conservation of water-retaining elements; and mechanical control of weeds in the drainage channels *(BOE [Official State Bulletin]* RD 4/2001).

3. The Policy Analysis Matrix

IN order to learn about the possibilities of maintaining rice cultivation in the Reserve, it is necessary to study its economic viability under different scenarios. Firstly, it is necessary to know to what extent farms' current economic returns are being affected by the changes in the CAP concerning rice regulations. Secondly, it is sensible to analyse the effect on profits of payments made under the Environmental Program *Protection of the Flora and Fauna in Coastline Wetland Sites: the Albufera of Valencia*. In both cases it is useful to apply the so-called *Policy Analysis Matrix* (PAM), which we briefly describe in the following paragraphs.

The *Policy Analysis Matrix* (Monke and Pearson, 1989) is a tool for quantitative policy analysis that embodies many insights from international trade theory and cost-benefit analysis. The PAM is the representation of two basic identities, the first of which defines the profitability as the difference between income and costs (rows), whereas the second measures the effects of the differences in incomes, costs and profits arising from distorting policies and market failures (columns). In this way, the Matrix allows us to compute the effects on income, costs and profits, of a particular policy. Table 3.1 shows a simplified PAM.

TABLE 3.1: The Policy Analysis Matrix

	Income	Costs		Profits
		Tradable inputs	Domestic factors	
Private prices	A	B	C	D
Social prices	E	F	G	H
Effects of both the domestic divergences and the efficiency-restoring policies	I	J	K	L

The *rows* of the matrix respectively represent:

- the private profitability from farming production (D = A – B – C)
- the social profitability (H = E – F – G)
- the *effects of the divergences*. They represent a net balance from the application of a combination of policies that create economic distortions (trade protection, price support, exchange rate misalignment, etc.), market failures, and correcting policies that aim to restore efficien-cy conditions. Positive or negative income *transfers* to the farming systems arise, insofar as the private growers operate with market prices that differ from the efficiency prices (social prices).

The *columns* of the matrix show *income* and *profits*, as well as the breakdown of *costs* into two columns, formed by the *tradable inputs* and the *domestic production factors* (capital, land and labour). The so-called *intermediate inputs* (fertilizers, pesticides, improved seeds, compound feeds, electricity, fuels, transport), must also be decomposed into elements of the *tradable inputs* type, and into *domestic factors*.

The main purpose of constructing a PAM is to capture the differences between private profitability and social profitability, although the latter is to be strictly understood in efficiency terms, and therefore without encompassing other possible social objectives, such as the *redistribution of income* or *food security*. Some particular conventions are adopted for pricing the *outputs* and *inputs*, in order to calculate social profitability. For those *outputs (E)* and *inputs (F)*, which are internationally traded, world prices (c.i.f. for imports and f.o.b. for exports) set up appropriate social values, whereas the valuation of *domestic factors (G)*, corresponds to their *opportunity cost*, that is, to the net income lost by not putting those factors to their best alternative use.

Differences between private and social valuations do not only affect *tradable inputs* and *outputs*. The valuation of *domestic factors* is also affected when the government taxes or subsidises land, capital or labour, or when their pricing is being affected by market failures. Whereas labour and capital are normally treated as variables, land is usually considered as a quasi-fixed factor in agriculture.

The analyst can make use of the *Matrix* to describe the contribution of a specific agricultural system to the achievement of non-efficiency objectives, and also to quantify the corresponding implications in terms of efficiency losses. Nonetheless, the assessment of the value of the specific *trade-offs* between different objectives is left to the political authorities´

judgement. An alternative procedure would consist of directly incorporating the non-efficiency objectives into the analysis, by *adding* the efficiency and non-efficiency effects in one single indicator. But, as Monke and Pearson (1989) point out, it poses the problem that the relatively clear and high-quality information related to the *efficiency* objective would in this way become mixed with a certain amount of more subjective and less rigorous information linked to the weightings assigned to other political objectives.

