

**EX ANTE EVALUATION
OF A MULTI-LEVEL GOVERNANCE
CAP STRATEGIC PLAN
FOR FARMLAND BIRD CONSERVATION**

**EVALUACIÓN EX-ANTE DE UN PLAN ESTRATÉGICO
DE LA PAC CON GOBERNANZA MULTINIVEL
PARA LA CONSERVACIÓN DE LAS AVES AGRARIAS**

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SUMMARY.—Curbing farmland bird decline is one of the environmental goals of the new Common Agricultural Policy (CAP) 2023-2027. Member State Strategic Plans must include specific measures within their Green Architecture (enhanced conditionality, eco-schemes and rural development interventions) to address this goal, whose effectiveness must be tested directly. We evaluated whether interventions included in the Spanish CAP Strategic Plan (PEPAC) to favour farmland birds would reach its goal by means of an *ex ante* evaluation. Spain is a stronghold for farmland birds in Europe and knowledge of their habitat requirements and responses to agricultural management has been reviewed recently. We analysed interventions included in the PEPAC to explicitly favour farmland birds and evaluated whether each of these interventions would address bird requirements fully, partially or not at all. We estimated the proportion of requirements fulfilled by the PEPAC for each Spanish Autonomous Region (in Spain, rural development interventions depend on regional governments, while conditionality and eco-schemes depend on the central government). We evaluated 204 interventions, three of them included in the enhanced conditionality pack, one in the eco-schemes pack and the remaining 200 in the rural development packs. The proportions of farmland bird requirements considered by the conditionality and eco-schemes were 60% and 50%, respectively. The proportion of requirements considered by rural development interventions averaged 17% when proportions reached by interventions developed for each agrosystem and Autonomous Region were combined. Combined *ex ante* evaluations of the three elements of the Green Architecture thus ranged between 31% and 42% among Autonomous Regions. We conclude that the Spanish PEPAC falls short of the ambition to achieve effective halting of farmland bird declines. Furthermore, interventions included within the three elements of the CAP's Green Architecture and among governance levels (central and regional governments) were not integrated to reach the minimum 10% threshold of uncultivated habitats established by current knowledge, thus hampering the general goal of supporting agricultural landscapes complex enough to ensure farmland bird conservation. —Pérez Pozuelo, P., Concepción, E.D., Azcárate, F.M., Bota, G., Brotons, Ll., García, D., Giralt, D., López-Bao, J.V., Mañosa, S., Morales, M.B., Navarro, A., Olea, P.P., Peco, B., Rey, P.J., Seoane, J., Suárez-Seoane, S., Schöb, C., Tarjuelo, R., Traba, J., Varela, F. & Díaz, M. (2025). *Ex ante* evaluation of a multi-level governance CAP strategic plan for farmland bird conservation. *Ardeola*, 72: 49-64.

Keywords: agrosystems, biodiversity, Common Agricultural Policy (CAP), CAP Green Architecture, CAP reform, conservation, Spain.

RESUMEN.—Atenuar el declive de las aves agrarias es uno de los objetivos de la nueva Política Agraria Común (PAC) 2023-2027. Para ello, los planes estratégicos de los Estados miembros deben incluir medidas específicas dentro de su Arquitectura Verde (condicionalidad reforzada, eco-regímenes y ayudas de desarrollo rural) para abordar este objetivo, cuya efectividad debe ser evaluada directamente. Mediante una evaluación *ex-ante*, examinamos si las medidas incluidas en el plan estratégico español de la PAC (PEPAC) para favorecer a las aves agrarias podrían potencialmente alcanzar su objetivo. España alberga una gran riqueza de aves agrarias y el conocimiento acerca de sus requerimientos de hábitat y sus respuestas a las prácticas agrarias ha sido recientemente revisado. Hemos analizado las

