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Are result-based schemes a superior approach to the conservation of High Nature Value grasslands? Evidence from Slovenia

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ABSTRACT

In this study, we explored the potential of the payment-by-results approach in supporting the maintenance of High Nature Value (HNV) grasslands in a typical HNV farming system and Natura 2000 site in Slovenia (Europe) with a high share of small farms, fragmented land ownership and long-term process of land abandonment. We tested the applicability of a hypothetical result-based scheme (RBS) for the conservation of dry grasslands and a set of associated plant indicators, and identified key obstacles to its implementation. Based on a statistical analysis of a survey with 263 farmers and a thematic data analysis of 62 farmer interviews and 10 in-depth interviews and focus groups with researchers, public officials and agricultural advisors, we found that a majority of both farmers and experts support the introduction of RBSs. The selected plant indicators were well-known among the local farmers and monitoring of their presence was preferred over the current system, which demands keeping records on the implementation of farming practices. However, although the RBSs seem to be a superior alternative to the current management-based schemes, their introduction might not be enough to ensure HNV farming systems' successful conservation. Our results indicate a lack of institutional capacity to implement RBSs on a larger scale, particularly in terms of data support and qualified staff in the advisory service and monitoring agencies. Furthermore, experience to date and mistrust among stakeholders indicate a questionable ability and motivation of authorities to develop locally-based, flexible and innovative agri-environmental measures. RBSs alone also do not adequately address some of the root causes for the disappearance of HNV grasslands, particularly: the lack of knowledge regarding the appropriate modern farming system(s) to ensure their sustainable management in line with conservation goals; specific needs of small farmers; and the need for a socially acceptable land policy reform to enable easier access to land. We argue that systematic investment in closing the existing data and research gaps as well as in increasing the capacity of key institutions at the national and local levels are needed, particularly in European regions of high conservation priority. Furthermore, better integration of nature conservation in different rural policies and a holistic developmental approach in (remote) rural areas are necessary to prevent further abandonment of HNV farming and enable the adoption of biodiversity-friendly farming models.

1. Introduction

In Europe, semi-natural grasslands have been established over millennia of low-intensity land use (Dengler et al., 2014; Hejcman et al., 2013). They often harbour unique and highly diverse communities of species and have thus high conservation value (Veen et al., 2009; Wilson et al., 2012). Due to recent changes in management, grasslands are now considered to be among the most endangered ecosystems in the European Union (EU) (EEA, 2020; IPBES, 2018; Janssen et al., 2016).

The deterioration of grasslands and consequent loss of biodiversity have been associated with the intensification of agricultural use, which is manifested in increased fertilisation, mowing frequency, sowing, drainage and grazing intensity, as well as conversion to arable land (Gao and Carmel, 2020; Marini et al., 2007; Stoate et al., 2009; Van Vooren et al., 2018). In addition, their long-term eutrophication may be contributed to by atmospheric nitrogen deposition (Bobbink et al., 2010;

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Boutin et al., 2017; Dupre et al., 2010). The disappearance of semi-natural grasslands is also accelerated by abandonment of farming in marginal areas, which are often characterised by lower productivity and negative socio-economic trends (Bonanomi et al., 2013; Giarrizzo et al., 2017; van Vliet et al., 2015). Consequently, conservationists have been struggling to establish suitable approaches to preserve the extensive use of grasslands and integrate it into modern farming systems (Keenleyside et al., 2014; Simoncini et al., 2019; Tardella et al., 2020).

In the EU, agri-environmental measures (AEM) have become an essential policy tool to support traditional and nature-friendly farming practices and have been a mandatory instrument within the Common Agricultural Policy (CAP) since 1992 (Batáry et al., 2015). In most schemes aiming at biodiversity objectives, farmers voluntarily commit to implementing prescribed farming practices, such as decreased fertilisation and delayed mowing, which are believed to support the conservation of targeted species and habitat types. In exchange, they are compensated for the income foregone and higher operational costs (Uthes and Matzdorf, 2013).

However, the management-based approach has many drawbacks. Since the payments are not directly linked to ecological effects, the results are often lacking due to poor targeting and insufficient evaluation (ECA, 2011; Kaligarič et al., 2019). Furthermore, these schemes usually allow for limited adaptation of management to local ecological conditions and year-to-year changes in weather, leading to decreased dynamics in management and habitat heterogeneity (Poschlod and WallisDeVries, 2002; Riley, 2006; Swagemakers et al., 2009). Despite decades of AEM implementation, there is also little evidence of long-term changes in the farmers' behaviour, group norms and attitudes towards the environment, which are considered essential for the uptake of nature-friendly farming practices (Burton and Paragahawewa, 2011; de Snoo et al., 2013, but see Cusworth, 2020). In many areas, successful implementation of AEM is thus hampered by inadequate design, unclear biodiversity outcomes and farmers' low interest in entering targeted schemes due to their prescriptive nature (Arnott et al., 2019; ECA, 2020; Kleijn and Sutherland, 2003).

