A Farmer's Toolbox for Integrated Pest Management

AGRI/2020/OP/0003

Case study

IPM implementation in rice in Spain

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Abstract

The selection of this case study was based on a set of distinctive factors:

1) rice is an extensive crop developed in a particular territory due to the need of compatibility with a Natural Park (Donaña),

2) there is a historical experience of 23 years of IPM practices,

3) there is an enormous adherence by farmers to IPM in the crop, and

4) there is an organization (Federation) which aggregates the provision of IPM services to over 60% of farmers in the region.

Over the years it has been possible to significantly reduce the number of phytosanitary treatments on rice crops and to implement a set of agricultural practices that encourage a reduction in the application of inputs and an increase in the ecosystem services provided by rice growers in the Seville region.

1. Introduction

Rice is one of the most grown and consumed cereals in the world. Rice, together with wheat and maize, occupies more than half the world's agricultural land.

World production exceeds 700 million tonnes and is obtained from around 160 million hectares, over 50% of which are in China and India, with 35% and 22% respectively. More than 90% of world production is obtained in Asia and only 6 to 7% of this production circulates in world trade, with the United States being the main exporter, with around 60% of rice traded.

Since the beginning of the century there has been an increase of more than 20% in world production, despite the weak increase in the area available for rice production. The great contribution has been the positive evolution of productivity, obtained by improving production methods and technology management, namely with the improvement of genetics.

Rice is consumed all over Europe, with quite different rates of consumption and types of rice, adapted to the different gastronomies and eating habits. Risotto in Italy, Spanish paella, white or aromatic rice in practically every country, make Europe the world's fourth importer. The area of rice production in Europe is around 430 000 hectares and European production (around 3 million tonnes) represents around 65% of the total consumption of Europeans.

Italy is the largest European rice producer, accounting for 52.6% of production in 2020. It is followed by Spain with 25.6% of production, Greece (10%), Portugal (4.6%), France (2.6%) and the remaining producing countries (Bulgaria, Romania and Hungary) (Figure 1).

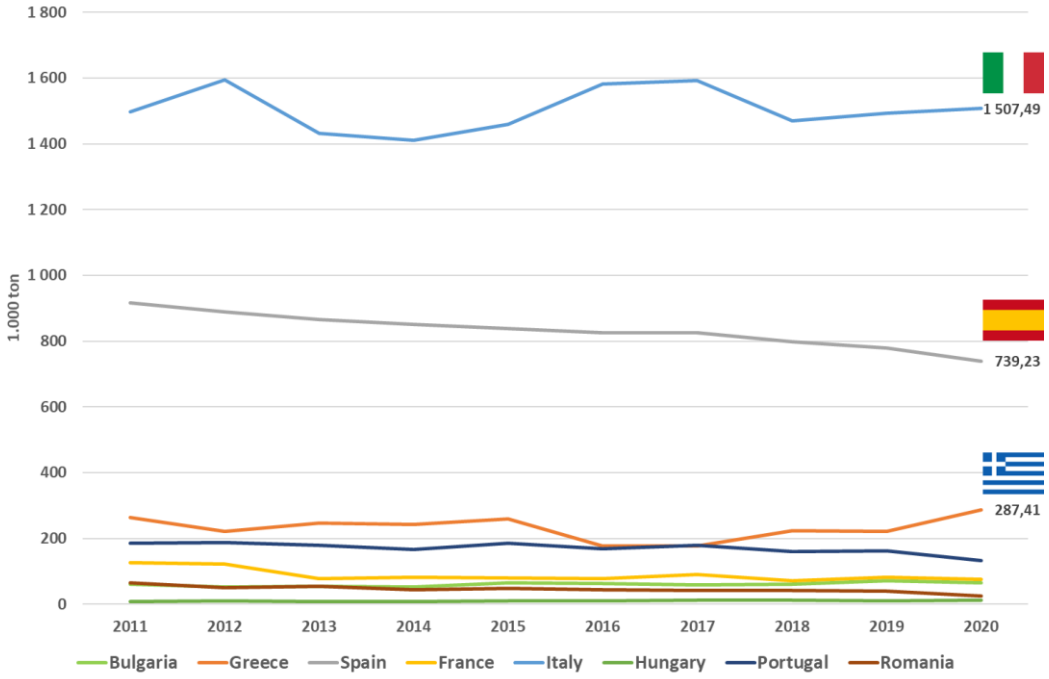

Figure 1 - Evolution of rice production in Europe (Source: Eurostat)