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medidas del PEPAC que explícitamente abordan la conservación de las aves agrarias y evaluado si cada una de estas medidas aborda sus requerimientos de forma completa, parcial o nula. Hemos estimado el porcentaje de requerimientos de las aves agrarias satisfechos por el PEPAC para cada comunidad autónoma (en España, las medidas de desarrollo rural dependen de las comunidades autónomas, mientras que la condicionalidad y los eco-regímenes dependen del gobierno nacional). Hemos evaluado 204 medidas, tres de la condicionalidad reforzada y una de los eco-regímenes, siendo las restantes 200 medidas de desarrollo rural. El porcentaje de requerimientos de las aves abordados por la condicionalidad y los eco-regímenes es del 60 % y del 50 %, respectivamente. El porcentaje de requerimientos abordados por las medidas de desarrollo rural es en promedio un 17 %, que resulta al combinar los porcentajes obtenidos para las distintas medidas y agrosistemas en que se aplican. En total, la efectividad potencial de las medidas de la Arquitectura Verde varía entre un 31 % y un 42 % entre comunidades autónomas. Concluimos que el PEPAC español podría mejorarse sustancialmente para revertir el declive de las aves agrarias. Además, las medidas incluidas en los tres componentes de la Arquitectura Verde de la PAC y en distintos niveles de gobernanza (nacional y autonómico) no se han integrado para alcanzar el umbral del 10 % de hábitats seminaturales establecido por la evidencia científica, lo que dificulta el objetivo de lograr una complejidad del paisaje suficiente que asegure la conservación de las aves agrarias.—Pérez Pozuelo, P., Concepción, E.D., Azcárate, F.M., Bota, G., Brotons, Ll., García, D., Giralt, D., López-Bao, J.V., Mañosa, S., Morales, M.B., Navarro, A., Olea, P.P., Peco, B., Rey, P.J., Seoane, J., Suárez-Seoane, S., Schöb, C., Tarjuelo, R., Traba, J., Varela, F. y Díaz, M. (2025). Evaluación *ex-ante* de un plan estratégico de la PAC con gobernanza multinivel para la conservación de las aves agrarias. *Ardeola*, 72: 49-64.

Palabras clave: agrosistemas, Arquitectura Verde de la PAC, biodiversidad, conservación, España, Política Agrícola Común (PAC), reforma de la PAC.

INTRODUCTION

Scientific evidence shows that farmland bird populations have been consistently declining in Europe in the last few decades (Inger *et al.*, 2015; Rigal *et al.*, 2023) mainly because of recent agricultural intensification (Donald *et al.*, 2001; Emmerson *et al.*, 2016). Intensification refers to management actions aimed at increasing yields of crops and livestock (Turner & Doolittle, 1978). Field-scale intensification consists in increasing inputs (agrochemicals, machinery, irrigation, etc.) to raise outputs per unit area or livestock unit (e.g., Herzog *et al.*, 2006; Kleijn *et al.*, 2009). Negative effects for birds arise either because of direct poisoning or other sources of direct mortality (Moreau *et al.*, 2022), or because of the reduction or elimination of refuges or resources due to the effect of agrochemicals or more intensive harvesting (Rigal *et al.*, 2023). Landscape-scale intensi-

fication refers to homogenisation of agricultural landscapes through crop specialisation, removal of unproductive landscape features and abandonment of marginally productive areas (Benton *et al.*, 2003), thus eliminating alternative or complementary habitats needed for feeding or nesting (Traba & Morales, 2019). Intensification effects are usually non-linear due to interactive effects at field and landscape scales (Concepción *et al.*, 2008, 2012; Rey *et al.*, 2019). Reversing intensification impacts on farmland birds thus requires the inclusion of conservation measures acting coordinately at both scales (Concepción *et al.*, 2008, 2012; Díaz & Concepción, 2016).

Agriculture in Europe has been largely driven by the Common Agricultural Policy (CAP) since its creation in 1962 (Emmerson *et al.*, 2016). The CAP was one of the first common policies of the European Union and was created with the aim of increasing agri-

cultural production, ensuring the availability of food at reasonable prices and contributing to providing a fair standard of living to farmers (Donald *et al.*, 2002; Díaz *et al.*, 2021). After several reforms, and when food production became guaranteed, additional objectives began to be addressed, such as environmental issues and rural development (Navarro & López-Bao, 2018; Pe'er *et al.*, 2019). The most recent CAP reform came into force on the 1st January 2023, and will be applied at least until 2027. This new programming period seeks to be socially fairer, greener and more performance-based than previous periods (European Commission, 2021). As a novelty, Member States have had to design their own CAP Strategic Plans, having more autonomy for targeting their specific needs, which still have to be associated with the CAP specific objectives established at an EU level.

The so-called CAP Green Architecture includes those CAP interventions specifically targeting environment, biodiversity and climate objectives. These may be clustered in five types: 1) enhanced conditionality; 2) eco-schemes; 3) agri-environmental and climate interventions; 4) support for areas with specific disadvantages; and 5) aid for non-productive investments. Eco-schemes are included within the direct payment interventions (the former CAP Pillar I; Münch *et al.*, 2023); these interventions, as well as the enhanced conditionality, are designed by the central government and implemented across all Spanish territories. The other three groups, belonging to the rural development interventions (former Pillar II; Münch *et al.*, 2023), are designed and implemented by each Spanish Autonomous Region (which can also decide whether or not to apply them in their territories), although a common baseline is established by the central government. Furthermore, while complying with enhanced conditionality is mandatory, participating in any other intervention is voluntary

for farmers. This multi-governance is useful to address the biological and agronomical complexity of Spain efficiently. However, it poses problems when implementing Green Architecture interventions, especially when designing protocols to evaluate its effectiveness, as compared to EU countries that have more centralised CAP governance systems (Pe'er *et al.*, 2022).