The PAM permits the construction of different *ratios*. The following three have been calculated in this paper:

Private Cost Ratio: PCR = C/ (A-B)

This is the quotient between the cost of the domestic factors, valued at private prices, and the value added, which is also calculated at private prices. The system will be competitive while the quotient is lower than or equal to unity.

Domestic Resource Cost Ratio: DRC = G/ (E-F)

This is the quotient between domestic factors' costs valued at social prices and the value added, also computed at social prices. *DRC* minimization is thus equivalent to the maximization of the social profits produced by the farming system analysed. An agricultural system enjoys a comparative advantage if its *DRC* ratio is less than unity, indicating that the economy is saving foreign exchange by means of domestic production.

Subsidy Ratio to Producers: SRP = L/E = (D-H) / E

Measures the *net transfer* to the farming system as a proportion of the total social income generated, allowing the analyst to discover to what extent the economic policy is subsidizing the system.

Since the seminal work by Monke and Pearson (1989), the PAM approach has been widely used. It has been applied to studying the private and social profitability of maize cultivation in Portugal, before this country joined the European Community (Fox *et al.*, 1990) and to analyse and discuss farm policy strategies in Kenya (Pearson *et al.*, 1995). It has likewise served to demonstrate the lack of private and social profitability of sugar cane cultivation in Indonesia at the end of the 80´s (Nelson and Panggabean, 1991), as well as the advisability of adopting maize cultivation technologies based on agroforestry systems, in preference to those based exclusively on the use of chemical fertilizers, in Sub-Saharan Africa (Adesina and Coulibaly, 1998). It has also been used to support a policy of crop diversification in Thailand which would not appear to be justified on a short-term basis for efficiency reasons (Yao, 1997*a*, 1997*b*). It has confirmed the comparative advantage of Chinese agriculture in labour-intensive crops, as opposed to land-intensive ones (Fang and Beghin, 2000).

The possibility of incorporating environmental considerations into the PAM considerably reinforces the interest of its application to the analysis of farming in areas of high ecological value. The few attempts to extend the use of the PAM in this way have started by recognising the capacity of agricultural systems to generate positive or negative e*xternalities,* which would justify public interventions. On purely theoretical grounds, it has been suggested that if external costs were associated with particular farming activities, estimates of these costs should be brought within the accounting framework (Kydd, Pearce and Stockbridge, 1997). And the PAM framework could also be used to replace the current value of different variables — income, costs, profits —, by their discounted value over a given time period, taking into account the effects of environmental degradation.

The difficulties of collecting data related to the environmental benefits and costs of particular farming systems probably explain the scarcity of empirical applications of an environmentally-enlarged PAM methodology. On this basis, we have chosen to follow the basic distinction between *sustainable* and *unsustainable* PAMs as recommended by Pearson, Gotsch and Bahri (2003). These research workers have suggested a step-by-step procedure for analysing environmental externalities using the PAM framework that has inspired our own work.

Therefore, the broadening of the PAM to depict the environmental effects displayed by specific cultivation systems still retains, in our approach, a basic methodological tenet of its initial construction: it is strictly grounded on economic efficiency considerations. In this respect, any *positive external effects* arising from farming, like the increase in the populations of valuable fish and bird species, that occur when rice growers use environmentally-friendly techniques, are not included in the social valuation row of the Matrix. Neither does it depict the welfare benefits derived from the elimination of a *negative externality,* such as the pollution of water. Despite this, it paves the way to fit the effects of multifunctionality-oriented policies into mainstream efficiency analysis. In this particular case, multifunctionality mainly translates into a concern for the environmental function of rice farming, which has motivated our inclusion of agro-environmental payments in the computation of PAM. According to the European legislation on rural development (Regulation CE 1698/2005), agro-environmental aids must reflect the additional costs and income losses arising from compliance with technical farming restrictions contained in the environmental regulations. Thus, agro-environmental payments should not be understood as a compensation for farmers', supply of public goods — landscape, biodiversity protection — that are jointly produced with commercial output. Therefore, it is evident that the usefulness of the PAM approach would be reinforced if it were complemented with other analytical tools, such as those that contemplate the evaluation of valuable natural or semi-natural spots by means of *contingent evaluation techniques*.