The area and production of rice in Spain has decreased slightly in recent years, especially since 2012, with several reasons for this decrease but mainly due to reduced economic competitiveness of its production (Figure 2). Andalucia is the province with the highest rice

production in Spain, accounting for 37% of the national total, followed by Extremadura, Catalonia and Comunidad Valenciana (Figure 3).

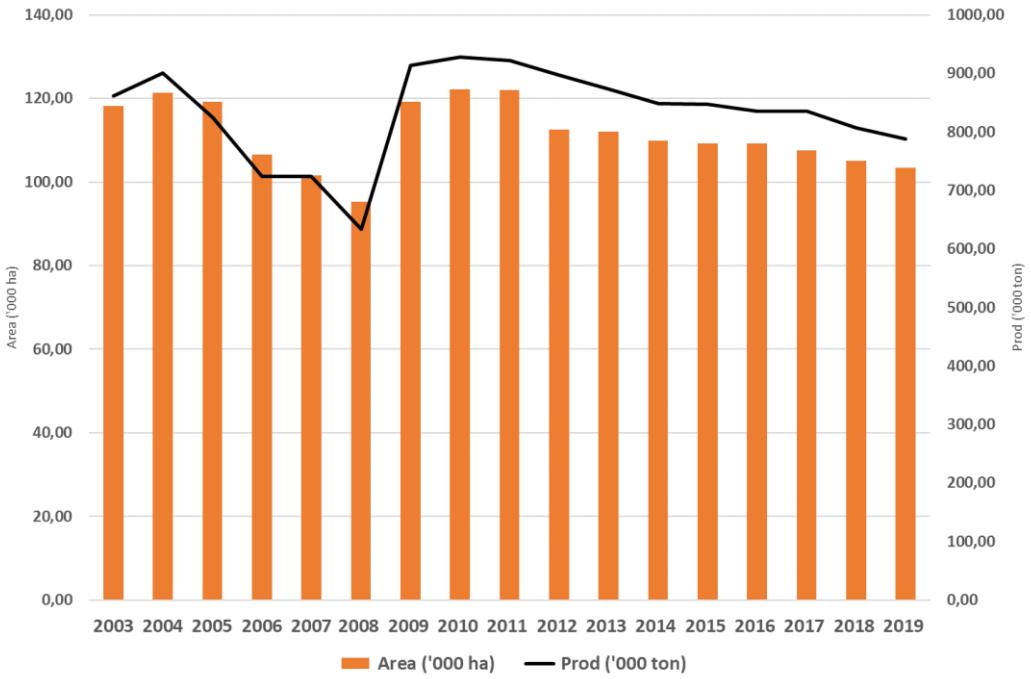

Figure 2 - Evolution of rice area and production in Spain (Source: MAPA)

