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Regional advantages and economies of size in Spanish rice farming

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I – Background

The new institutional environment emerging from Spain accession to the EC in 1986 affected the size and composition of the Spanish rice supply. Estimated production in 1991 was 581.9 thousand tons, about 26 percent higher than in 1985. This increase in rice production was mainly the result of expansion in rice acreage which reached 93,500 ha in 1991, an historical record.

The new institutional environment within the EC was favourable to rice cultivation in the country. The historical acreage restrictions were suspended and producer aids were introduced for indica rice. Moreover, the level of institutional prices increased to the higher EC level, and trade with other EC members was liberalized. However, in 1991, production incentives derived from the adjustment to the EC market regulations came to end indicating the beginning of a less favourable institutional environment. In this year intervention prices diminished for the first time and the amount of the subsidy to indica producers reached its lowest level. Moreover, it can be expected that the GATT agreement and the reform of the EU regulations for rice will produce a further reduction in protection levels. This might stop or even reverse the production trends described above.

Spain rice producing areas present very diverse structural and agro-ecological conditions This determines their capability to undertake technical and structural changes to confront eventual reductions in protection levels. Therefore, future reforms in the institutional framework will not affect all rice producers equally. In the following sections main rice production areas in Spain are described and their potential for development is assessed.

II – Characteristics of Spanish rice farming

Rice was first grown in Spain by the Arabs about the year 800. For many years rice cultivation was confined to a limited number of rivers and estuarine areas which run into Mediterranean sea. Valencia was the leading region. In 1860 approximately rice was introduced in Tarragona in the Ebro river delta and around 1930 rice cultivation spread to non-Mediterranean regions (Font de Mora, 1939). Since 1970 Seville is the leading rice-producing region in the country, although since 1985 rice cultivation increased substantially in Extremadura and other interior areas. Weather problems have seriously affected production in Seville and Extremadura in later years. *Table 1* shows the evolution of the rice acreage by region in the period 1940–94.

Table 1. Rice acreage by region in selected year (,000 ha)

	Tarragona	Valencia	Seville	Extremadura	Others	Total
1940	14.6	27.6	2.3	-	3.6	48.1
1950	16.8	27.2	6.1	0.3	8.8	59.2
1960	17.6	25.5	14.5	0.5	7.6	66.9
1970	13.1	16.9	22.0	10.2	2.3	64.7
1980	16.6	15.8	27.3	5.9	2.6	68.4
1985	18.5	16.1	30.0	5.0	4.9	74.5
1990	18.6	15.6	34.0	14.0	6.8	89.0
1991	20.0	15.7	34.5	15.6	7.6	93.5
1992	22.5	15.7	20.5	20.3	6.7	85.7
1993	20.9	15.6	2.9	-	9.0	48.4
1994	20.9	15.6	6.3	9.0	11.3	63.1

Source: MAPA (1994)

1. Resource conditions

The Spanish rice production is situated between the 42 and 36 North latitude. Rice areas can be classified into humid and non-humid. Humid areas are found in the regions of Seville, Tarragona and Valencia along the delta lands of the Guadalquivir, Jucar and Ebro rivers respectively. They represent about 75 percent of the total acreage.

Most of the rice acreage in Seville, Tarragona and Valencia is characterized by heavy clay soils with low permeability. This makes rice the only possible crop to be grown. A second characteristic of rice fields in these three regions is their proximity to National Parks and sites of special ecological importance. In Seville the south-west fields limit the Doñana Natural Park. In 1983, 25 percent of the Ebro Delta in Tarragona was declared a National Park. The Park areas are scattered throughout the Delta and in some cases they are totally surrounded by rice fields. In Valencia the Albufera National Park is situated in the centre of the rice fields. The proximity to the natural parks has two negative consequences for rice cultivation: the higher cost of agrochemical application due to special pesticides regulations and the occasional damage of rice crops by the parks wildfowls.

Non-humid areas are found in Extremadura and other interior regions. Here rice is cultivated in new irrigated areas and was first introduced as a means of land reclamation. The soils of these regions are suitable for a great variety of crops. Growing rice needs only some compactation of soils in order to minimize permeability.

Most of the water requirement for rice in Spain is supplied by flood irrigation. Distribution of irrigation water is organized by water management organizations. Farmers manage their fields independently. The only exception is Valencia where rigidness in the irrigation system does not allow such autonomy. Water consumption differs within regions, depending on water availability, soil conditions and production practices. In low rainfall years water restrictions are often implemented in Seville and to a less scale in Extremadura. In 1983, rice farmers in Seville were unable to plant due to water shortages and in 1989 only one third of the regular area was sown. Moreover, excessively salty water due to the invasion of sea water often injured the rice plants reducing yields.