Some European countries have introduced result-based schemes (RBSs), which remunerate farmers for the achievement of conservation outcomes. These are measured with indicators, such as the number of plant species, presence of bird nests or conservation score. RBSs can be implemented as either "pure" payment-by-results schemes or "hybrid" schemes, where some farming practices are still prescribed as a baseline requirement. Despite the increasing number of these schemes in recent years, however, they are overall still quite rare in Europe and are often only implemented on a pilot basis (Herzon et al., 2018).

Studies have emphasised that RBSs often enable better targeting and cost-effectiveness than management-based schemes (Burton and Schwarz, 2013; Sidemo-Holm et al., 2018; White and Hanley, 2016). They are usually well-received by farmers (Birge et al., 2017; Matzdorf and Lorenz, 2010; Schroeder et al., 2013; Wezel et al., 2018), although there are still few quantitative studies of their preferences towards different types of schemes. In addition, RBSs are thought to help build social capital of and within the farmer community by more actively engaging farmers' knowledge and experience and rewarding their conservation performance (Birge and Herzon, 2019; Burton and Schwarz, 2013).

However, the possibility of using RBSs has been found to be limited to environmental problems that are well spatially defined and researched and where effective indicators can be developed (Herzon et al., 2018; Kaiser et al., 2019). Consequently, RBSs are believed to be more suitable when the AEM aims to support already established farming practices and traditional systems, as opposed to areas where considerable ecological improvement is needed. In the latter case, farmers usually have little experience with recommended management, and the achievement of biodiversity results may exceed the typical five-year duration of AEM contracts (Uthes and Matzdorf, 2013). Finally, there should be sufficient and stable political and institutional support for the development of RBS. This includes openness to more flexible and innovative policy instruments, active engagement of research and nature conservation institutions and sufficient capacity of the advisory service and monitoring agencies (Birge et al., 2017; Hiedanpää and Borgström, 2014; Meyer et al., 2016).

Most research work, piloting and implementation of RBSs have taken place in Western, Central and Northern Europe (Burton and Schwarz, 2013; Herzon et al., 2018). Here, they have often been carried out in areas with modern agriculture and a predominant share of medium to large-sized family farms, even if these areas are considered as more extensive and peripheral in the national context. In addition, these RBSs have evolved in a political and socio-economic environment where nature conservation, environmental protection and climate change are critical societal issues (Chaisty and Whitefield, 2015), so there are strategic and active attempts to improve public policies in this field (e.g. see O'Rourke and Finn, 2020).

Despite the advantages of payment-by-results measures, the question, therefore, remains whether the RBS can also be successfully applied in regions and continents with different socio-economic contexts (Herzon et al., 2018). One such example are the EU Member States in Central and Eastern Europe (Gorton et al., 2009), where many regions are characterised by lower agricultural productivity than in Western Europe, a large share of small farm holdings, high land fragmentation and a predominance of subsistence and semi-subsistence farms (Sutcliffe et al., 2015). Such traditional farming systems are particularly valuable from a conservation point of view because they (still) support high levels of biodiversity and populations of many threatened species (Tryjanowski et al., 2011). Therefore, they are sometimes referred to as High Nature Value (HNV) farmland (Strohbach et al., 2015).

However, the existing CAP does not seem to promote HNV systems effectively, despite some targeted measures (Babai et al., 2015; Keenleyside et al., 2014; Martino and Muenzel, 2018). Several studies even suggest that the current models of CAP income support to farmers accelerate HNV abandonment (O'Rourke et al., 2016; Ribeiro et al., 2018), which may partly explain the recent biodiversity decline in this part of Europe (Reif and Vermouzek, 2019; Šumrada et al., 2021). Furthermore, there is still a considerable gap in the literature on what kind of policy instruments would be effective in maintaining HNV farmland or at least in supporting sustainable modern farming systems that would provide comparable biodiversity levels (Batáry et al., 2015; Catsadorakis, 2007; Fischer et al., 2012).

Our study aims to address this gap by exploring the potential of payment-by-result approaches in supporting the maintenance of HNV farmland in Central and Eastern Europe, and the potential obstacles to their development and implementation. For this purpose, we developed a pilot RBS for the conservation of dry grasslands in the Natura 2000 site Kras in Slovenia and thus assessed its suitability in a region, where this policy approach has not yet been established (Herzon et al., 2018). We use an interdisciplinary mixed methods approach (Kinnebrew et al., 2020) to address the following research goals:

(1) to develop a list of indicator species for the Natura 2000 habitat type Eastern sub- Mediterranean dry grasslands *(Scorzoneratalia villosae)* (62A0);
(2) to check local farmers' familiarity with the selected indicators and their preferences towards the RBSs;
(3) to discuss the prospects and limitations of RBSs in the HNV farmland with researchers, decision-makers and agricultural advisers.