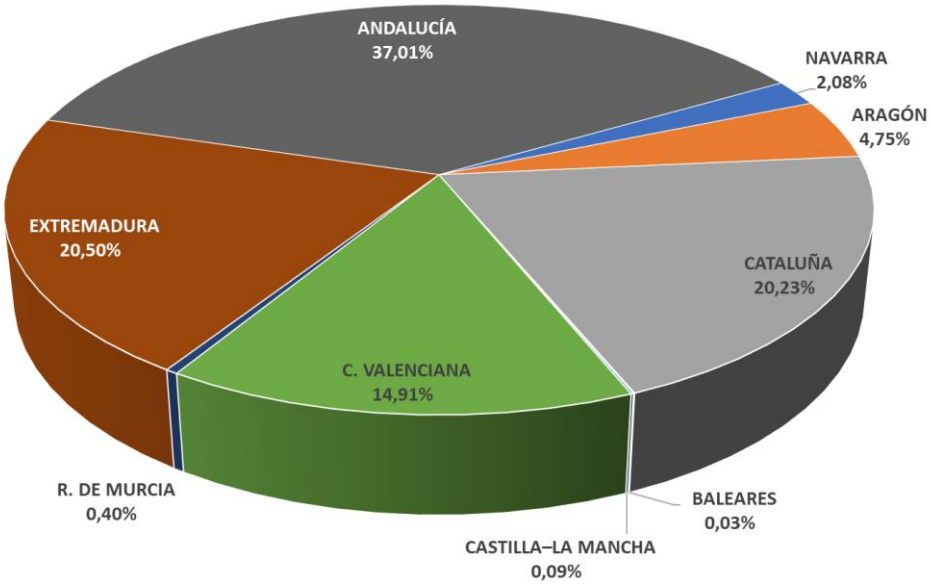

Figure 3 - Provincial distribution of rice production in Spain in the 2019 campaign (Source: MAPA)

Within the autonomous community of Andalusia, the province of Seville has 92% of the surface area dedicated to rice cultivation, extending between both banks of the river Guadalquivir, mainly in the municipalities of Isla Mayor, La Puebla del Río, Aznalcázar, Los Palacios y Villafranca, Dos Hermanas and Utrera. Thanks to its location next to the Doñana Natural Park,

one of the largest wetlands in Europe, making it a perfect ecosystem for the area's birdlife, which implies the search for environmentally sustainable agricultural methods.

For all these reasons, the rice field of the "Marismas" del Guadalquivir is currently the most important in Spain and one of the most important on the European continent. However, this is the fruit of a process of great dynamism and vitality carried out in a short time span of just a few decades, which has enabled a profound demographic, economic and social transformation of the territory.

In fact, the soils of the "Marismas" are young, flat, uniform, very deep, with a clayey or silty-clay texture, almost devoid of coarse elements and of low permeability. Drainage is totally impeded so that the impermeable layer usually starts at a depth of only 10-15 cm. The organic matter content is not high (around 2-2.5%) and the soil pH is between 7 and 8.5. The soils of the "Marismas" have a high potassium content and a medium richness in phosphorus, with some soils somewhat deficient in this nutrient. The iron and carbonate content tends to be appreciably high. In cultivated areas the surface horizon (the first 20-25 cm) is desalinated due to the dragging of soluble salts by rain and irrigation, and sometimes also due to the existence of drainage (drains). The subsoil is highly saline, with an electrical conductivity of more than 4 mmhos/cm, which causes slight production losses.

A century ago, the Guadalquivir "Marismas" were unused land. Now, the Seville "Marismas" are one of the driving forces of the agricultural economy of Seville and Andalusia, as stated in the "Study of the economic and social impact of rice cultivation in the Guadalquivir marshes as a driving force for the Andalusian economy". This study states that, with a contribution to the labour market of more than five thousand jobs and one hundred million euros paid in wages, the rice industry, as a backbone, and its related activities, are generators of wealth and employment for the Andalusian and Sevillian economy. It represents 1.9% of the jobs and 4.8% of the salaries paid in the Agriculture, Livestock, Forestry and Fisheries sector in the Andalusian region. To these figures must be added sales of more than 680 million euros and a contribution of 38 million euros to the public coffers, making it a real engine of growth in its environment. It is not in vain that Seville stands out as the leading Spanish province in terms of total rice production, and this is particularly important in the case of the indica variety, where the rice fields of the "Marismas" del Guadalquivir provide almost half of Spanish production and more than 15% of European production.

2. Research theme

In Spain, IPM in rice farming started in 1998. In Andalusia, the adhesion of farmers to this production method was gradual. In the first year, it covered about 30% of the area, and at the end of 6 years (2004) adherence was almost 100%.