Spain includes in its CAP Strategic Plan (PEPAC, in its Spanish acronym) the need to 'Promote the alleviation of the decline or the reversal of the demographic trend of decline shown by the populations of steppe birds and other representatives of agricultural environments, as indicators of the health of these ecosystems' (need 06.02 within objective 6 of the PEPAC; MAPA, 2023). Spain is in fact a European stronghold for farmland birds, hosting significant European populations of both common and endangered species (Suárez *et al.*, 1997; Emmerson *et al.*, 2016). This is seemingly due both to a later start of agricultural intensification, as compared to other European countries (Donald *et al.*, 2001; Rigal *et al.*, 2023), and its large size and complex geography, with multiple types of farming systems hosting different species and habitats (Díaz *et al.*, 2006). The need for curbing farmland bird declines is also a goal for other EU Member States since the only official indicator of the environmental value of European agricultural systems is the Farmland Bird Index, that combines the population trends of a number of common bird species dependent on farmland (Díaz *et al.*, 2022).

Several studies and assessments have already evaluated the adequacy of CAP measures for biodiversity conservation. Among the more recent ones, two comprehensive studies (Díaz *et al.*, 2021; Pe'er *et al.*, 2022) gathered the opinion of hundreds of experts to summarise recommendations on Strategic Plans. The first study involved 27 scientists suggesting guidelines for the

development of the PEPAC before it was elaborated. That study, which focused on the relationship between agronomic management and biodiversity, concluded that the PEPAC must clearly define its objectives for each of the eight main Spanish agrosystems (Mediterranean arable crops, agro-silvo-pastoral systems or dehesas, olive groves, vineyards, mixed Euro-Siberian systems, extensive and transhumant grazing systems, fruit orchards and rice fields) and that all CAP conservation measures should be locally adapted and improved through adaptive management (Díaz & Concepción, 2016; Díaz *et al.*, 2021). Furthermore, these objectives must be aligned with European and national environmental strategies such as the EU Biodiversity Strategy, the EU Farm to Fork Strategy, the National Strategy for the Conservation of Pollinators and the National Strategy for Green Infrastructures. The second study involved over 300 European experts to establish guidelines for the Strategic Plans that each Member State had to develop. The main conclusions of this study were the need: 1) to increase the extent of non-productive areas such as fallows, field margins and grasslands to at least 10% at both farm and landscape scales; 2) to increase funds to mitigate the negative effects of agriculture on biodiversity and climate; and 3) to conduct a continuous evaluation and monitoring of the results obtained.

Landscape complexity modulates the effectiveness of conservation measures in agricultural systems (Concepción *et al.*, 2008, 2012). A minimum landscape complexity is needed to increase local diversity by means of local-scale conservation measures, until a threshold is reached where neither increasing complexity nor local environmental practices increase local diversity further (Tschardt *et al.*, 2005; Concepción *et al.*, 2008, 2012). Considering this, the goal of CAP mandatory interventions (enhanced conditionality) and those designed for massive uptake by farmers

(eco-schemes and support for areas with specific disadvantages) should be attaining at least 10% of non-productive surface (covered fallow, permanent field margins, stone walls, ponds, ditches, etc.) at both field and landscape scales. This landscape heterogeneity will ensure that other voluntary interventions (agri-environmental and climate interventions and aid for non-productive investments) can be effective in achieving their specific goals (Concepción & Díaz, 2019; Concepción *et al.*, 2020).

The new CAP introduces the Performance Monitoring and Evaluation Framework (PMEF), a key element of the new delivery model (Regulation EU 2021/2115). The PMEF indicators will be used to monitor the Strategic Plans during their implementation, enabling corrective measures for better achievement of their goals. In addition, each Member State sent the European Commission an *ex ante* evaluation of its entire CAP Strategic Plans, focusing on whether or not the ten specific objectives of the current CAP have been addressed, but without evaluation on whether all available scientific knowledge has been considered in its design (Regulation EU 2021/2115). However, we consider it essential to make prior assessment of how the new Spanish Green Architecture could potentially affect farmland bird populations by evaluating how CAP interventions targeting the need 06.02 aligns with current available knowledge of their ecological requirements (Díaz *et al.*, 2021). Correspondence between knowledge and interventions can be used to estimate the potential effectiveness of the evaluated interventions (Llusia & Oñate, 2005).