Anyway, we believe that performing a PAM analysis of the private and social profitability of rice farming in a highly regarded ecosystem, is a matter of great practical importance. It permits us to calculate the lower limit to the valuation of jointly produced public goods that might justify the estimated social efficiency losses arising from farming, when commercial production, as in this case, is not competitive at world prices.

4. Construction of the PAM for Rice Cultivation in the Albufera Lake Area of Valencia

A matrix was initially constructed on the basis of the techniques and costs observed in the existing agricultural practices (*sustainable* PAM) [3]. Then we built the *unsustainable* PAM [4] through the reconstruction of the costs and income structure of a virtual farm that had not been subjected to any obligations derived from current environmental regulations. The latter's cells were constructed by taking into account any changes in the income and costs per hectare that would occur after changing actual cultivation techniques, deemed *sustainable,* to make them *unsustainable,* and by including the decrease of income caused by farmers no longer being eligible for agro-environmental payments under the unsustainability assumption. The effect on yields from the reduction of fertilizer dosage, as a consequence of applying current environmental regulations, has been established at 5%, according to Sendra (1997).

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3. We consider that the crop is sustainable if it fulfils the Natural Park's Legislation and the requirements of the *Protection of the Flora and Fauna in Coastline Wetland Sites* Program. The data used to elaborate the farms' budgets were collected in 2003 from interviews with the farmers who participate in the aforementioned Program and also with members of co-operatives and technical personnel of service firms specialised in selling farm inputs in the area.

4. The cultivation techniques classified as sustainable differ from those that are unsustainable in three fundamental aspects that must be fulfilled by the former category: a dose of 110 units of nitrogen fertilizer per hectare must not be exceeded, insecticides cannot be used to control the American crab, and chemical controls must be substituted by manual or mechanical controls of weeds on the banks and in irrigation channels. The environmental requirements that affect this farming system in the Albufera area are of two kinds: those linked to the Park (*DOGV [Valencian Government Official Bulletin],* Decrees 89/1986 & 96/1995) and those derived from the legislation that regulates agro-environmental aids (*BOE [Official State Publication],* Royal Decree 4/2001). Except the ban on the use of insecticides, that arises from the Natural Park regulations, all the remaining conditions obey to the agro-environmental program.

Other than the distinction between *sustainability* and *non-sustainability*, a double accounting system operates in both matrices: at *private* prices and at *social* prices. The *social* prices were obtained from the *international prices* (c.i.f. prices for imports) for *paddy* rice and for tradable inputs. Taking international prices as an efficiency benchmark follows a recommended practice, even in the presence of international market distortions (Monke and Pearson, 1989 and Pearson, Gotsch and Bahri, 2003). It was also assumed that the euro / dollar exchange rate was not policy-distorted, a reasonable assumption, and that market prices of capital and labour services rightly reflected their opportunity cost. The monetary value of family labour was computed in accordance with the market salary paid for equivalent tasks. Land rent at social prices was made equal to zero, given the impossibility of growing alternative crops on the land presently dedicated to rice fields within the protection perimeter of the Albufera, both for legal reasons derived from the Natural Park regulations and for physical reasons connected to the seasonal flooding of the cultivation plots. Should abandonment be the alternative to rice growing — a plausible assumption under local conditions — the land's rent must be valued at zero cost for society in terms of efficiency.