2. Farm structure

Rice growers population in Spain has drastically decreased in the last 35 years. This reduction in the number of rice growers contributed to increase the size of rice farms. However, the process of structural change necessary to achieve optimum farm size has been limited by the rigidness of the agricultural land market and the high price of land.

Although there are some exceptions, rice farms in Spain tend to be very small and are often scattered in several plots. In the Mediterranean regions of Tarragona and Valencia which account for 37 percent of Spain rice supply, the average size of rice farms is 4 and 2 hectares, respectively. Rice farms are larger in the other two major rice producing areas. The estimated average size of rice farms in Extremadura is 7 hectares and in Seville 23 hectares.

Diversity is also found in farmers' profile. The age of rice growers tend to be high. A large proportion of individuals are over 55 years old or even in their retired years. The Mediterranean regions—Tarragona and Valencia—have the older population. In these regions rice growers are usually part-time farmers. In Tarragona a large proportion of growers are full employed in the industry and service sectors. Rice cultivation is often their second source of income. In Valencia the opposite is true. Rice growing usually is the main source of income—except for very small farmers—, although it is often supplemented with part-time working in other activities—agricultural or not. In Seville, part-time farming is usually limited to the smallest farms and we found the largest number of corporate farms. Small full-time rice farmers are predominant in Extremadura.

The land tenure system also varies by region with land under renting having the most importance in Tarragona and Valencia.

III – Technology

1. Varietal composition

Rice research was institutionalized in Spain in 1913. At first, the work on rice improvement consisted only in mass selection, with new varieties being introduced from other countries but, in the mid-twenties, work on artificial crossing begun and its impact has been substantial (López Campos, 1970).

First, the replacement of traditional varieties by higher yielding modern varieties was made possible. Genetic advances also resulted in the improvement of other agronomic characteristics such as tillering and germination capacity and resistance to lodging. The availability of these genetic material made technically possible and economically feasible in the 1960s the adoption of new planting and harvesting methods such as direct seeding and mechanical harvesting, with a beneficial effect on Spanish rice economy (Herruzo, 1985).

Rice breeding also affected the type of rice cultivated. Low quality short-grain varieties occupied most of the rice area in the 1940s and 1950s as emphasis was placed in high production. However, this type of rice was gradually substituted throughout the 1960s by higher quality medium-grain varieties (Herruzo, 1985). These varieties were predominant in Spain until 1986.

Spain internal market situation was never conducive to the expansion of indica rice. Frequent and severe price fluctuations and relative low guaranteed prices explain the limited acceptance of this type of rice by Spanish farmers. The new institutional environment within the EC has changed this situation. Most favourable policies and the availability of well adapted foreign varieties contributed to the diffusion of indica rice in the most temperate regions. An additional factor responsible for this rapid diffusion was the effort of the industrial sector to adjust the milling machinery.

In 1991, more than 90 percent of rice acreage in Seville was planted with indica rice. In Extremadura, the proportion of indica rice was 30 percent and it has been increasing rapidly. Expansion of indica rice in other producing regions is currently constrained because of the high sensibility of available rice varieties to these regions of lower temperatures. Moreover, local rice industries still lack adequate milling equipment and marketing expertise to market long-grain rice. This results in a lower price for this type of rice relative to medium-grain rice.

2. Mechanization

Spain rice production practices have undergone a substantial transformation during the last three decades. The reduction in agricultural labour which took place after 1960 increased rural salaries inducing a process of capital-intensive technological development in the agricultural sector. The rice industry responded to this new environment with the adoption of modern labour-saving technology—machinery, herbicides—and with the introduction of new cultural practices.

The process of diffusion of mechanical harvesting with self-propelled combines started at the beginning of the 1960s. Also, in the 1960s, weed control and post-harvest activities began to be mechanized. In 1966, farmers in the Seville region initiated the substitution of hand transplanting for the less labour-intensive direct seeding. By 1977, rice transplanting had been totally abandoned and the rice area was sown throughout the country with airplane seeders, ground broadcasts and by hand (Herruzo, 1986).