This study addresses whether the PEPAC would contribute to curb farmland bird decline by means of an *ex ante* assessment. We evaluate: a) whether interventions included in the PEPAC take current knowledge on farmland bird requirements into account (Díaz *et al.*, 2021), and b) whether central

and autonomous government interventions are aligned to achieve CAP biodiversity goals (Pe'er *et al.*, 2022). On the basis of these evaluations, we aimed to detect key failures in the design of the PEPAC and outline its adaptive improvement following the new CAP guidelines.

MATERIALS AND METHODS

Spain is the second largest EU Member State and the fourth largest (after France, Italy and Germany) in terms of CAP funds (Münch *et al.*, 2023). The Spanish CAP Strategic Plan (PEPAC) was approved on 1st January 2023 and reviewed on 1st September 2023 (MAPA, 2023). We considered the interventions of the PEPAC explicitly targeting the need 06.02 regarding farmland birds (see above), included in the latest PEPAC version. We have evaluated interventions included under enhanced conditionality (Good Agricultural and Environmental Conditions –GAEC– 3, 4 and 9), eco-scheme 5 (establishment of biodiversity areas), several agri-environmental and climate interventions, support for areas with specific disadvantages, and aid for non-productive investments (Appendix 1). Statutory Management Requirements –SMR– 3 (Birds Directive; 2009/147/EC), 4 (Habitats Directive; 92/43/EC) and 8 (Sustainable Use of Pesticides Directive; 2009/128/EC) were not evaluated since their development in the PEPAC was too general to be referred to specific bird requirements.

Farmland bird requirements reviewed in Díaz *et al.* (2021) were summarized into eight land use and management categories that the Strategic Plan should address: field size, linear and singular landscape features, landscape mosaics, grasslands and semi-natural habitats, fallow and livestock load, tillage, irrigation, and agrochemicals (Appendix 2). Each category includes specific

management actions more or less quantitative and detailed according to scientific knowledge on each of the eight main Spanish agrosystems: Mediterranean arable crops, agro-silvo-pastoral systems or dehesas, olive groves, vineyards, mixed Euro-Siberian systems, extensive and transhumant grazing systems, fruit orchard, and rice fields (Supplementary Materials in Díaz *et al.*, 2021, also accessible through <https://view.genial.ly/606227e1cec16a0d41abbae9>). Some of the desirable actions (i.e. actions needed to meet farmland bird requirements) include generalist actions that should be implemented on all agrosystems, such as maintaining or increasing landscape features, while others are more specific of certain agrosystems, such as the ban on afforestation in Mediterranean arable crops.

Ex ante evaluation was conducted by establishing whether each intervention of the Strategic Plan targeting farmland bird conservation included desirable actions. We evaluated whether interventions 1) completely considered all actions included in each of the eight land use and management categories (e.g. when all linear and singular landscape features are protected), 2) considered only elements of desirable actions (e.g. when there are limits to the use of pesticides but not for fertilisers) or considered them only partially (e.g. when permanent grasslands are protected in arable systems, but without reference to a minimum amount) or 3) did not consider any action when the definition of the intervention should have included them (e.g. when control of irrigation is not considered in either perennial or annual Mediterranean systems). We assigned scores of 1.0, 0.5 and 0.0, respectively, to these outcomes. The score for each intervention was then obtained by dividing the sum of partial scores by the number of the desirable action categories it should have considered. Scores estimate the knowledge transfer or completeness of incorporation of

available knowledge on the design of each intervention of the Strategic Plan. Average scores across all interventions targeting farmland birds thus estimate the overall scientific support of the Strategic Plan for farmland bird conservation (Llusia & Oñate, 2005).

Separate evaluation of interventions included in each of the three elements of the CAP Green Architecture (enhanced conditionality, eco-schemes and rural development interventions) allowed us to determine a) the potential effectiveness of CAP interventions (estimated as the degree of inclusion of desirable actions) and b) to what extent central and autonomous government interventions were integrated to achieve CAP

biodiversity goals (estimated by checking whether overall implementation ensured a minimum of 10% uncultivated habitats).

