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Rice farming competitiveness in European Mediterranean wetlands: Evidence from Spain's Albufera Natural Park

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ABSTRACT.- *Beyond the conventional role of providing food, rice farming in European Mediterranean wetlands also performs a valuable non-marketable function related to the provision of environmental services. Recent reforms of the Common Agricultural Policy (CAP), and increasing access of third party countries to the internal European market, are imposing uncertainties on the competitiveness of European rice growers. This paper studies the private profitability of rice cultivation in the Albufera Natural Park (Eastern Spain), after the 2003 CAP reform. Our results show that the competitiveness of this highly multifunctional farming system depends crucially on current CAP supports. However, improving managerial performance would raise farms' competitiveness, helping to preserve the role of the Albufera in providing environmental services. Finally, we find that outsourcing labour and capital services constitutes a managerial strategy that helps farmers to enhance their profit-efficiency.*

KEY WORDS: European Mediterranean wetlands, multifunctionality, *Albufera Natural Park*, rice farming, *CAP* support, competitiveness, profit-efficiency, outsourcing.

JEL CLASSIFICATION: C61, D61, Q12, Q18.

1.- Introduction

The analysis of developed countries' agricultural systems is currently influenced by new visions of the role played by farming in a broad societal context. The traditional food-and-fibre production function is being downplayed, while there is an increasing concern with the role of farming in the stewardship of nature. Also, the ability of agriculture to sustain a minimum of economic activity in less favoured areas, thus guaranteeing their economic viability, receives considerable attention within the context of rural development policies. *Multifunctionality* has been coined as a workable concept to deal with these multiple facets of modern farming.

The OECD (2001) provides a working definition of the *multifunctionality of agriculture*, which includes two main elements: multiple outputs being jointly produced, and some of them exhibiting the characteristics of externalities or public goods, with the implication that markets are either lacking or operating deficiently. The *OECD*'s definition is distinctively positive, because multifunctionality is considered a characteristic of most agricultural systems, and not a value in itself. This concept has also been approached from a normative standpoint: multifunctionality reflects the objectives of society with regard to the economic, environmental and social functions of agriculture. The normative approach is more multidisciplinary and policy oriented, and economic efficiency is no longer the only valid performance indicator. Instead, a multicriterion analysis has been recommended (Pingault, 2004).

A practical consequence of the increasing public awareness of the non-productive functions of farming has been the use, in the discourse of the European Union, of the *multifunctionality argument* to legitimate policy support for agricultural production. Nonetheless, a markedly complex relationship exists between farm output and socially valuable non-commodity outputs, so that relying on market support for farm output as a way of securing agricultural-related public goods is a risky strategy. Technical relationships between the two types of goods, i.e. the degree and specific form of production *jointness*, will vary between different locations, as will also the public appreciation of a particular mix of commodity and non-commodity agricultural outputs. Despite the insistence in the political discourse on the link between farm output and environmental functions, land use is far more important than the amount of farm output with regard to the role of agriculture as a multifunctional activity (Burrell, 2003). Moreover, it is likely that subsidising farm output will result in agricultural production competing with, instead of complementing, the supply of other, *multifunctional*, outputs (Harvey, 2003).

In this framework, our paper contributes to the current strand of literature in the field of agricultural economics by reflecting on present features and future prospects of a highly valuable agro-ecological system, which is being endangered by a lack of economic viability: rice farming in European Mediterranean wetlands. Rice production in these areas supports a wealth of biodiversity, and displays other non-productive functions, but private profitability is undermined by cost disadvantages against international markets. Recent changes in rice's *Common Market Organisation* (*CMO*), and the trend towards a complete elimination of trade barriers *vis-a-vis* less developed countries, cast serious doubts on the future of these farming systems. Particularly, we focus our analysis on rice farming in the *Albufera Natural Park*, located in the region of Valencia (Eastern Spain), because it represents the sort of rice fields that were mentioned as a source of positive environmental externalities in the review of the Spanish literature on agricultural multifunctionality commissioned by the *OECD* (Tió and Atance, 2001).

The *Albufera Natural Park* is located in the vicinity of the Metropolitan Area of the city of Valencia, with some 1.5 million inhabitants, protects 21,120 hectares of wetland complex, and was declared a *Ramsar* site[1] in 1990. Its semi-urban character enhances the value of this area as a natural resort of great recreational interest. The *Albufera* is a fresh water coastal lagoon, surrounded by rice fields that cover a surface of 14,350 hectares of land. Cultivation is completely mechanised, and the crop is irrigated through flooding, using waters from the basin of the rivers *Túria* and *Júcar*. Moreover, rice has been a traditional monoculture in this area.