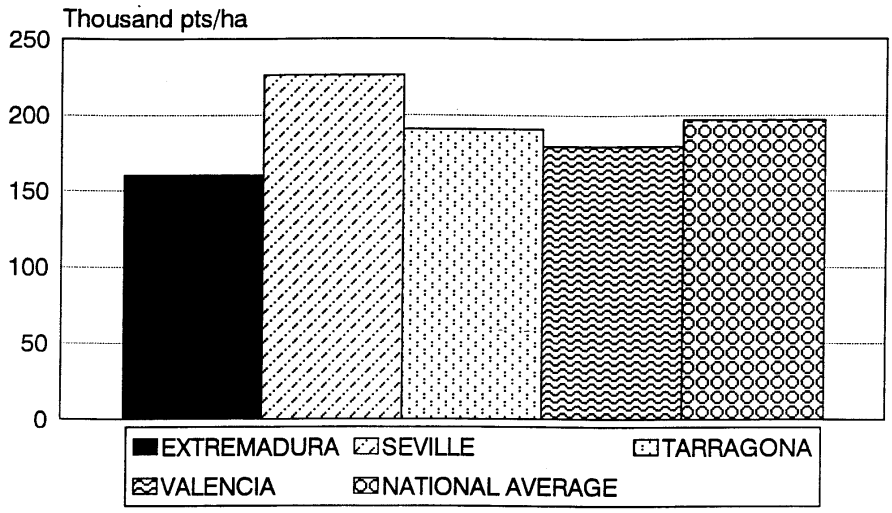
3. Disease and pest controls

The principal disease of rice in Spain is blast, caused by *Piricularia oryzae*. Breeding resistance is the only known remedy to control the disease. However, preventive treatment can stop the spread of the disease. Other diseases affecting rice are *Helminthosporium oryzae* and *Sclerotiam oryzae*. Insects do not generally present a major problem to rice production in Spain. In Tarragona and Valencia, the rice stem borer *(Chilo suppressalis)* is the most damaging pest. In Seville and Extremadura rice suffers the most serious attacks from "pudenta" *(Eusarcoris insconspicuus)* (Batalla, 1989). Both insects are being controlled mostly through government sponsored aerial insecticides application. There are some farmer associations to undertake an integrated control of these pests. The most troublesome weed is "serreig" *(Echinocloa sp.).* It is controlled almost exclusively by herbicides. Red rice *(oryza sativa)* has been a serious problem in recent years but is now under control.

IV – Production costs

Estimates of rice per hectare cost of production by region in 1991 are presented in *figure 1.* The highest per hectare cost of production, 226,200 pts, was reported by Seville while the lowest, 159,900 pts, was reported by Extremadura. Tarragona had the second per hectare total cost of production, 183,800 pts, and Valencia ranked third at 179,500 pts. The national average per hectare production cost was 196,584 pts in 1991.

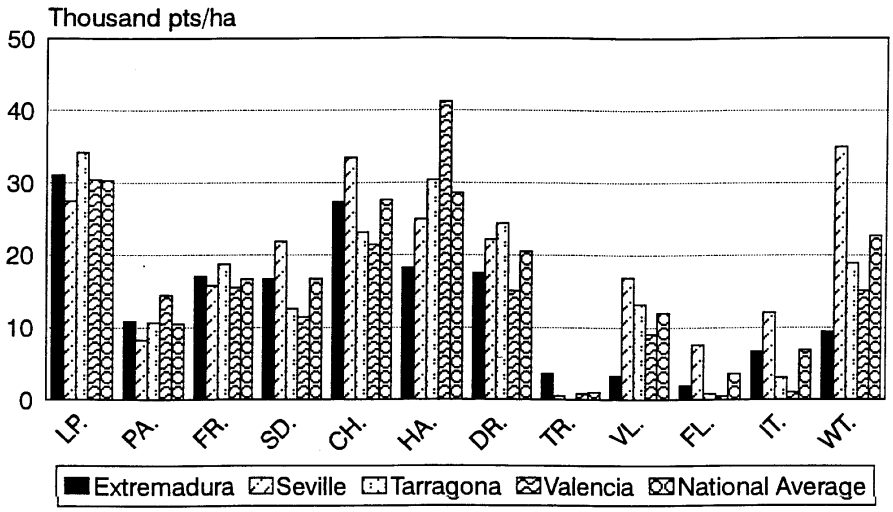
Figure 1. Per hectare production costs by region and national average



Source: Herruzo and Zekri (1993).