An additional provision is required to assign numerical values to the cells that correspond to *marketable inputs* and to *domestic factors*. According to Monke and Pearson (1989), it is advisable to break down the costs paid for fertilizers, seeds, the use of rented machinery, and other marketable inputs, into their strictly tradable components on the one hand, and into the remuneration of the capital and labour embodied in their transport, transformation and commercialisation, on the other. The *Input-Output Tables* from the Valencian Region Statistical Institute (Institut Valencià d'Estadística, 1995) have been used for this purpose. On the other hand, the Value Added Tax has also been discounted, as has the European Union's External Tariff Rate, from the private prices of the tradable goods in order to obtain *social prices*.

Only slight differences remain between the valuation at private and social prices of the tradable inputs, once tax effects have been eliminated, given the low or nil tariff rate applied to these goods. Larger differences have only been found for certain fungicides (triciclazol-based, or in mixtures of carbendazamin and flusilazol), and these may be attributed to market price segmentation applied by multinational chemical companies. As for the output — the *paddy* rice —, the differences between domestic farm prices and *international prices* are significant, and they reflect the protection that the CAP grants to European growers. We have estimated that the *inter-*

national price is 0.177 [5] euros / kilo after the drying process, whereas the domestic price for the grower would be 0.26 euros / kilo. The aid per hectare received in 2003 may stand at 119 euros / ha [6]. Observed average yields have been applied to calculate income per hectare, these being 6,958.8 kilos / ha for the sustainable PAM, and 7,325 kilos / ha for the unsustainable PAM.

We have completed the analysis by incorporating the new support mechanisms for rice production, which are coming into force in the European Union during 2005-2006 (Regulations 1785 / 2003 and 1782 / 2003). The new Common Market Organization (CMO) for rice includes a reduction in the intervention price from 298.35 euros per tonne to 150 euros per tonne, in order to bring domestic prices closer to the international prices. Rice farmers have been compensated by raising the subsidy paid per tonne to 177 euros, of which 102 euros are to be *decoupled* from current production, as part of the new Single Farm Payment [7]. The remaining 75 euros per tonne, multiplied by the historical national rice yields, are to be paid as a crop-specific aid per hectare. This means that from the 2005 / 2006 marketing year onwards, a coupled subsidy of 476.25 euros per hectare sown of rice will be paid to Spanish growers, in accordance with an official yield estimate for Spain of 6.35 tonnes / ha, and a decoupled subsidy of 647.70 euros per hectare will also be granted as a Single Farm Payment to those farmers who had previously received the rice CMO subsidy under the old Regulation during the years 2000, 2001 and 2002.

Our PAM-building exercise is conducted for 2003, where the pre-reform rice CMO applies. Furthermore, we add a new scenario corresponding

5. The average price considered for imports of medium-sized grain paddy rice unloaded in the port of Valencia in 2003 is 0.173 euros / kg, to which the average unloading charge has been added, estimated at 0.004 euros / kg.

6. This figure represents the net aid after deduction of the penalties that arise from having exceeded the CAP's Basic Designated Surface in Spain in this same year (see footnote 7).

7. After the CAP's reform of 2003 — named *Mid-Term Review* —, farmers are entitled to benefit from a single payment scheme if they have been granted a payment in a reference period, comprising the calendar years 2000, 2001 and 2002, under at least one of a list of former support schemes that includes a rice regulation established in 1995 (Regulation EC 3072 / 95). The reference amount shall be the three-year average of the total amount of payments granted under the former scheme. Farmers may use the eligible farmland for any agricultural activity, with some exceptions for permanent crops, fruits and vegetables, or leave it uncultivated but under an obligation to keep their parcels in good ecological conditions. Additionally, a crop specific payment (*coupled*) of 476.25 euros per hectare of land sown under rice shall also be granted. A national base area (*Basic Designated Surface*), not to be exceeded by claimants of this rice specific payment has been established. Overrun of this area implies a proportional reduction in the area per farmer for which aid is claimed in that year. See for details Council Regulation (EC) 1782 / 2003. Full implementation of these provisions will not occur until the end of 2005 / 2006 marketing year.

to the new post-reform rice CMO that will be applied at the end of the 2006 marketing year. This new scenario uses all the data corresponding to 2003 — domestic and international prices for inputs and outputs, etc. — but changes the amount of support provided by CMO subsidies according to the new CAP legislation.