Rice fields act as seasonal aquatic ecosystems, given that they are flooded some weeks in spring and during summer, a season in which the Mediterranean wetland areas

[1] *Ramsar* sites are those included in the *Convention on Wetlands of International Importance Especially as Waterfowl Habitat*, signed in 1971 in the Iranian city of *Ramsar*. This agreement is an intergovernmental treaty for the conservation and wise use of wetlands, primarily oriented towards providing habitat for waterbirds, but increasingly concerned with biodiversity conservation in general.

undergo drought conditions, and also at some stage in winter, for ecological reasons. Seasonal flooding of rice fields, like those belonging to the *Albufera* area, contributes to mitigating the damage caused by the draining of former natural wetland sites in the Iberian Peninsula throughout the last century (MAPA, 2003). A wide variety of waterbirds feed off the fish and insects that inhabit the rice fields, and for certain species, such as herons, they supply between 50 and 100 % of the food needed during the breeding season. It has been estimated that at least twenty five 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.

Biodiversity protection is not the only non-commodity output produced by this multifunctional agricultural system. It is also worth mentioning the function of purification by decantation of the urban residual waters that are emptied into the lake, as well as the important public health function that is performed by preventing a marsh land area developing into a source for transmitting diseases, all of which feature among the environmental services that this cultivation provides (Estruch *et al.*, 2003). The rice fields and the *Albufera Natural Park* also constitute a highly regarded traditional landscape, which has been preserved by virtue of the restrictions on land use imposed by the Parks legislation.

A severe profitability crisis of rice farming in this area would lead to abandonment of rice growing, but more importantly, it would also seriously affect the other functions, i.e. ecological, sanitary, landscape, performed by this agricultural system. This is precisely the main motivation of this paper, which intends to analyse both short- and long-term economic competitiveness of rice farming in the *Albufera Natural Park*, after the 2003 *Common Agricultural Policy* (*CAP*) reform. Besides, we pay particular attention to the economic efficiency of individual farms and its determinants. Our main results show that the viability of rice growing depends decisively on the maintenance of the current *CAP* support levels. However, we also find that many farms could improve their managerial performance, which would help to enhance the competitiveness of this highly multifunctional agricultural system.

The rest of the paper proceeds as follows. Section two describes the current *CAP* support to European rice growers, and computes some conventional competitiveness indicators of rice farming in the *Albufera Natural Park*. In section three, profit efficiency and its determinants are analysed at the farm level. A final section summarises the main findings and highlights some concluding remarks.

2.- Profitability of rice farming in the *Albufera Natural Park*.

The assessment of rice farming profitability that we make in this paper is based on data from a comprehensive survey made by the authors to analyse in depth certain economic and agronomic issues of the *Albufera Natural Park* rice farming system. The data correspond to the year 2004. Polls were conducted on 141 farms exclusively dedicated to rice growing in the neighbourhood of the *Albufera* lake, with nearly one hundred questions aimed at characterising the productive process, and describing farmers' socioeconomic characteristics. In addition, the survey included a wide-ranging set of questions relating to farmers' qualitative perceptions, some of them closely related to the environmental role played by this agricultural system. The initial sample was afterwards submitted to a process of detection of outliers using *scatter-plots* and some measures of *leverage*. Lack of response on some relevant variables and deletion of potential outliers reduced our final sample to 131 rice farms.

Profitability of rice farming in the *Albufera* area depends, on the one hand, on sales revenue, heavily influenced by the gradual closing of the gap between domestic and international prices. On the other hand, it depends on a system of institutional support that the *CAP* confers on rice growers. Rice farmers operating within the *Albufera Natural Park* are provided with two different types of support, according to European Union legislation. The first one corresponds to agro-environmental payments, and is intended to protect the important environmental functions performed by rice farming in this area. Currently, payments to rice farmers amount to 398 euros per hectare (*Regulation CE 1698/2005*).

The second support mechanism is embedded in the system of specific market interventions and trade protection that the *CAP* uses to uphold farmers' income. Recent changes in the *CAP*'s mechanisms of income support to rice growers have added to the uncertainty concerning the future prospects of rice farming in the *Albufera Natural Park*. Since the *CAP* reform of 1992, rice farmers had 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 access of imports to European domestic markets. Furthermore, the *Everything But Arms Initiative*, adopted by the European Union in favour of less developed countries (*Regulation EC, 416/2001*), aims to facilitate food imports from these economies, mainly bananas, sugar and rice. Under its provisions, duty free access for rice will be granted in September 2009. Finally, the direct aid per hectare was subject to a progressive penalty should the *Basic Designated Areas* for rice cultivation be exceeded.

