

Implementation of targeted agri-environmental schemes for biodiversity conservation in Croatia

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Abstract

The aim of this research was to analyse the adoption patterns of targeted agri-environmental schemes (AES) for biodiversity conservation among farmers in Croatia in the programming period 2014–2022. We present a statistical analysis of farm enrolment data from the Agency for Payments in Agriculture, Fisheries and Rural Development. Specifically, we focused on two schemes, which targeted priority grassland habitat types and species. In 2021, about 25,000 hectares from 1,012 farm holdings were enrolled in the Preservation of High Nature Value Grassland scheme (10.1.3.), and 617 hectares (126 farm holdings) were enrolled in the Pilot Measure for the Protection of the Corncrake (*Crex crex*) (10.1.4.). Our analysis revealed that, in both schemes, enrolled farmers were significantly younger compared to those that did not enrol, and in the Corncrake scheme, farmers also had higher education levels. However, no significant differences were observed in gender or farm type. The majority of enrolled plots were under 1 ha in size, reflecting the highly fragmented structure of Croatian agriculture. Further research is needed to better understand the underlying reasons for the low enrolment rates, especially in the Corncrake scheme. These insights could support the design of targeted advisory services and awareness-raising campaigns aimed at increasing participation among underrepresented groups, such as older farmers and those managing small, fragmented landholdings.

INTRODUCTION

The Republic of Croatia is located at the crossroads of several biogeographical regions (Continental, Alpine and Mediterranean), which, along with ecological, climatic and geomorphological conditions, make it one of the countries with the richest biodiversity in Europe (Baltaret, 2010). The Natura 2000 network in Croatia covers 36.7% of the land area and consists of 38 areas designated as Special Protection Areas based on the Birds Directive and 744 Special Areas of Conservation based on the Habitats Directive (Ministry of Economy and Sustainable Development, 2022). However, the biodiversity policy integration in the agricultural sector has been relatively weak, which is reflected in a limited array of targeted measures within the agricultural policy and a lack of capacities for collaboration between nature conservation and farming sector institutions (Radović, 2023.; Sladonja et al., 2012.; Balazsi, 2018). First targeted schemes for biodiversity conservation were thus introduced only in 2013, when the Croatian agricultural policy was harmonised with the Common Agricultural Policy (CAP) (Mikuš et al., 2019).

Designed to promote agricultural practices that contribute to environmental sustainability and enhance biodiversity, the Agri-Environment-Climate Measure (AECM) within Croatia's 2014–2020 Rural Development Programme was supported with €118 million from the European Agricultural Fund for Rural Development (EAFRD), representing approximately 5.9% of the total EAFRD allocation to Croatia (Ministry of agriculture, 2018). Within the AECM, the three key schemes for biodiversity conservation on grasslands were 10.1.3. Preservation of High Nature Value Grassland (HNV Grassland scheme) and two schemes, which targeted specific Natura 2000 sites and farmland species, namely 10.1.4. Pilot Measure for the Protection of the Corncrake (*Crex crex*) (Corncrake scheme) and 10.1.5. Pilot Measure for Butterfly Protection (*Phengaris teleius*, *Phengaris nausithous*, *Phengaris alcon* and *Coenonympha oedippus*) (Butterfly scheme). In all three voluntary schemes, enrolled farmers were obliged to participate for five years, to attend regular training and to document the practices they carried out in the enrolled grasslands. However, the schemes differed on, for example, mowing dates and specific agrotechnical requirements.

The voluntary character of AECM was found to be one of the key drawbacks in tackling the continued biodiversity decline at the EU level as the number of farmers who opt to enrol in the targeted and "dark green" schemes remains relatively low (Gamero et al, 2017; Pe'er et al, 2022). Participation rates in AECM have been shown to vary widely across EU Member States, largely as a result of complex and context-specific interactions between environmental conditions, economic incentives and socio-political frameworks (Podrúzsik & Fertő, 2024). In recent years, a growing number of studies have thus examined different factors that influence farmers' decision-making and willingness to enrol in these schemes (Schulze et al, 2024; Klebl et al, 2023). The aim of this research was to analyse the level of

enrolment and socio-economic characteristics of participating farmers in the targeted schemes for biodiversity conservation within the Croatian CAP in the programming period 2015-2022.