Between 2006 and 2008 there was a reduction in the level of agro-environmental support for Integrated Protection in the region (especially in the production area in the Donaña Natural Park) and, above all, there was a prolonged drought in the region that greatly conditioned the possibility of rice production in the region and had a direct impact on the area allocated to Integrated Rice Protection in the province (Figure 4). This decline in Andalusia was directly reflected in Spanish rice production, as can be seen in the Figure 2.

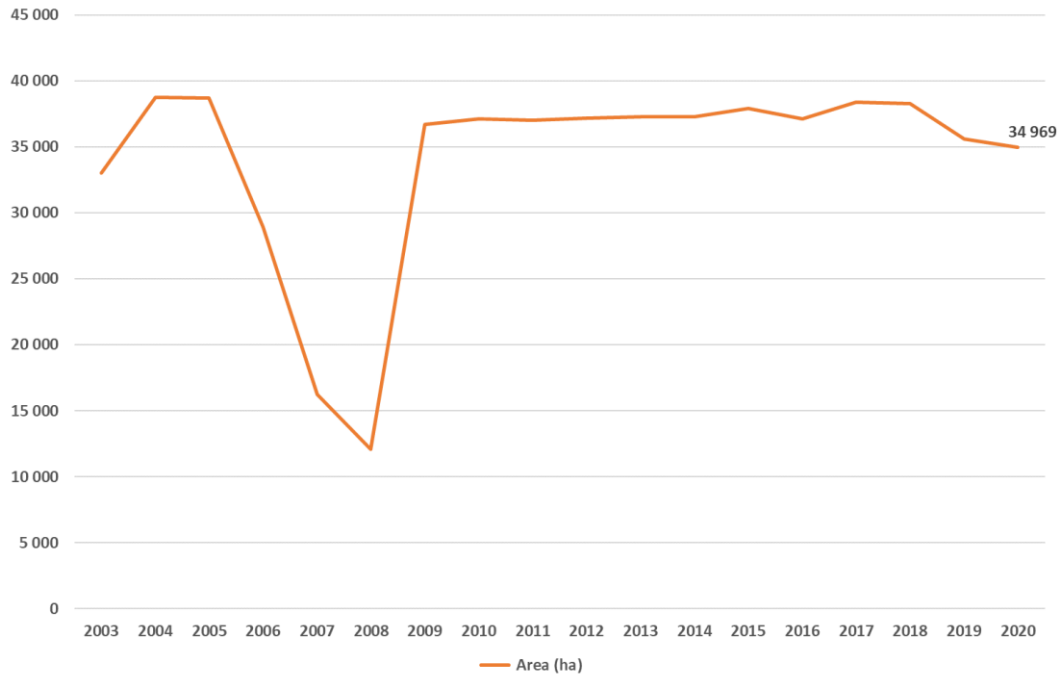

Figure 4 - Evolution of IPM rice area in Andalucía (Source: Junta de Andalucia)

One of the most striking factors of IPM in rice in Andalusia is its high adherence by farmers. Even with a decrease in the area in the last three years, adherence to IPM still remains close to 90% (Table 1). This percentage is particularly significant when the average adherence to Integrated Protection in rice, in total in Spain, is around 60% according to data from MAPA.

Table 1 - Level of adherence of farmers to IPM in different crops in the province of Andalusia in the 2019 campaign (Source: Junta de Andalucia)

Crop	Total Area (ha)	Area IPM (ha)	IPM (%)
Garlic	5 488	493	8.98%
Alfafa	9 545	871	9.13%
Cotton	65 071	45 216	69.49%
Almond	198 983	4 944	2.48%
Blueberries	3 428	2 393	69.81%
Rice	**39 362**	**34 969**	**88.84%**
Persimmons	1 952	248	12.70%
Winter cereals	569 833	5 622	0.99%
Citrus	80 523	4 710	5.85%
Raspberry-Blackberry	2 445	1 417	79.29%
Strawberry	6 619	5 248	57.96%
Stone fruit trees	10 130	1 268	12.52%
Protected vegetables	51 756	9 827	18.99%
Olive groves	1 609 649	393 183	24.43%
Sugar beet	7 636	4 612	60.40%
Tomato for processing	7 847	2 368	30.18%
Wine grapes	26 348	2 011	7.63%
TOTAL	2 696 615	519 400	