After the 2003 reform of the *CAP*, the intervention price for paddy rice was cut by 50 %, with the purpose of reducing the gap between international and domestic European prices. By way of compensation, farmers are now 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 rice's *Common Market Organisation* (*CMO*) established in 1995 (*Regulation EC, 3072/95*). In accordance with the Spanish official yield estimates, rice farmers around the *Albufera* receive a *decoupled* subsidy of 647.70 euros per hectare. Additionally, a crop-specific *coupled* payment of 476.25 euros per hectare of land sown under rice is also granted. The reformed *CAP* also maintains a *Basic Designated Area*. Exceeding this area implies a proportionate reduction in the area per farmer for which coupled aid is claimed (*Regulation EC, 1782/2003*).

Let us now move to the assessment of private profitability of rice growing in the *Albufera* under the post-2003 reformed *CAP* support scheme. Any evaluation of the future prospects of a system of small farms has to start by testing its economic sustainability. Economic returns to family labour have to be compared with the alternative returns available off-farm. The opportunity cost for family labour can be ascertained from market wage rates in the farm labour market, or in other economic activities, when, as in the case of the *Albufera* rice system, there are plenty of opportunities for farmers or their relatives to take local service, manufacturing or building industry jobs. A basic distinction needs to be drawn, however, between short-term competitiveness, when assets that are farmer's property should be considered as sunk costs, and long-term competitiveness. In the long-term an opportunity cost has to be attributed to all farm assets, including land and capital owned by the farm household.

Indicators of both short- and long-term competitiveness are computed according to the definitions provided in Monke *et al.* (1998, pp. 8-10). Our short-run indicator evaluates the ability of farms to remain temporarily in operation even if farming revenue does not allow the recovery of the full opportunity cost of all family-owned farm assets. It measures the ratio between farm revenues, net of intermediate input costs and payments for hired labour and rented land or machinery, and the input of family labour to the farm, which is measured in *Annual Working Units* (*AWUs*). The remuneration imputed to a unit of family labour is thus inclusive of the returns earned by capital and land owned by the family. In the long-term a farming system should provide all employed resources a rate of return close to the return obtained in their best alternative use. It means that capital and land owned by the agricultural household have to be fully costed. Accordingly, our long-run competitiveness indicator is computed as the quotient between farm revenues, when the cost of all inputs, except family labour, has been subtracted[2], and the input of family labour to the farm.

Competitiveness has been assessed at the farm level under two different scenarios concerning the sources of farmers' income. In the first one, farmers' income is computed by adding up the revenue obtained for output sales at market prices and support corresponding to agro-environmental payments, and the post-2003 *CMO* subsidies. Only

[2] Services of own capital have been priced using the cost of hired machinery, as a conventional opportunity cost. In addition, the private rent of land has been established according to the most common quotations for transactions in the local farmland rent market, currently around 721 euros per hectare.

coupled subsidies have been considered, as the *decoupled* ones are not rice-specific. The second scenario represents a *virtual* situation where rice farmers are deprived of *CAP* support, so that revenue from output sales constitutes their only source of income. Indicators of competitiveness expressed per *AWU* of on-farm family labour are presented in *Table 1*, which also shows net returns per farm.

The most outstanding result is that rice farming could not survive in the long-term if deprived of *CAP* support. Even in the short-term, net economic returns to farmer's labour are very modest if agro-environmental and *CMO* subsidies are not taken into account. Let us now compare the returns obtained by an *AWU* of on-farm family labour in the long-term, inclusive of financial support under *CAP* regulations, with the incomes available off the farm. In our sample, only 8 % of off-farm family labour is employed in the farming sector, so that the comparison should be established with earnings from non-agricultural occupations. Current economic conditions suggest that a reasonable benchmark corresponds to the average wage income in the building industry. According to the estimations provided by the Spanish *Instituto Nacional de Estadística*, in the region of Valencia the average labourer in the building industry earned some 14.788 euros on an annual basis in 2004[3]. This figure is significantly higher than the 11.182 euros earned in rice farming, as showed by our long-run competitiveness indicator.

The literature in the field of agricultural economics has pointed out that farmers may willingly work for an implicit wage lower than the alternative wage that its labour force could command in the labour market (López, 1986, Fall and Magnac, 2004). This preference is fully rational if some special amenities of on-farm labour compared to off-farm waged jobs are considered. The autonomy granted by owning the farm, the quality of rural life, and the higher cost of life in urban areas, could make up for the difference in earnings between farming and alternative off-farm jobs.