The data, in euros per hectare, are shown in table 4.1 — sustainable PAM, table 4.2 — unsustainable PAM, and table 4.3, which depicts the effects of the new support system. Only a valuation at private prices is provided in table 4.3, as the PAM valued at social prices remains the same as in tables 4.1 and 4.2. Private profits have been calculated in the tables under two alternative assumptions: including land rents in the costs or considering the remuneration of land as a part of profits that cannot be computed separately.

TABLE 4.1: Policy Analysis Matrix (*Sustainable*)
(euros/ha)

			Costs										
		Income	Tradable inputs					Domestic factors				Profits	Profits[b]
			Fungicides	Herbicides	Fertilizers	Seeds	Energy	Others[a]	Capital	Labour	Land		
Private prices	**Output value**	1809	41	142	54	21	126	261	812	1070	721	–921	–200
	CMO subsidies	119											
	Agro-environmental subsidies	398											
Social prices	**Output value**	1232	27	142	51	19	99	225	826	1037	0	–1195	–1195

[a] Other inputs that cannot be broken down.
[b] Profits plus land rent.

TABLE 4.2: Policy Analysis Matrix (*Unsustainable*)
(euros/ha)

		Income	Costs									Profits	Profits[b]
			Tradable inputs					Domestic Factors					
			Fungicides	Herbicides	Fertilizers	Seeds	Energy	Others[a]	Capital	Labour	Land		
Private prices	**Output value**	1905	44	144	93	22	130	200	867	842	721	–1038	–317
	CMO subsidies	119											
Social prices	**Output value**	1297	30	144	88	19	103	164	842	836	0	–931	–931

[a] Other inputs that cannot be broken down.
[b] Profits plus land rent.

TABLE 4.3: Policy Analysis Matrix. Calculation with private prices and with the support system corresponding to the new OCM
(euros/ha)

		Income	Costs									Profits	Profits[b]
			Marketable inputs					Domestic factors					
			Fungicides	Herbicides	Fertilizers	Seeds	Energy	Others[a]	Capital	Labour	Land		
Sustainable PAM	**Output value**	1232	41	142	54	21	126	261	812	1070	721	–1141	–422
	CMO subsidies	476											
	Agro-environmental subsidies	398											
Unsustainable PAM	**Output value**	1297	44	144	93	21	130	200	867	842	721	–1289	–567
	CMO subsidies	476											

[a] Other inputs that cannot be broken down.
[b] Profits plus land rent.

5. Results

USING tables 4.1, 4.2 and 4.3, the following ratios were calculated: *Private Cost Ratio* (PCR), *Domestic Resource Cost Ratio* (DRC), and *Subsidy Ratio to Producers* (SRP) — see table 5.1.

TABLE 5.1: Private and Social Profitability Indicators for Rice Cultivation in the Albufera of Valencia

Indicator	Sustainable PAM[a]	Sustainable PAM[a]	Unsustainable PAM[a]	Unsustainable PAM
PCR	1.47	1.10	1.65	1.20
PCR[b]	1.66	1.24	1.96	1.42
DRC	2.34	2.34	2.02	2.02
SRP	0.22	0.81	–0.08	0.47
SRP[b]	0.04	0.63	–0.28	0.28

[a] Including the private valuation of land rent in cells C and G (*domestic costs*) of the Matrix. An alternative would be to include land rent in cells D and H (*profits*), as has been done in the other two columns. A value equal to zero at social prices has been assumed for the land rent.
[b] These correspond to the scenario of the reform of the CMO for rice in the *Mid-Term Review*.