3. Methodology

The development of the Case Study went through 3 distinct phases:

- **Selection** - the project launched a tender to collect entities that expressed interest in being one of the case studies of this pilot project. Following a conversation with ASAJA officials, the case of rice in Andalusia was identified as an excellent example of IPM application.
- **Conversations with ASAJA** - In a series of telephone conversations with ASAJA officials it was possible to collect a set of basic information and identify the best interlocutor to gather primary information on the case (Federación de Arroceros de Sevilla).
- **Interview with FEDERACIÓN DE ARROCEROS DE SEVILLA** - Online meetings with the General Director and the Technical Director of the Federation, which contributed to detailing the case for implementing IPM in rice farming in Andalucia.

4. Activities and results

4. 1 Objectives

The Spanish rice sector was grouped under the Spanish Rice Farmers' Union Federation, based in Valencia, which was set up in 1933 and which represented and defended the interests of the national rice sector uninterruptedly until 1985. Since 1986, the Seville rice farmers understood from the beginning that the lack of unity in which they were involuntarily involved was not good for their interests and founded the Seville Rice Farmers Federation (FEDERACIÓN DE ARROCEROS DE SEVILLA), which was constituted in 1986, understanding the need for an association to represent and defend the interests of all kinds that affect the sector as a whole before the various bodies and institutions of the State, Community and Autonomous Community Administrations, Regional Councils, Local Corporations and any other public or private entity.

Farmers can also belong to grain storage cooperatives. For the drying and storage of grain and to defend the final selling price of the product. There are three cooperatives in the sector that manage between 20.000 and 120.000 tonnes of paddy rice. There are also farmers who either manage its storage and sale or deliver it directly to the industry once the harvest has been harvested.

4.2 Governance and functioning of the initiative

Since 1998, the year in which the IPM began in the cultivation of rice in Seville, the Federation has coordinated and managed the implementation of this cultivation system, contracting and training the field technicians, as well as carrying out analyses, bulletins, etc.

In 2008, due to a very difficult year because of the drought that affected the region, the Federation did not hire the field technicians for this campaign. However, some farmers sought to create alternatives, their own or organized, which continued even when the Federation resumed all work related to the provision of IPM services. Today, farmers benefiting from technical support for IPM by the Federation represent about 60% of the rice area.

The number of farms belonging to the Rice Growers' Federation is around 958. The size of the farms is quite heterogeneous, with an average farm size of 33.65 hectares. In total, 20 000 ha are covered by the Federation's service provision. Today, there are 32 field technicians accompanying the farmers (in the past there were 64 technicians).

4.3 Results (and successes)

Rice cultivation is very specialized, as it must be grown on rice beds used specifically for this purpose. In Seville, work to prepare the soil begins in spring, and there is a series of agricultural practices, mainly related to weed control and maximizing the germination and sprouting of the rice, during the summer period, culminating in the harvest in the months of October and November (Figure 5).

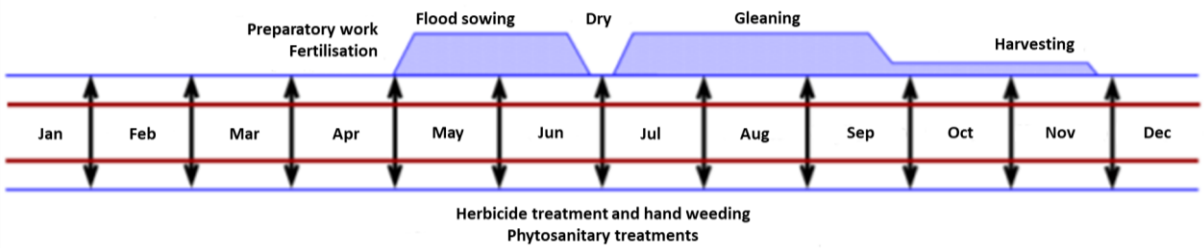

Figure 5 - Scheme of the reference calendar for crop cultivation practices in rice-growing in Andalusia (adapted from Manuel Aguilar)