But looking only at average long-term income per *AWU* might be misleading. The average daily earnings from farming of a family labour unit could be on a par with its

[3] Annual earnings in manufactures and services are 17.531 and 16.008 euros, respectively. Moreover, average remuneration in agricultural occupations is 12.051 euros.

opportunity costs and yet not guarantee the farm's viability. This would be the case if the total return to labour is too small to absorb the household labour force, or even to guarantee a full time job for the farmer. In the *Albufera Natural Park*, no farmer possessing a rice farm of the average size would be able to survive, after correctly pricing its productive assets, on the sole basis of the remuneration of farm labour income. This is because the aggregate use of labour on the farm is equivalent to merely 0.2 *AWUs*. The assessment of competitiveness when net returns are computed per farm, shows that, even allowing for *CAP* support, the revenue derived from farming falls clearly short of the minimum judged necessary to earn a living (see also *Table 1*).

Summing up, current economic viability of rice farming in the *Albufera Natural Park* depends crucially on the continuation of *CAP* support. Furthermore, even in the event of current support being maintained, rice farmers will have to adjust in the coming years to a less protective environment, with increasing access of third countries' exporters to the internal European market. Lack of competitiveness requires rice farmers to follow a strategy of adjustment that pays due consideration to all available alternatives. Several managerial strategies are already being observed. Some farmers follow a strategy of achieving a greater scale of operations, either buying or renting land, or making more efficient use of their machinery by performing some mechanised tasks for other farmers. Other rice growers are pursuing a very different path of adjustment, taking part-time off-farm jobs and outsourcing many of the productive tasks to service firms or co-operatives. Obviously, a wide range of intermediate situations also exists. Anyhow, the new scenario for European rice farmers demands an exploration of the different ways of overcoming the aforementioned lack of competitiveness. We next focus our attention on changes conducive to achieving better profit-efficiency levels.

3.- How far are rice farms in the *Albufera Natural Park* from profit-efficiency?

In this section we explore the possibility of improving farms' management as a feasible way out from the lack of competitiveness of rice farming in the *Albufera Natural Park*. By doing so, we hope to reach a better understanding of the conditions that would improve the chances of keeping in place this multifunctional farming system. Assuming that managerial decisions of rice growers are intended to maximise profits, our aim here is to compare the observed behaviour of each rice farm in the sample with best observed practices, i.e. practices of those farmers that maximise profits, in terms of a performance index. With this purpose, we make use of mathematical programming and *Data Envelopment Analysis* (*DEA*), introduced by Charnes *et al.* (1978). Reig-Martínez and Picazo-Tadeo (2004) highlight the usefulness of these techniques for analysing farming systems. Further details on *DEA* are in Cooper *et al.* (2004).

It has been occasionally argued that some farmers would not actually follow a profit maximising strategy, but rather a strategy aimed at maximising a utility function that does not necessarily match the profit function (Gómez-Limón *et. al*, 2004). In order to test for this possibility, rice growers interviewed in our survey were asked to manifest their degree of agreement with the following assertion: *the most important target for a farm is to maximise profit*'. Possible responses ranked from 1 (total agreement) to 5 (total disagreement), 3 representing the neutral answer. Based on this scale of responses, nearly 80 % of the farmers declared their agreement or total agreement with this statement. Thus, we can legitimately assume that rice growers in the *Albufera* follow a profit maximising strategy, and then evaluate their relative performance.

Prior to assessing performance, the rice farming productive process needs to be characterised. In doing so, one output and eight production factors are considered. Output is measured in kilograms of rice production. The only fixed input is cultivated land (hectares), while variable production factors are: farm-owned and outsourced labour (measured in *AWUs*), farm-owned and outsourced capital (expenditure in euros), fertilisers, seeds, herbicides and fungicides (all measured in euros).

Concerning prices, the price of rice has been set at 0.24 euros per kilogram, and it is assumed to be the same for all farms in the sample. This choice is based on the fact that all farmers produce similar varieties of rice, which are sold in the local market with no price differences. Family-owned labour has been priced using the cost of outsourced labour, as a conventional opportunity cost. The expenditure on farm-owned capital services has been computed, as previously noted, in terms of opportunity cost, considering total hours of use of own machinery and the price of outsourced capital services. It is assumed that all farms share the same price for labour and capital, because the markets for both production factors are local markets with no observed difference of prices. Finally, the price of inputs which are measured in monetary units has been conventionally set to one. *Table 2* provides some descriptive statistics.