Firstly, it is necessary to highlight the *negative* character of the economic results achieved by rice growers in the Albufera of Valencia. Making the computation with private prices, and with regard to the CMO preceding the last CAP reform, profits oscillates between an amount of –200 euros per hectare, a situation of a practical equilibrium when the land income is not separately included as a component in the domestic factor costs (cell C) but is added to profits in the sustainable PAM, and –1,038 euros, when the remuneration assigned to the land shows up in C, and the computation is made under the assumptions corresponding to the unsustainable PAM.

Calculation of the crop's *social profitability* achieves even more negative results, given that the elimination of subsidies reduces the social price valuation of farm income relative to the valuation at private prices. The net result at social prices fluctuates between –931 euros per hectare (unsustainable PAM) and –1,195 euros per hectare (sustainable PAM). It should be remembered that PAM's definition of *social profitability* does not includes an appraisal of the worth of the positive environmental externalities arising from the flooding of the rice fields. But we can make use of differences between private and social profits per hectare to establish a lower threshold for the valuation of the annual supply of public goods services, jointly provided with rice output. Doing so, and taking into account the area annually sown of rice, we estimate that the figure would stand somewhere between 11.09 and 14.27 million euros [8]. A valuation higher than this could serve to justify agricultural support afforded to rice farmers, under the *multifunctionality* argument [9]. We do not undertake a valuation exercise in this paper, but we can illustrate this idea using the findings of some published research work. The value at 2003 prices of an individual's willingness to pay to visit the Park for recreation purposes may stand at 5.72 euros, according to a study that used contingent valuation techniques (Del Saz and Suárez, 1998). Using an estimation of 3.6 [10] million visitors each year — the Park is close to a densely populated Metropolitan Area — may give a total annual valuation of 20.5 million euros for the Park's services. This figure only accounts for some of the use values of the Park, leaving aside existence and option values. It is true that the use and existence values of the Park do not only depend on the environmental, ecological and landscape functions of rice fields, but certainly the above back-of-the-envelope calculation conveys some orders of magnitude that are relevant in giving empirical support to policy discussions.

We have built the reformed CMO scenario under the assumption that only the *coupled*, or crop specific payment, estimated at 476 euros per hectare sown of rice should show up within the income cell. The Single Farm Payment has not been included as a component of rice growers' income, as farmers are entitled to this payment by virtue of production decisions taken some years ago, while not current rice cultivation is being required. It seems the right thing to do, if we are concerned with farmers' incentive for rice production arising from agricultural policy measures. But, of course, it

8. Using the sustainable PAM, and assuming that private profits include land rents. The first figure corresponds to the CMO that will come into force during 2005-2006, whereas the second figure corresponds to the CMO prior to the latest reform.

9. We only pretend to illustrate the potential of the PAM methodology to shed light on a highly contended policy issue. Discussing agricultural multifunctionality within the framework of PAM allows to recognise that in many cases the public goods argument in favour of domestic farm support is much more defensible at the local or regional level, as public goods services are frequently provided by site-specific farming systems, than at national level, where the danger of *trade protectionism in disguise of multifunctionality* more easily arises. In other words, domestic rice production could be judged multifunctional or not, with regard to highly specific local circumstances and the PAM lends itself to the analysis of different ecosystems of rice production within the same country.

10. Provided to the authors by the office of the Valencian Town Council responsible for the Park.

is debatable whether fully *decoupled* payments are really conceivable in agriculture, at least under conditions of uncertainty, according to their side effects on wealth, insurance and liquidity (Hennessy, 1998). Farmers — see table 4.3 —, earn a total of 2,106 euros per hectare when they operate with sustainable techniques and only 1,773 in the other case, when they are not eligible for agro-environmental payments. They make losses in both cases, even when profits are enlarged to include land rents. Our analysis show that, after the *Mid-Term CAP Reform*, economic incentives for rice production in the Albufera of Valencia have clearly diminished [11].