RESULTS

The Spanish CAP Strategic Plan (PEPAC) included 204 interventions targeting farmland bird conservation, considering both the interventions designed at the national level (three Good Agricultural and Environmental Conditions –GAEC– and one eco-scheme), and the sum of those designed by each Autonomous Region for each of the eight main Spanish agrosystems (Figure 1 and Appen-

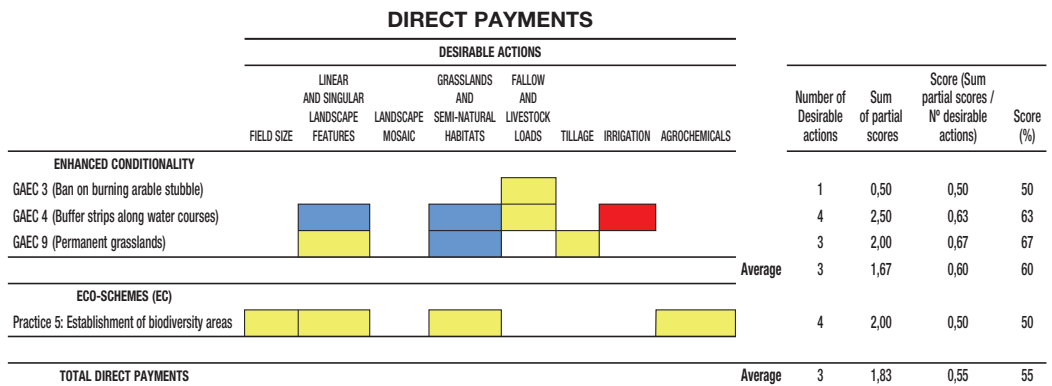


FIG. 1.—Heat map summarising the evaluation of knowledge transfer to direct payment interventions. The evaluation has been made for each of the PEPAC interventions explicitly targeting need 06.02 (farmland bird conservation) and considering the eight main categories of desirable actions (needed to meet farmland bird requirements) that interventions should contemplate (Díaz *et al.*, 2021). Red: interventions that have not considered any known bird requirement (partial score 0.0); yellow: partial consideration of requirements (partial score 0.5); blue: full consideration (partial score 1.0); empty cells: desirable actions not targeted by direct payment interventions. See text for details and Appendix 2 for definitions of desirable actions.

[Mapa de calor que resume la evaluación de la transferencia de conocimiento científico a las intervenciones de pagos directos. La evaluación se ha hecho para cada intervención del PEPAC que explícitamente aborda la necesidad 06.02 (conservación de aves agrarias) y considerando las ocho categorías de acciones deseables (necesarias para satisfacer los requerimientos de las aves agrarias) que las intervenciones deberían contemplar (Díaz *et al.*, 2021). Rojo: intervenciones que no han considerado ningún requerimiento de las aves (puntuación parcial de 0.0); amarillo: consideración parcial de los requerimientos (puntuación parcial de 0.5); azul: consideración total (puntuación parcial de 1.0); celdas vacías: acciones deseables no abordadas por las intervenciones de pagos directos. Véase texto para más detalles y Apéndice 2 para la definición de las acciones deseables.]

dix 3). There were 200 rural development interventions targeting birds explicitly in the PEPAC, with 12 interventions on average per Autonomous Region (range 4-19) and 88 region × agrosystem actual combinations (Figure 2 and Appendix 3).

Direct payment interventions –GAECs and eco-schemes– considered on average 55% of known bird requirements (Figure 1), 60% and 50%, respectively. Proportions fulfilled by the 200 rural development interventions varied between 0% (beekeeping for biodiversity in all agrosystems and regions) and 90% (maintenance or improvement of traditional habitats and farming activities that

preserve biodiversity in Catalanian extensive grazing systems; Appendix 3). Scores for sets of rural development interventions for each agrosystem in each region varied between 0% (e.g. perennial crops in Comunidad Valenciana, Andalucía and Aragón) and 50% (rice fields in Comunidad Valenciana and extensive grazing systems in Cataluña) and averaged 17% (Figure 2). Proportions fulfilled by rural development interventions varied between 8% and 29% among Autonomous Regions (Figure 2) and thus overall fulfillment combining direct payments and rural development varied between 31% and 42%, 36% on average (Figure 3).