Regarding the nature of inputs, here we depart from conventional literature that considers all farm-owned production factors as fixed, including land, labour and capital. In our particular case, considering within-farm labour and capital as variable production factors allows us to capture an important structural characteristic of Valencian agriculture: the importance of part-time farming and outsourcing as determinants of production management (Arnalte and Estruch, 2000). The highly diversified economic structure of the neighbourhood where rice fields are located, close to the city of Valencia and its metropolitan area, largely favours part-time farming, allowing farmers to earn wage income from employment in the local agricultural labour market or, increasingly, in services or industry. In addition, many mechanised tasks in rice farming are outsourced in the broad sense that they are not performed by the farmer or his family, but by small local service firms or co-operatives. As a result, both part-timing and outsourcing allow decisions on optimal allocation of farm-owned labour and capital to enter into farmers' short-run managerial strategy on the adjustment of production factors.

Let us now move to the assessment of profit efficiency. Computation of the productive plan that maximises short-run profit for each of the $i = 1,\ldots,131$ rice growers in our sample, requires the comparison of their actual observed data on output and inputs, with those of farms showing best observed practices, i.e. profit-efficient farms. Formalising, the productive plan that maximises short-run profit of farm i' arises from the following optimising program:

$$Profit\left(r,p,x_f^{i'}\right) = Max_{x_v^{i'},y^{i'},z^i}\left(ry^{i'} - \sum_{v=1}^{8} p_v x_v^{i'}\right)$$

subject to:

$$\begin{aligned} & y^{i'} \le \sum_{i=1}^{131} z^i y^i \\ & x_f^{i'} = \sum_{i=1}^{131} z^i x_f^i && f = 1 \\ & x_v^{i'} \ge \sum_{i=1}^{131} z^i x_v^i && v = 1,...,8 \\ & z^i \ge 0 && i = 1,...,131 \\ & \sum_{i=1}^{131} z^i = 1 \end{aligned} \tag{1}$$

y^i, x_v^i and x_f^i being, respectively, the observed output and both variable and fixed inputs on farm i. Output price and prices of variable inputs are denoted by r and p_v, in that order, while z^i represents the weighting of each farm i in the composition of the efficient frontier. Furthermore, the set of restrictions characterises a technology with variable returns to scale (Banker *et al.*, 1984), satisfying the standard axioms proposed by Shephard (1970).

Computation of the profit-maximising productive plan for each rice farmer in the sample allows a *profit-efficiency indicator* to be worked out, by comparing current observable profit levels with profits that could be achieved after a profit-maximising adjustment of both variable inputs and output. According to Färe *et al.* (1994; p. 214), this index of overall efficiency arises from the following relationship:

$$Profit\left(r,p,x_f\right) = \frac{ry}{O_g\left(x,y,p,r\right)} - O_g\left(x,y,p,r\right)px_v \tag{2}$$

where $O_g(x,y,p,r)$ is the so-called *graph measure of profit-efficiency*, and $Profit(r,p,x_f)$ is the short-run profit computed as the solution to program (1).

Results are summarised in *Table 3* The mean of the individual scores of profit-efficiency is 0.826, with no substantial differences among farms. In addition, only seven rice growers behave efficiently. On average, revenue should be increased by 13 % and costs cut by 22 % in order to attain profit-efficiency. Furthermore, cost reductions needed to achieve profit efficiency are particularly important for farm-owned labour and capital. This finding has a straightforward implication for rice growers in our sample: they could improve their competitiveness in the short-run by improving managerial performance. Obviously, better management would make it easier for many farms to remain in operation, helping to preserve the role of the *Albufera Natural Park* in the provision of environmental services, as well as protecting biodiversity and landscape.

Additionally, we have explored the financial consequences of getting rid of managerial inefficiencies for the farms in our sample. *Table 4* displays the values for the conventional indicators of competitiveness presented in section 2, computed using profit-maximising data. Prior to commenting on these results, let us point out that the pursuit of a strategy of profit-maximisation leads to an increase of net returns per farm, but also to a reduction in the use of on-farm family labour[4], given that own labour has been considered a variable production factor. Therefore, the increase in competitiveness due to achieving profit-efficiency needs to be interpreted as the result of two forces acting in the same direction at the farm level: an increase in net returns, and a cut in the use of family labour.

The improvement in the economic returns per *AWU* of on-farm family labour, once profit-inefficiencies have been eliminated, is quite impressive. Now, the amount of farm income that rewards a family's productive assets far exceeds the annual income of the average labourer in manufacturing, even in the absence of agro-environmental and *CMO* subsidies. Farmers are thus able to achieve short-run competitiveness. Long-run competitiveness also improves dramatically, but in this case the ability of farms to survive still depends on the continuity of policy support. Agricultural households would still be in the red if all productive assets were fully costed, according to their opportunity costs, and *CAP* subsidies were not flowing in. The difference with regard to the profit-inefficient situation is that now losses are being cut to 3.083 euros per *AWU* of on-farm labour.