MATERIAL AND METHODS

The analysis was based on data from the Paying Agency for Agriculture, Fisheries and Rural Development (PAFRD) for the 2014-2022 programming period, which included data on agricultural support and structural characteristics of agricultural holdings, LPIS data and spatially referenced data on eligible areas for the HNV Grassland scheme and Corncrake scheme. The following variables were analysed: farm type, education level and age of farmers, and size of enrolled plots of grasslands. Data processing and statistics were performed in R (version 4.0.2) using the dplyr package (Wickham et al, 2023). We compared the structural and socio-economic characteristics of farmers who enrolled in the schemes with the entire population of eligible farmers using the selected statistical tests. Independent samples t-tests were used to examine the differences in the mean values of numerical variables (e.g. plot size and age), while non-parametric tests were used to analyse categorical variables. The chi-square test of independence was used to compare the distributions of gender and educational level categories between the groups of farmers who enrolled in the measure and the eligible farmers who did not enrol. For the farm type variable, Fisher's exact test was used to examine the difference in distribution with respect to the enrolment in the scheme (frequencies were less than 5).

RESULTS AND DISCUSSION

Analysis of the scheme Preservation of High Nature Value Grasslands (10.1.3.)

Our results showed that in the period from 2015-2022, 103,867 hectares or 19,393 farms were eligible to enrol in the HNV grassland scheme. However, in 2021, 1,021 farms (5.3%) enrolled 24,861 hectares (23.9%). The majority of these farms are family farms, predominantly managed by male owners, with an average age of 58 years, with secondary education as the most common level of qualification. In the analysed area, as many as 58.16% of plots are less than one hectare (ha) in size (Table 1). The smallest land plot in this scheme was 0.02 ha, and the largest was 276.56 ha. The average plot size was 5.09 ha. Both the number of farms and the number of hectares have increased since 2015 (Figures 1 and 2).

The results of the independent samples t-test showed that the average size of the plots of grasslands that were enrolled in the schemes ($M = 5.10$ ha) was statistically significantly higher compared to those that weren't ($M = 0.89$ ha) ($t = 8.244$, $df = 1039.6$, $P < 0.01$). There was also a statistically significant difference in the age of farmers ($t = -19.562$, $df = 1159.2$, $p < 0.001$) as the holders who enrolled in the scheme were on average younger ($M = 50.08$ years) compared to those who didn't ($M = 59.65$ years). However, there was no statistically significant difference in gender distribution ($X^2 = 1.8487$, $df = 1$, $p = 0.1739$), the type of farm ($p = 0.995$) and the level of education ($p = 0.3863$).

Table 1. Socioeconomic characteristics of farmers who enrolled in agri-environmental schemes High-nature Value grasslands (10.1.3.) and Corncrake protection (10.1.4.)

	HNV Grasslands		Corncrake	
	N	%	N	%
Type of farm:				
Family farm	852	82.32	139	73.94
Self-sustaining farm	123	11.88	41	21.81
Legal entities	58	5.61	8	4.25
Didn't declare	2	0.19		
Gender:				
M	766	74.01	136	72.34
F	269	25.99	52	27.66
Age:				
<45	432	41.74	61	32.45
46-65	414	40.00	79	42.02
>65	189	18.26	48	25.53
Level of education:				
Incomplete primary school	11	1.06	3	1.60
Primary school	100	9.66	17	9.04
Secondary school	486	46.96	90	47.87
Higher education, university or college	106	10.24	24	12.77
Didn't declare	332	32.08	54	28.72
Size of plots (ha)				
>1	602	58.16	139	73.94