RURAL DEVELOPMENT

Autonomous Regions	Agrosystems								Average
	Mediterranean arable cops	Rice fields	Olive groves	Vineyards	Fruit orchards	Mixed Euro-Siberian systems	Dehesas	Extensive grazing systems	
Galicia	20			27		32		36	29
Castilla y León	32		18	18	18	22	40	40	27
Asturias						21		32	27
Cataluña	19	17	19	19	19			50	24
Islas Baleares	17		17		17			38	22
Navarra	30	0	25	21	25	25		17	20
Castilla-La Mancha	23		9	12	9		34	17	18
Cantabria						0		29	15
Extremadura	17	14	15	9	9		19	19	14
Comunidad de Madrid	25		14	9	9		13	13	14
Aragón	23	33	0	0	0			25	13
Andalucía	14	25	0	0	0		25	25	13
Islas Canarias	0			4	7			38	12
Pais Vasco				4	4	13		25	12
La Rioja	11		19	19	8			0	11
Comunidad Valenciana	16	50	0	0	0			0	11
Region de Murcia	19		7	7	6			0	8
Average	19	23	12	11	9	19	26	24	17

FIG. 2.—Heat map summarising the evaluation of average knowledge transfer (figures in cells are percentages) to rural development interventions (see Appendix 3 for individual scores). Red: average score = 0; orange: average score < 25%; yellow: 25% < average score < 50%; blue: average score > 50%; empty cells: agrosystems not present in the Autonomous Region.

[Mapa de calor que resume la evaluación de la media de transferencia de conocimiento científico a las intervenciones de desarrollo rural (véase Apéndice 3 para las puntuaciones individuales). Rojo: puntuación media = 0; naranja: puntuación media < 25%; amarillo: 25% < puntuación media < 50%; azul: puntuación media > 50%; celdas vacías: agrosistemas no presentes en la comunidad autónoma. Las cifras en las celdas son porcentajes.]

Direct payments officially considered only six out of the eight groups of bird requirements, as they did not include measures directed towards the maintenance of landscape mosaics and bird needs related to irrigation. Rural development interventions did not solve the last shortcoming either, as irrigation effects were only considered fully in six of the 88 region \times agrosystem combinations (Appendix 3). Finally, interventions did not ensure the maintenance of 10% uncultivated elements at both farm and landscape levels (direct payment descriptions in Appendix 1), only allowing a maximum of 7% for rainfed arable land and much less for other agrosystems.

DISCUSSION

Ex ante evaluation of whether the Spanish CAP Strategic Plan (PEPAC) adequately includes knowledge of farmland bird requirements revealed a partial and mixed use of available information (Díaz *et al.*, 2021; Pe'er *et al.*, 2022). Direct payment interventions addressed most groups of bird requirements but not all of them. Nevertheless, important interventions that could potentially benefit farmland bird populations, and whose inclusion would have improved direct payment average scores (e.g. GAEC 7 and 8), have not been officially considered. Finally, compulsory (enhanced conditionality) and massive

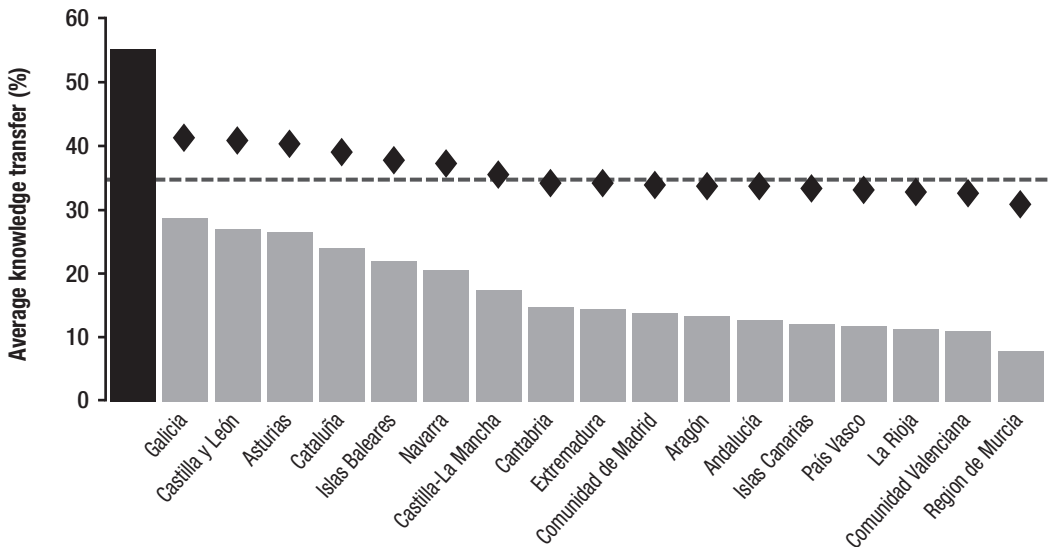


FIG. 3.—Combined evaluation of average knowledge transfer of interventions targeted to farmland bird conservation by Spanish Autonomous Region. Black bar on left indicates average knowledge transfer to direct payment interventions (Figure 1), grey bars average knowledge transfer to rural development interventions (Figure 2) and diamonds average knowledge transfer in each Autonomous Region. Dotted line shows the across-regions average.