Assessment of competitiveness in terms of net returns per farm also reveals a substantial amelioration of profitability. But in this case the improvement is not so marked. The reason is that the average farm is too small to afford farmers a fulltime job. The modest absolute levels of economic returns per farm, even after economic inefficiencies

[4] The path from farmers' observed behaviour to best practices, defined in terms of profit-efficiency, implies a change in farms' input-mix. Particularly, moving to profit-efficient productive plans implies a sharp reduction in the on-farm employment of family labour, which should be reduced, on average, by 44 %.

have been eliminated, points to a fundamental structural weakness of rice farming in this area, related to the small size of most farms. Accordingly, farm concentration should be pursued as a policy target in the long run, besides the emphasis on an improvement of short-run farm efficiency levels.

With the intention of going further into the study of managerial efficiency, we have carried out a second-stage analysis aimed at investigating the factors related to farms' performance. Performing second-stage analyses is a customary practice in the empirical literature on efficiency measurement. The most common approach has been to regress, mostly using censored *Tobit* regression, non-parametric *DEA*-based estimates of efficiency on a set of environmental variables to account for exogenous features that might affect performance. Nonetheless, in a recent paper, Simar and Wilson (2007) show that these procedures may lead to wrong results, mainly because of the serial correlation of the first-stage *DEA* estimates and the correlation between the error term and the set of covariates in the second-stage regression. Instead, *bootstrapping* procedures are proposed to allow for better estimation and statistical inference. In this paper, we use Simar and Wilson's *simple algorithm* to explain farms' managerial inefficiency, defined as the inverse of the profit-efficiency scores obtained in our *DEA*-based first stage. In order to avoid an excess of methodological details in the main text of the paper, the key insights of this algorithm are summed up in *Appendix 1*.

Regarding the features capable of influencing managerial performance, we include traditional variables such as farmers' educational level, age and farm size, in addition to a variable that captures a specific characteristic of rice farming in the *Albufera*: the degree of outsourcing. Education is proxied by the average years of schooling, and size is measured in hectares. Furthermore, outsourcing is proxied by the cost of outsourced labour and capital services as a proportion of the total cost of these production factors. *Table 5* displays the estimated parameters, and their confidence intervals. The number of replications in the bootstrap procedure has been set at 1000.

Empirical evidence reveals, with a 95 % confidence level, that outsourcing positively and significantly affects rice farmers' managerial performance, so that the bigger the weighting of outsourced labour and capital on farms' total use of these inputs, the smaller their profit-inefficiency[5]. This result is in line with previous literature, which has pointed to the importance of outsourcing as a managerial strategy aimed at increasing competitiveness in farming systems with a predominance of small farms, and where farmers can profit from local flexible labour markets (Picazo-Tadeo and Reig-Martínez, 2006). Besides, outsourcing is a strategy increasingly adopted by Spanish farmers[6], especially for performing those tasks that require the use of machinery (Langreo, 2002). This is precisely the case of rice farming in the *Albufera Natural Park*, where capital services are actually the main component of the set of outsourced inputs[7].

Rice cultivation requires the use of different types of specialised machinery. However, due to the small dimension of most rice farms around the *Albufera*, owning the equipment necessary to perform all the tasks involved in rice farming becomes a highly unprofitable managerial strategy. Instead, capital services are for the most part outsourced. Outsourcing reaches highest levels at harvesting, because of the specific and expensive combine-harvester required, although it is also important in other specific tasks like sowing, ploughing or performing phytosanitary treatments. In general, capital services are outsourced to other rice farmers in the area who, as mentioned in section 2, have decided to follow a managerial strategy aimed at attaining a greater scale of operations by using their own machinery to perform mechanised tasks for other rice farmers. Sometimes, these labourers adopt the legal form of small service firms, or they work for co-operatives performing services for their members.

The key matter here is the greater efficiency displayed by those professional labourers or service firms that are actually performing mechanised tasks on behalf of rice farmers in

[5] Accordingly, our first-stage efficiency analysis reveals that the path to profit efficiency operates through a reduction in the use of both labour and capital which, however, affects farm-owned production factors disproportionately more, thus increasing the degree of outsourcing.

[6] Strategies conducive to a higher use of external services in agriculture have also been observed in other European areas, mostly in Italy (De Filippis, 1985) and France (Harff and Lamarche, 1998).