1-10	310	29.95	45	23.94
10 to 100	119	11.50	4	2.13
>100	4	0.39	0	0

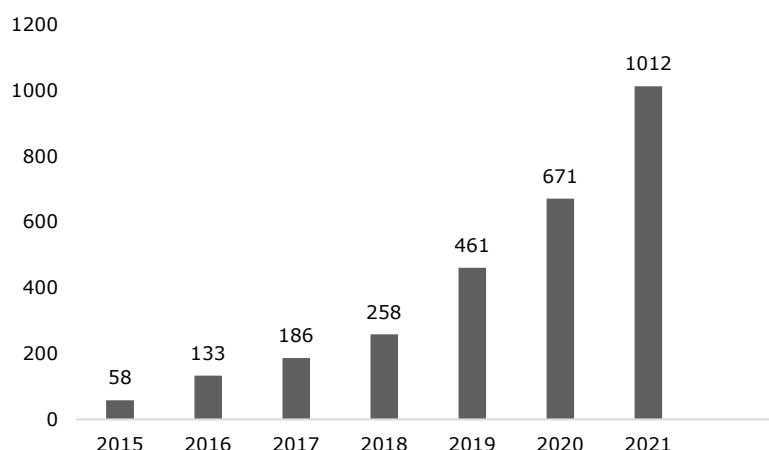


Figure 1. Number of enrolled farmers in the HNV grassland scheme in 2015-2021

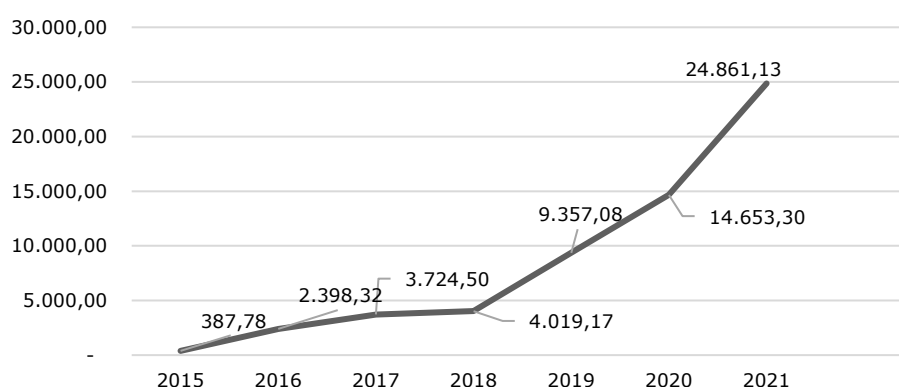


Figure 2. Number of hectares enrolled in the HNV grassland scheme in 2015-2021

Analysis of the scheme Pilot Measure for the Protection of the Corncrake (*Crex crex*) (10.1.4.)

In the Corncrake scheme, agricultural land must be registered in the LPIS system and designated as grassland within the ecological network, with at least 30% of the area located within a Natura 2000 site (Narodne novine, 2022). Our analysis showed that between 2015 and 2022, 7,382 farms (48,648 hectares) were eligible to enrol in this scheme. However, in 2021, only 616.84 hectares (1.3%) were enrolled by 126 farms (1.7%). The structure of farms was similar to that of the HNV grassland scheme, as the majority were family farms, predominantly managed by male owners, with an average age of 57 years. Secondary education was the most common level of qualification. In the analysed area, as many as 73.94% of plots are less than 1 ha (Table 1) with the average size of 1,24 ha. Further analysis determined that the smallest enrolled plot of grassland was just 0.04 ha in size and the largest 31.65 ha. The growth of both the number of enrolled farms and the number of hectares was observed every year (Figures 3 and 4).

The independent samples t-test results showed no statistically significant difference in the average size of the enrolled grassland plots and those that weren't ($t = 0.81$, $p = 0.4198$). A statistically significant difference was found in the age of farmers ($t = -15.481$, $p < 2.2e-16$) as enrolled farms had a lower average age of the holder ($M = 53.39$ years) compared to those that didn't ($M = 57.65$ years). There was no statistically significant difference in gender distribution ($X^2 = 1.2482$, $df = 1$, $p = 0.2639$) and the type of farm ($p = 0.08372$). However, a statistically significant difference was found in the education level ($X^2 = 11.727$, $df = 3$, $p = 0.001$); farmers who enrolled in the scheme were significantly more likely to have secondary or higher education, whereas those who did not enroll were more likely to have completed primary school or did not complete it at all.