[Evaluación combinada de la transferencia de conocimiento científico a las intervenciones que abordan la conservación de las aves agrarias según comunidades autónomas españolas. La barra negra indica la transferencia de conocimiento a las intervenciones de pagos directos (Figura 1), las barras grises la media de transferencia de conocimiento a las intervenciones de desarrollo rural (Figura 2) y los rombos la media de transferencia de conocimiento en cada comunidad autónoma. La línea de puntos muestra la media de todas las comunidades autónomas.]

uptake directed (eco-schemes) interventions did not ensure the maintenance of 10% uncultivated elements at both farm and landscape levels (direct payment descriptions in Appendix 1). This shortcoming could lead to a lower effectiveness of rural development interventions on farmland bird conservation compared with what we have predicted, as a minimum landscape heterogeneity is needed for more specific measures to be effective, as has been demonstrated in the past (Tscharntke *et al.*, 2005; Concepción *et al.*, 2008, 2012).

Rural development interventions evidenced a lower incorporation of knowledge of bird requirements in their design, as their average scores were considerably lower than those for direct payment interventions. The differences between Autonomous Regions and among agrosystems were also considerable. For example, commitments for dehesas, extensive grazing systems and rice fields had the highest average scores. In contrast, commitments for permanent crops (olive groves, vineyards and fruit orchards) received the lowest scores, with little or no use made of available knowledge in their design. There was no Autonomous Region with an average score over 30%, although this could be partly due to low consideration of agrosystems covering low proportions of regional agricultural area (e.g., rice fields in Extremadura, or fruit orchards in Comunidad de Madrid). Overall, considering both the direct payment and rural development interventions (Figure 3), average scores were below 50%, which means that available knowledge of bird requirements has not been fully incorporated, and that the design of interventions targeting farmland bird conservation could be greatly improved (Appendix 4).

Despite the PEPAC's lack of ambition regarding need 06.02 (stopping or reverting farmland bird loss), direct payments designed by the central government had considerably higher average scores than rural

development interventions designed by the Autonomous Regions (Figures 1 and 2). Furthermore, Spain has not set explicit national values for the relevant targets of the EU Biodiversity Strategy. One of those targets is achieving inclusion of at least 10% of agricultural area within high-diversity landscape features by 2030, also ensuring connectivity among habitats (Pe'er *et al.*, 2022). Although not mandatory, the PEPAC could have aimed at maintaining 10% of the non-productive agricultural area, preferably by integrating Green Architecture elements with a multi-level governance perspective. Enhanced conditionality could have included commitments and associated verification mechanisms to preserve existing landscape features, as well as to prevent field size increases resulting from land consolidation. Eco-schemes could have promoted landscape complexity by increasing semi-natural habitats, especially in more simple landscapes. On this basis, agri-environmental and climate interventions could, and preferably should, have addressed the conservation objectives of each region and agricultural system (Concepción & Díaz, 2019; Concepción *et al.*, 2020; Díaz *et al.*, 2021).

Several factors might underlie the insufficient integration of scientific knowledge of farmland bird requirements into the PEPAC. Overall *ex ante* assessments of Member State CAP Strategic Plans (Münch *et al.*, 2023) indicate that market sustainability is the common priority objective, with little or no consideration of the ecosystem services provided by agriculture. These services, such as pest control, recreation, generating scenic values or wildfire prevention, are essential for justifying the subsidies received by European farmers (Swinton *et al.*, 2007; Plieninger *et al.*, 2012). Firstly, several Autonomous Regions have targeted the farmland bird objective only by supporting commitments on a few and not very widespread or representative crops (e.g., rice fields in Extremadura,