[7] Actually, in our sample, 88 % of the capital services utilised are outsourced, on average, while only 18.5 % of labour is outsourced.

the *Albufera Natural Park*. Several empirical arguments support this assertion. On the one hand, since machinery can normally only be exploited to the full by performing tasks for other farmers, professional labourers own the specific equipment required to perform efficiently each single task in rice farming. Conversely, rice farmers who do not externalise capital services are forced to use the same machinery to perform quite different tasks, unavoidably reducing their effectiveness, e.g. they use only a small farm-tractor for both ploughing and sowing, although effective performance of the former would require the use of a more powerful machine. On the other hand, professional labourers generally make use of the latest technologies. For instance, they predominantly use farm-tractors fitted with a *GPS* device, capable of achieving a high level of precision in sowing, fertilising or applying phitosanitary treatments, thus avoiding overlapping of the areas treated and contributing to savings of seeds, fertilisers or herbicides and fungicides. Nonetheless, the main source of cost savings derived from the use of new technologies comes from reducing the labour input, given that they are mostly labour-saving technologies.

Let us now come back to the analysis of the features able to affect rice farms' performance. Apart from outsourcing, none of the other variables seem, at the standard confidence levels, to have a statistically significant relationship with managerial performance. This comes as a surprise, since one would expect farms managed by younger farmers or farmers with a higher educational level to show higher profit-efficiency levels. Nonetheless, our view here is somewhat different. Due to the wide-spread strategy of outsourcing labour and capital, what really matters to explain farms' managerial efficiency is the skilfulness of the external labourers or service firms performing outsourced tasks, and not so much the particular ability of the farmer, proxied by variables like education or age. As noted, these service firms enjoy some kind of competitive advantage, because they can more easily acquire specialisation skills, i.e. expertise in operating with machines that incorporate new technologies (Picazo-Tadeo and Reig-Martínez, 2005).

This research has the ultimate purpose of helping to bring economic analysis closer to the concerns of policy-makers. In our view, our results affect a couple of issues of interest for agricultural policies. On the one hand, policy measures targeted at spreading best practices among rice farmers in the *Albufera Natural Park*, might be of some help in improving rice farmers' competitiveness, thus contributing to sustaining this multifunctional farming system. On the other hand, these policies should pay attention to the concerns of individual rice farmers, but chiefly to the upgrading of organisational skills and access to the latest technologies on the part of those service firms and co-operatives that contribute substantial capital and labour inputs to different tasks in rice farming.

As a final comment, let us mention that further research should include consideration of additional aspects not covered in this paper. We have focused on the profitability of rice production in the *Albufera Natural Park* wetlands, as a necessary condition for the maintenance of biodiversity and other ecological functions in this area. Our results clearly show that achieving profit-efficiency could substantially mitigate farmers' losses. But they still reveal a lack of long-run competitiveness for the average farm in our sample. This means that keeping this farming system in operation implies a cost in terms of economic efficiency, as conventionally defined in the literature. Therefore, it is a matter for technical judgment and political decision whether the value of the public goods provided is worth this cost. A more definite answer could only be provided after a careful exercise in public goods valuation, using any of the available methodologies. We leave this task for further research.

4.- Summary and concluding remarks

Rice farming in European Mediterranean wetlands performs, beyond its traditional food supply function, the essential role of providing environmental services and protecting biodiversity and landscape. The need to open the internal European market to third countries' exporters imposes serious uncertainties on future profitability prospects for European rice growers, who have traditionally exhibited substantial cost disadvantages compared to international markets. In this paper, we focus on the private profitability of rice farming in the *Albufera Natural Park*, located in the East of Spain, after the 2003 *CAP* reform. Farms' competitiveness in this valued multifunctional agricultural system is currently compromised, jeopardising the provision of essential environmental services carried out by rice fields.

Based on information from a survey conducted specifically for this study, we have assessed short- and long-term competitiveness, under two different scenarios: including and excluding income support from agro-environmental and *CMO* subsidies. Results are conclusive: current rice farming profitability dramatically depends on the continuation of *CAP* support. Nonetheless, even if the current support is maintained, rice growers will need to adjust in the coming years to a more competitive environment, because of the increasing access of third countries to the internal European market, and a progressive closing of the gap between domestic and international rice prices. This scenario requires exploring fresh ways to overcome lack of competitiveness. In this paper, we particularly focus on changes conducive to achieving better management.

Our findings show that rice farms in the *Albufera Natural Park* could increase competitiveness by improving their profit-efficiency levels. Better managed rice farms would be able to survive in the short-term even if they were deprived of *CAP* support, helping to preserve the environmental role played by this highly multifunctional agricultural system. Improving management would also help to raise competitiveness in the long term, although in this case the economic viability of farms would still depend on the continuity of policy support. Furthermore, our results indicate that outsourcing certain tasks to external service firms improves the chances of rice farms attaining profit-efficiency. Enhancing managerial performance is not the only consequence of outsourcing, as it also facilitates the adoption of a time-saving strategy on the part of those part-time farmers that absolutely predominate in this area. The small size of the farms and the economic conditions prevailing in this *periurban* agriculture strongly favour this strategy, which possibly could not be satisfactorily put to use in other agricultures.