Figures higher than unity for the *Private Cost Ratio* prove that the cost attributed to the use of *domestic factors*, either through market prices, or by means of *shadow pricing*, as in the case of family labour, systematically exceeds the Value Added. Under the scenario of CMO reform *PCR* values increase, due to a deterioration in revenue per hectare of rice farming.

The *Domestic Resource Cost Ratio* also exceeds unity, and displays higher values than those obtained for its private prices equivalent ratio (PCR). This can be explained by the reduction that income valuation at social prices undergoes when it is computed with neither the trade protection afforded by the European Union nor the corresponding subsidies. Obviously rice production in the Albufera of Valencia is not internationally competitive, since the domestic cost of labour, capital and other non-tradable inputs practically doubles the Value Added at international prices.

Before the last CAP Reform, and in the case of the *sustainable* PAM, the *Subsidy Ratio to Producers* points to net transfers representing 22% of the output social value, when land rent is included as a cost for growers, and it reaches 81% when land rent is amalgamated with farm profits. Differences between income per hectare at private and social prices, represent 1,094 euros, out of which 53% corresponds to trade protection effects, 36% to agro-environmental payments, and the remaining 11% corresponds to subsidies per hectare. The new CMO makes the *SRP* figures to fall.

We now summarise some basic findings from our analysis. First, in the CAP's pre-reform scenario, changing from unsustainable to sustainable farming techniques slightly decreases output value and increases costs, both calculated at private prices. The net effect is a worsening of farms' financial situation, which comes mainly from higher labour costs of environmentally-friendly cultivation techniques and a estimated decrease in yields of 5%. Thus, the private costs of compliance with the environmental regulations

11. But total income earned by farmers have increased, if the estimated value of the Single Farm Payment, that amounts to 647 euros per hectare, is taken into account.

can be estimated in 281 euros per hectare. Second, the agro-environmental program payments of 398 euros per hectare overcompensate this profit losses. Third, the social costs of compliance represent the foregone national income that goes with the adoption of a sustainable system of rice farming. They can be measured as the decrease in social profits from table 4.2 to table 4.1, which amounts to 264 euros per hectare. Fourth, under the new CMO scenario the gap between private and social profitability for sustainable farming techniques diminishes.

The closing of the gap between private and social profits translates into a decrease in the implicit social transfers to a farming system that does not enjoy a comparative advantage with regards to the world market. Thus, the new system of support for rice farmers, after the CAP *Mid-Term Review* of 2003, seems to represent a move in the right direction in terms of resources' allocation. On the other side, the Single Farm Payment, a *decoupled* policy tool introduced with CAP's reform, will support farmers' income, cushioning the effects of the sharp decrease in price intervention levels. Taking a longer term perspective, European authorities have yet to provide a clear justification for this new type of incomes policy, but the complex issue of CAP's legitimacy falls outside of the scope of this paper.

6. Conclusions

WE have assessed the private and social profitability of rice-growing in a wetland area of high ecological value, where Natural Park regulations apply, using the *Policy Analysis Matrix* methodology as described by Monke and Pearson (1989). Moreover, it has been adapted to take into account those re-strictions derived from fulfilling environmental restrictions (Pearson, Gotsch and Bahri, 2003), and also the corresponding economic compensations granted to the farmers. The results have stressed the fact that profitability is negative, both at private and at social prices, and that the analysed farming system — rice cultivation in the Albufera of Valencia (Spain) — is not internationally competitive.

In spite of the significance of the income transfers received by virtue of CAP provisions and under the *Protection of the Flora and Fauna in Coastline Wetland Sites: the Albufera of Valencia* Program, private profits remain negative. This bare fact conveys the message that the crop's economic sustainability is not guaranteed in the long term, given that the total farm income received by farmers does not cover the opportunity costs of the quasi-fixed factors (Monke, Avillez and Pearson, 1998). Nonetheless, family farms may survive within a shorter temporal horizon, accepting a lower remuneration for farm-owned production factors, family labour particularly. Restructuring is also under way, not only through the classical form of an increase in the average size of farms, but also through the outsourcing of many growing tasks and the hiring of machinery.