or fruit orchards in Comunidad de Madrid), whereas regionally important agrosystems have not been considered (e.g. fruit orchards in Comunidad Valenciana, Aragón or Andalucía). In addition, there were no direct payment interventions targeting the maintenance of landscape mosaics. GAEC 7 and eco-schemes 1, 3 and 4 would have been used to solve this shortcoming. Similarly, little or no consideration of bird requirements related to irrigation has been incorporated into the PEPAC design, in spite of the ample available information on the negative effects of irrigation on farmland bird populations (Díaz *et al.*, 1997; Suárez *et al.*, 1997; Giralt *et al.*, 2021; Cabodevilla *et al.*, 2022). Failures to incorporate key environmental requirements would presumably imply limited positive impacts on farmland bird conservation. Secondly, interventions with no scientific support for the conservation of farmland birds have been used for targeting need 06.02. Beekeeping for biodiversity is a clear example, as there is no evidence of direct positive effects of honey bees *Apis mellifera* on farmland birds, and indirect negative effects can be expected as has been demonstrated for wild pollinators and plants (Agüero *et al.*, 2018; Herrera, 2020). Finally, low environmental ambition is also shown by the fact that several compulsory or wide-scale interventions with known potential benefits have not been officially considered to contribute to farmland bird conservation (need 06.02). This could be the case of Good Agricultural and Environmental Conditions –GAEC 8– (Minimum share of agricultural area devoted to non-productive areas; Appendix 4), which might have been used as an effective baseline that will ensure landscape heterogeneity (Traba & Morales, 2019). Furthermore, the Spanish government revoked the implementation of GAEC 7 (crop rotations) and the first requirement of GAEC 8 (a minimum of at least 4% of arable land at farm level to be devoted to non-productive areas and

features) in 2023. The first requirement of GAEC 8 will not be implemented in 2024 either (EC, 2024), thus hampering the need to achieve a landscape structure complex enough to allow other interventions to be effective. Despite promises on structural changes in the CAP design and evaluation (Navarro & López-Bao, 2018, 2019; Pe'er *et al.*, 2019; European Commission, 2021), it seems clear that the idea of supporting a multifunctional agriculture to justify subsidies is still unsatisfactorily developed by the current PEPAC.

Ex ante evaluations based on relative incorporation of current knowledge can be interpreted in terms of the expected effectiveness of specific interventions, groups of interventions, and the overall PEPAC (Llusia & Oñate, 2005). Available comparisons among *ex ante* and *ex post* evaluations support a general direct relationship between both evaluations, although *ex ante* scores tend to overrate effectiveness (Tarjuelo *et al.*, 2021). *Ex ante* evaluations and expert opinions are useful to design conservation measures but they should not replace proper *ex post* evaluations. Each evaluated intervention should be tested to check its real effectiveness by comparing farmland bird abundance and trends with abundance and trends in proper control fields where these interventions are not implemented (Kleijn *et al.*, 2006; Concepción *et al.*, 2008; Rey *et al.*, 2019). The results obtained in these direct evaluations can be used to manage measures adaptively (Díaz & Concepción, 2016), following the spirit of the new CAP Performance Monitoring and Evaluation Framework (Regulation EU 2021/2115).

As mentioned by Münch *et al.* (2023), the European CAP Strategic Plans make a clear emphasis on targeting the market needs of the agricultural sector, being less ambitious for rural development, climate and environment. Spain was not an exception, scoring below EU average regarding ambition on

environmental objectives. The low potential effectiveness of the evaluated interventions can result from the scarce correspondence between intervention commitments and bird requirements. There are aspects that are not considered by the PEPAC as well as interventions with no scientific support. Furthermore, there is no clear integration among the elements of the Green Architecture and among the national and regional governance levels, despite the scientific consensus of using mandatory measures to attain an appropriate landscape structure that would ensure the effectiveness of more targeted measures.

The PEPAC has great room for improvement if it is to reach its goal of conservation of farmland birds. At the national level, improvement can be achieved by developing the potential positive effects of several GAECs and eco-schemes and revoking current temporal derogations of positive interventions. At the regional level, more inclusion of available knowledge on bird requirements and more coherence among interventions and commitments are needed (see Appendix 4 for details).

Reaching the CAP environmental and social objectives through the adaptive management of Strategic Plans is an issue engaging the entire country, so central governments should coordinate the design of country-wide interventions as well as integrating goals considering potential trade-offs. Evaluations of whether Plans incorporate and promote knowledge on how effective actions are in reaching multiple goals is thus urgently needed. This would allow much higher ecological and social coherence of the new CAP Green Architecture implementation.

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Appendix 1. Evaluated interventions' main commitments.

[Principales compromisos de las medidas evaluadas.]

Appendix 2. Agronomic measures known to affect farmland birds in Spain (after Díaz *et al.*, 2021) grouped according to main bird requirements.

[Medidas agronómicas conocidas que afectan a las aves agrarias en España (según Díaz *et al.*, 2021) agrupadas de acuerdo con sus principales requerimientos.]

Appendix 3. Evaluation of knowledge transfer to rural development interventions according to Autonomous Regions and agrosystems.

[Evaluación de la transferencia de conocimiento a las intervenciones de desarrollo rural según comunidades autónomas y agrosistemas.]

Appendix 4. Recommendations to improve the Spanish PEPAC for farmland bird conservation.

[Recomendaciones de mejora del PEPAC español para la conservación de las aves agrarias.]



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