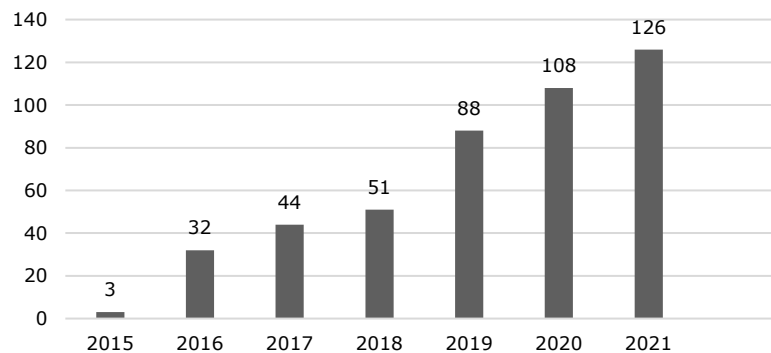


Figure 3. Number of enrolled farmers for targeted AES for corncrake in 2015-2021

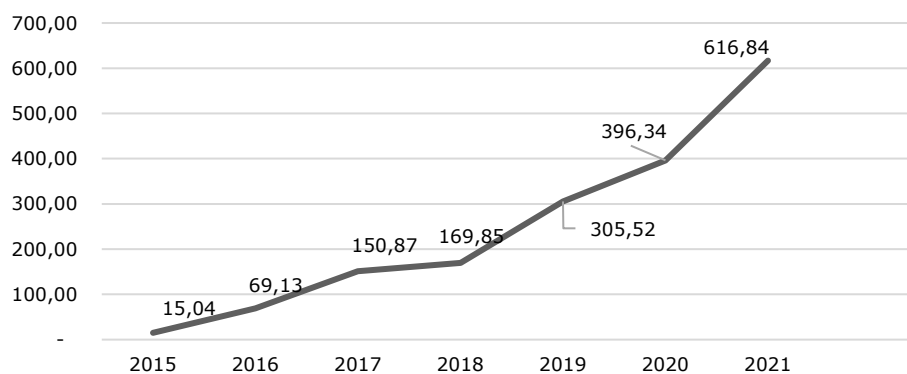


Figure 4. Number of hectares for targeted AES for corncrake in 2015-2021

The acceptance of agri-environmental and climate measures (AECM) largely depends on the characteristics of agricultural holdings and farmers. For example, family farms tend to be more reluctant to participate in AECM compared to commercial farms (Capitanio et al., 2011), while wealthier, larger and more specialised farmers in terms of production (Grammatikopoulou et al., 2016; Cullen et al., 2021) are generally more willing to adopt such measures. However, the vast majority of enrolled plots in Croatia were less than 1 hectare in size, which probably reflects the structural characteristics of Croatian agriculture with high land fragmentation and the predominance of small farms. Demographic factors, such as the age and education of farmers, can also play an important role in the adoption of AECM. For example, research on the adoption of agri-environmental schemes for grassland conservation in Slovenia, showed that older farmers were generally less inclined to participate in the scheme due to concerns about administrative burden and potential personal health-related issues, and reluctance to burden their successors with long-term commitments (Novak et al., 2022). This might explain why younger farmers were more likely to enrol in both of the analysed schemes.

CONCLUSION

Our analysis has shown relatively low participation levels in both analysed schemes, with only 23.9% of eligible grasslands enrolled in the Grassland scheme in 2021, and 1.3% of eligible hectares in the Corncrake scheme. Given that the target values, which were set in the Prioritised Action Framework for the Natura 2000 sites in Croatia for the programming period 2021-2027, are considerably higher (namely 25,000 ha for the Grassland scheme and 4,000 ha for the Corncrake scheme, respectively) (Narodne novine, 2022), there is a pressing need to adjust the design and implementation of both schemes to increase the enrolment rates among farmers. To effectively address the low enrollment rates, we recommend conducting in-depth analyses to uncover the specific barriers faced by farmers. Based on these insights, tailored advisory services and well-targeted information campaigns should be developed, focusing particularly on groups with consistently lower participation, such as older farmers and those managing fragmented land structures.

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