Private profit figures are strongly dependent on the *shadow price* assumed for family labour. We opted to apply the hourly wage rate currently paid for hired labour, accepting that this might somewhat exaggerate the opportunity cost of family labour for reasons shown in the literature (López, 1986, Sadoulet, De Janvry and Benjamin, 1998).

The finding that social profitability is also negative, has to be contemplated from the perspective of the type of methodology being applied. The PAM does not directly permit an overall welfare balance to be established, rather it allows for a somewhat more limited approach, one that is restricted to the *efficiency* notion in a strict economic sense. It means that international prices are taken as a reference to calculate income and tradable input costs, whereas domestic factors are priced at their opportunity costs. If, instead, a broader perspective were adopted, a wider range of positive externalities could also be considered. They mainly arise from the role as semi-natural wetland sites that flooded rice fields play, as well as from other factors linked to highly regarded landscape aspects and to identity values. In order to make that approach operational the analyst should rely on methodologies, such as contingent valuation, that could complement the use of the Policy Matrix and also avoid the risks of allocating arbitrary weights to non-efficiency objectives (Del Saz and Suárez, 1998). Instead, we have resorted to the agro-environmental payments granted to farmers under the *Protection of the Flora and Fauna in Coastline Wetland Sites: the Albufera of Valencia* Program. But we recognise that these payments are only intended to cover the differential costs and revenue losses arising from the fulfilment of environmental regulations, as stated in CAP's legislation (Regulation CE, 1698/2005) and in no way, even if they somehow exaggerate these costs and losses, can be considered as a remuneration for the joint production of public goods.

In spite of its stated limitations, the *Policy Analysis Matrix* remains a valid instrument to analyse the competitiveness of a farming system. Furthermore, as our work demonstrates, it is also useful for finding out the efficiency costs in which society may voluntarily incur to secure the supply of highly valued public goods, like landscape values and biodiversity protection, and to achieve other social objectives, like farm income support. The knowledge of these social preferences requires other analytical tools. However, the PAM can be used to assess the minimum social valuation of the aforementioned public goods required in order to compensate the efficiency costs incurred. In the present case, the figure would stand somewhere between 11.09 and 14.27 million euros, when the affected land surface and the overall income transfer per hectare to the farmers are taken into account.

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ABOUT THE AUTHORS

ERNEST REIG MARTÍNEZ has a PhD in economics from the University of Valencia, and is professor of applied economics at the same university as well as a senior researcher at the Instituto Valenciano de Investigaciones Económicas (Ivie). He is a member of the editorial boards of *Economía Agraria y Recursos Naturales* and *Investigaciones Regionales* and of national and international research teams that analyze the multifunctionality of agriculture. His fields of specialization are regional economic analysis, agro alimentary economics and the analysis of efficiency and productivity in the presence of environmental effects. He has authored various books and more than thirty articles in national and international specialized journals.
E-mail: ernest.reig@uv.es

VICENT ESTRUCH GUITART holds a PhD in agricultural engineering from the Polytechnic University of Valencia where he is a lecturer in the Department of Economy and Social Sciences. He is a member of the research group *Economía Rural y Agroambiental* (ERA). His work focuses on two lines of research: the study of the socioeconomic effects that applying agricultural environment programs is generating in the agrarian sector, and the analysis of the existing relationship between the support mechanisms applied by the Common Agricultural Policy in different agricultural and cattle subsectors, and the processes of structural transformation that farms are experiencing in each one of those subsectors.
E-mail: vestruch@esp.upv.es

Any comments on the contents of this paper can be addressed to Ernest Reig Martínez at ernest.reig@uv.es.

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Fax: 94 424 46 21

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Tel.: 91 374 54 00
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informacion@fbbva.es
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