Before the start of IPM implementation, rice farmers followed a fixed treatment schedule. That calendar, implied, as a minimum, the following phytosanitary treatments, in 100% of the rice areas in the region:

- A pre-sowing treatment against *Chironomus spp*. (red caterpillar);
- 1 treatment against lepidoptera and aphids;
- 2 treatments against Pudenta (*Eysarcoris ventralis*);
- 3 applications against *Echinochloa* (1 at sowing - pre-emergence - and 2 contact treatments);
- 1 treatment against rushes and other cotyledons.

Today, after 23 years of accumulated knowledge, the number of treatments is much reduced and is now only done in areas where there is a risk of pests or diseases or where the presence of weeds is detected. For example, the treatment against *Chironomus spp*. (red caterpillar) is no longer done. In terms of insecticides, only aphid treatments are now used, if necessary (this is done on 60 to 70% of the total annual area). In terms of herbicides, is usually done 1 treatment against Ciperáceae (in 90% to 95% of total area) and 1 treatment against *Echinochloa*, but usually only in 40 to 45% of the fields. No more treatments against *Pudenta* are done at Sevilla rice fields.

The regular presence of field technicians has contributed and continues to contribute to these results. Farmers, who in 1998 showed some reluctance, have become used to the regular visits of the technicians and have confidence (a decisive factor in changing practices on the part of farmers) in their technical recommendations, especially in phytosanitary treatments and practices for weed control.

Currently, the work of FEDERACION's field technicians focuses on carrying out field visits, recommending phytosanitary treatments, filling field booklets, taking weekly samples (each technician sends to Sanidad Vegetal (the official body of the Junta de Andalucia for this matter) a sample of one plot, in which they monitor the level of data along the “Marisma”), give support during audits by Independent Certification Bodies and a final campaign report.

In the early days of IPM implementation, there was, on average, one technician for every 500 ha. Currently, each technician monitors a maximum of 600 ha.

The digitalization of field notebooks, an important part of the field technicians' work, contributed greatly to this increase in the area covered by a technician. From 2000 onwards, TRIANA (Integrated Treatments in Andalusia in Agriculture) was developed with Sanidad Vegetal (Junta de Andalucia)

The TRIANA computer programme is a tool for crop management from the technical point of view, especially in the case of integrated production plots. It can incorporate climatic and analytical information, crop operations, etc. to the management of the different samplings, with their subsequent graphic elaboration. It allows the analysis of the accumulated information and the consequent decision making, adding the preparation of the farm notebook and complementing it with help on phytosanitary aspects. Since 2010 they have been using a more updated version that allows them to incorporate a set of other information necessary for other certifications of good agricultural practices (e.g., GLOBALGAP) and good social practices (e.g. GRASP).

For a better advisory service, the field technicians use information from Phytosanitary Alert and Information Network of Andalusia (RAIF), from a network of public and private meteorological stations along the “Marisma” and information collected from sensors placed in the middle of the crop which analyse climate data to predict pests and diseases. These sensors are placed in homogeneous zones throughout the crop area.

In rice farming, weed control is essential as weeds compete with rice for space, light, and nutrients, especially during the seedling and tillering stages of rice. Weeds not only reduce grain yield and quality, but also increase the costs of production, harvesting, drying and industrial processing. They also host and are sources of infection for numerous pests and diseases.

Any cultivation practice directly or indirectly influences the competitiveness of rice against weeds. Not only soil fertility, but also preparatory work, land levelling, fertilization, choice of variety, sowing date and dose, irrigation water management, manual weeding, crop rotation (infrequent in our conditions), and the severity of pest and disease attacks, all these factors undoubtedly affect the vigor, level of infestation and species of weeds infecting the paddy field. A rice plant, for example, weakened by pest attack competes at a disadvantage with them.