In *figure 2*, production costs in the four regions are divided into twelve components. This disaggregation of production costs helps to identify the sources of regional discrepancies production costs shown in *figu - re 1*. Seville's per hectare costs exceeded national average costs due to higher expenses in purchased irrigation water, chemicals, seeds, fixed labor and interest expenses in operating loans. The Extremadura lowest costs were mainly due to cost of irrigation water and labor. Valencia and Tarragona had the highest costs machinery intensive operations such as harvesting and land preparation.

Figure 2. Per hectare cost of factors of production



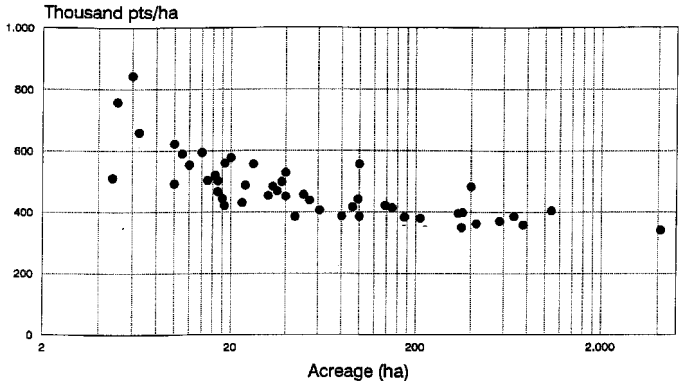
PA: tillage operations; PA: fertilizing, planting and chemical applications; FR: fertilizer; SD: seeds; CH: chemicals; HA: harvesting; DR: drying; TR: transportation; VL: seasonal labor; FL: fixed labor; IT: interest expenses; WT: irrigatlon water.
Source: Herruzo and Zekri, 1993.

1. Economies of size

In *Figures 1 and 2*, cost estimates of machinery operations were based on the price of custom operations in each region (non-cash costs are not accounted for in production costs estimates in figures 1 & 2). Thus, these production cost estimates cannot be used to identify economies and diseconomies of size in the sector.

The impact of farm size in rice production costs for Seville in 1992 can be ascertained from *Figure 3* taken from Herruzo y Morote (1994). In *Figure 3* the horizontal axis represents farm size in log-scale and the vertical axis represents per hectare production costs. The relationship between farm size and per hectare production costs is displayed by a scatter plot. The “envelope” curve of the scatter plots can be considered the long-run average cost curve in the region. Conceptually, this long-run average cost curve represents the most efficient method of producing each level of output, considering all possible combinations of variable and fixed inputs. The determinants of the shape of the average cost curve are economies and diseconomies of size.

Figure 3. Production costs by size, Seville



Source: Herruzo and Morote (1994)

The long-run average cost curve implied by *Figure 3* declines consistently up to about 60 hectares of size and then remains stable (horizontal) showing substantial economies of size. These size economies are the result of reduced machinery and equipment costs and the lowest opportunity cost of labor as farm size increases (Herruzo & Morote, 1994). On the other hand, the highest segment of the medium size farms (60 to 100 hectares) exhibited per hectare production costs similar to those of the large farms. Thus, there seems to be technical economies between these two groups of farms.

Conclusions

Future developments in rice production in Spain will depend on the capacity of the rice sector to confront forthcoming challenges stemming from a more competitive environment. Presently, there are three circumstances which can negatively affect the competitiveness of Spain rice sector: a) the inadequacy of its farm structure; b) the scarcity of irrigation water and the potential increase in the price of this resource; and c) the growing restrictions environmental regulations. However, these circumstances do not affect all rice producing regions equally.

It appears that a large proportion of rice farms in the Mediterranean regions of Tarragona and Valencia will encounter the most serious difficulties in undertaking the necessary technical and structural changes which could be required to face a process of market liberalization. The situation is particularly critical in Valencia where rigidness of the irrigation system and the deficient farm structure make it very difficult to adopt major technological innovations. The conditions for rice cultivation are relatively better in Tarragona, however, again the small size of the rice farms, and the scarcity and the high cost of farm labour restrain the development of the sector.

The non-Mediterranean regions appear to be in a more advantageous position. The farm structure makes possible a more rational use of agricultural inputs and the farm population is younger. In addition, both Seville and Extremadura are well suited for growing indica rice in high demand in Europe. Seville has been the most innovative region. It has the largest farms and it has been the leading region in introducing indica rice. However, the growing scarcity of irrigation water in the region limits any major rice acreage expansion in the near future. Water restriction can also become a problem in Extremadura in low rainfall years. Although recent improvement in irrigation infrastructure allows for limited acreage expansion under normal weather conditions.

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