From an *economic policy* standpoint, we consider that our findings lead to noteworthy implications for policy-makers. Agricultural policies aimed at spreading technological innovation and best managerial practices might contribute to improving rice farms' competitiveness. Moreover, these policy measures should mainly target the service firms and external labourers that are, actually, involved in performing some outsourced tasks in rice farming. Finally, a strategy of farm amalgamation aimed at attaining a greater scale of operation also emerges as a policy target to be pursued, besides the emphasis on an improvement of short-run farm efficiency levels.

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Tables

Table 1.-
Indicators of current competitiveness of rice farming in the *Albufera Natural Park*. Averages.

	Return per *AWU* of on-farm family labour (euros)		Return per *farm* (euros)	
	Including CAP support	*Excluding CAP support*	*Including CAP support*	*Excluding CAP support*
Short-run competitiveness	32,953	10,744	6,138	2,474
Long-run competitiveness	11,182	-11,028	1,893	-1,770

Table 2.-
Characterisation of rice farming production process (averages per farm)

			Quantities		Price
Variable	Description	Units	Mean	Standard deviation	(euros per unit)
Output	Rice	Kilograms	34,712	62,208	0.24
Fixed input	Cultivated land	Hectares	4.2	7.6	-
Variable inputs	Own labour	AWU	0.16	0.23	12,052
	Outsourced labour	AWU	0.04	0.08	12,052
	Own capital	euros	1,223	4,163	1
	Outsourced capital	euros	1,747	3,181	1
	Fertilisers	euros	477	905	1
	Seeds	euros	584	1,074	1
	Herbicides	euros	686	1,333	1
	Fungicides	euros	276	603	1

Table 3.-
Computed scores of farms' profit-efficiency.

	Mean	Standard deviation	Maximum	Minimum
Profit-efficiency	0.826	0.090	1.000	0.471

Table 4.-
Indicators of competitiveness of rice farming in the *Albufera Natural Park* computed using profit-maximising data. Averages.

	Return per *AWU* of on-farm family labour (euros)		Return per *farm* (euros)	
	Including PAC support	*Excluding PAC support*	*Including PAC support*	*Excluding PAC support*
Short-run competitiveness	75,164	33,547	7,008	3,345
Long-run competitiveness	38,353	-3,083	3,445	-218

Table 5.-
Determinants of profit-inefficiency. Confidence intervals at 95 %.

	Estimated parameter	Lower bound	Upper bound
Constant	1.28017	1.08972	1.48644
Age	0.00128	-0.00177	0.00378
Education	-0.00026	-0.00898	0.00826
Size	-0.00864	-0.01536	0.00132
Outsourcing	-0.23277	-0.43375	-0.01910
Sigma	0.16627	0.13529	0.19982

Appendix 1.-

Performing the *simple algorithm* proposed by Simar and Wilson (2007; pp. 141-143) to explain managerial performance requires, in the case of our empirical application, to follow the next three steps:

Step 1.- Use maximum likelihood to obtain estimates $\hat{b}$ and $\hat{s}_e$ of b, and s_e, respectively, in the truncated regression of the inefficiency scores estimated in the *DEA*-based first stage ($INEF$) on a set of covariates z_i, using the subset of i = 1,…,m < 131 inefficient observations, i.e. observations with a score of profit inefficiency greater than one. Formally:

$$INEF_i = z_i b + e_i \qquad \text{(A1)}$$

Step 2.- Loop over the three steps (2.1) to (2.3) L times to obtain a set of bootstrap estimates of b and s_e:

Step 2.1.- For each i = 1,…,m, draw e_i from the following normal distribution:

$$N\left(0,\ \hat{s}_e^2\right) \text{ left truncated at point } \left(1 - z_i\hat{b}\right) \qquad \text{(A2)}$$

Step 2.2.- Yet again, for each i = 1,…,m, compute:

$$\left(INEF_i\right)^* = z_i\hat{b} + e_i \qquad \text{(A3)}$$

Step 2.3.- Use maximum likelihood method to estimate the following truncated regression:

$$\left(INEF_i\right)^* = z_i b + e_i \qquad \text{(A4)}$$

Jointly, steps (2.1) to (2.3) yield a set of bootstrap estimates of b and s_e:

$$\wp = \left\{\left(\hat{b}^*, \hat{s}_e^*\right)_b\right\}_{b=1}^{L} \qquad \text{(A5)}$$

Step 3.- Finally, use values in $\wp$ and the original estimates of b and s_e to construct estimated confidence intervals for b and s_e.