Therefore, since slight modifications in cultivation practices can lead to significant differences in the degree of infestation of different weed species, good cultural practices combined with proper chemical control (herbicides) are basic in an integrated weed control program.

Herbicides are fundamental in integrated weed control, although these chemical methods must be combined or complemented with preventive and cultural methods, mentioned above, to obtain effective weed control. As for pests, as with weeds and diseases, Integrated Production provides a series of strategies and methods to minimize the losses caused by these enemies of rice, with as low costs and environmental impact as possible.

4.4 Barriers (to implementing the project)

At the beginning of the implementation of IPM in the region, there was some resistance in the adhesion on the part of farmers, but that the demonstration of technical results allowed the adhesion of farmers, in about 6 years, to become practically 100%.

The presence of the technician in the field is one of the factors that transmits more confidence to the farmer. Before, the technician was 70% in the field and now, because of the bureaucratic load, he/she is at most 30% in the field. This is clearly an issue that can contribute to reducing the producer's recognition of the added value of the service.

The adhesion to IPM is greatly boosted by the agri-environmental aid provided for in the CAP, especially in the area of influence of the Donaña Natural Park, where there is a need for a compatibility of practices which, if not properly valued, lead to a lack of interest in the measure. Over the years there has been a decrease in the value of aid for IPM in rice and even in the current CAP reform proposal was presented a value of support in the order of 50€/ha (before it was around 250€/ha, having already been over 350€/ha at the first years) which has been strongly contested by Federación de Arroceros de Sevilla and which could greatly condition the future of IPM in rice farming and jeopardize all the work done over the past 23 years. It is important to note that the "Marisma" land has no other cultural option and that the rice provides a great potential for the presence of a diversity of steppe birds that are the distinctive "trademark" of the Natural Park.

Another relevant issue is the compatibility of production with a growing bird population in the Natural Park. Many of the birds whose population is growing, such as storks, flamingos or sparrows, have caused increasing damage to the rice crop, mainly by trampling at a stage of rice growth when there is no possibility of crop recovery.

At the same time as this damage is increasing, it is difficult to get a response from agricultural insurance, which only compensates farmers for very low levels of loss.

On the other hand, and taking into account the role of rice fields in enhancing the landscape, biodiversity, social dynamics, etc, there are no instruments that value these ecosystem services, which would be a way to recognize the role of rice producers and a tool to encourage the adoption of new cultural practices and reduce some doubts about the future of rice farming in the Natural Park area.

Finally, there has been a reduction in the diversity of phytosanitary products, in particular herbicide active substances, which make weed control more difficult and can lead to resistance phenomena.

5. Discussion and conclusions

The impacts of the implementation of IPM practices in rice cultivation in the Seville region are an excellent example of the impacts that this tool has for the improvement of cultural practices and competitiveness of producers.

The Seville region, apart from being the most important rice producing region in Spain and one of the most important in Europe, has productivity levels above the national and European averages.

Rice production in the region is one of the main agricultural activities, with strong weight throughout the rural economy, being a sector very sensitive to the volatility of world prices of this commodity.

The specificity of the territory, at the Guadalquivir “Marisma” and in the Donaña Natural Park, is an ecosystem of high ecological value, which serves as a habitat for numerous species, and that most of the rice produced in Seville is exported, which gives the sector a key international sphere. Recently Federación de Arroceros de Sevilla has applied for the Protected Designation of Origin "Arroz de las Marismas del Guadalquivir", a tool that can serve to certify all the rice produced in the area and guarantee its quality for the consumer and a possibility to increase value to this particular production.

However, there are several challenges facing the sector, including growing competition, price volatility, the ageing of the rural population, the need for better industrial processing and one of the rice growers' main issues: the problem of water. This is one of the most important elements for the future, as the scarcity of water resources for irrigation alters the salinity conditions suitable for rice.

The new CAP should have a set of instruments that encourage the maintenance of rice production in the region and the deepening of IPM practices that will enhance the economic, environmental, and social sustainability of these rural areas.

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