2. Study area

The research was carried out in a Natura 2000 site – Kras (SI3000276, SI5000023), a 216 km^2 region in southwestern Slovenia located above the Gulf of Trieste in the northern Adriatic Sea (Fig. 1). We chose this study area because it represents a typical sub-Mediterranean

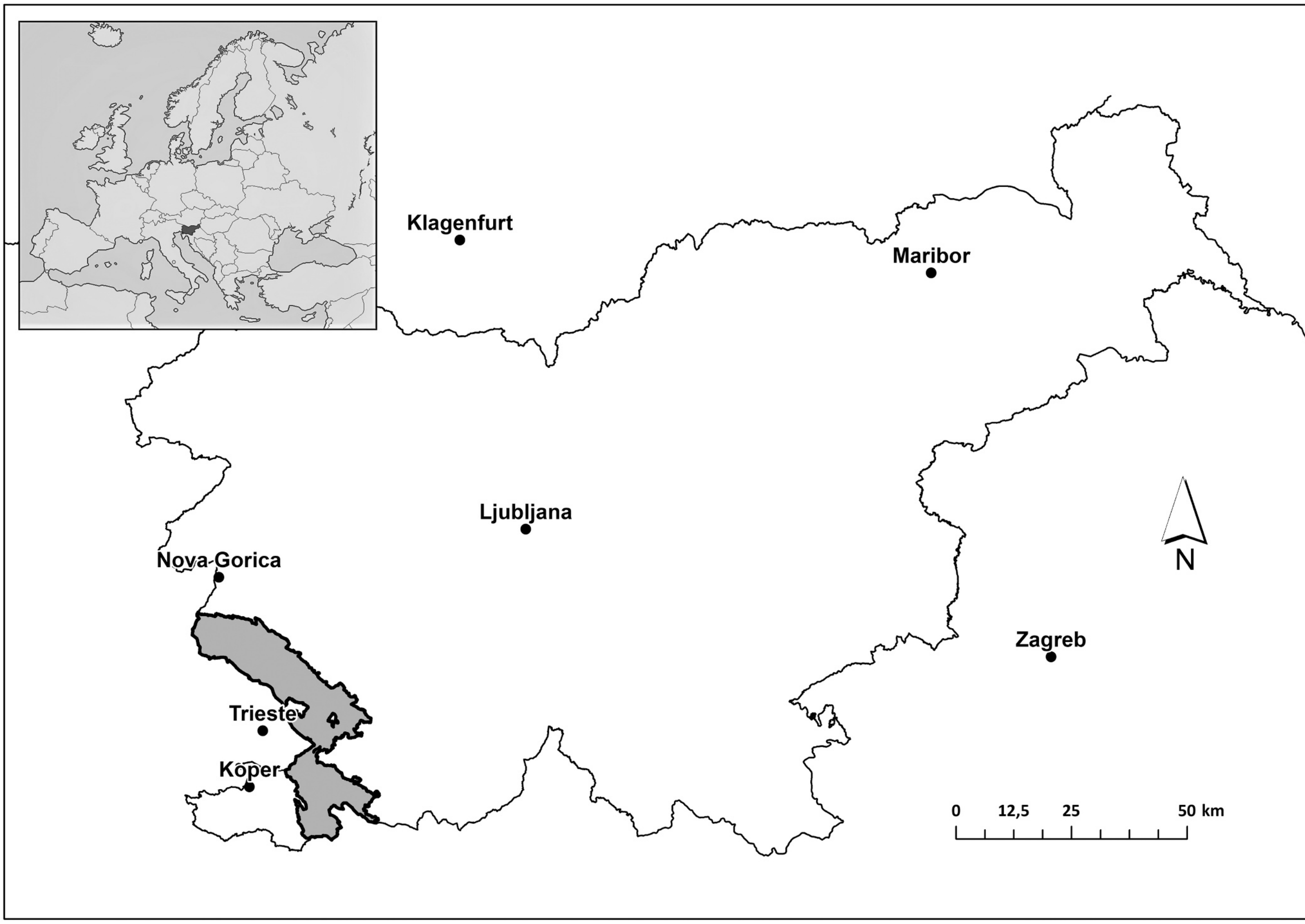

Fig. 1. Map of the study area (grey area) in Slovenia (source: Surveying and Mapping Authority of the Republic of Slovenia).

region with extensive grazing and mixed HNV farming systems that have led to the development of highly diverse grassland communities (Kaligarič et al., 2006). Furthermore, in recent decades, this area has been characterised by a widespread abandonment of farming (Kaligarič and Ivajnšič, 2014), similar to many remote regions in the Mediterranean and in Central and Eastern Europe (Kosić et al., 2012; Kuemmerle et al., 2008; Levers et al., 2018).

Kras is a low limestone plateau (200–500 m a. s. l.), characterised by distinctive topographic karst features (e.g., dolines, sinkholes, caves; Zorn et al., 2020) and sub-Mediterranean climate (Komac et al., 2020). High maximum temperatures with minimal precipitation in summer months (Kozjek et al., 2017), permeable carbonate bedrock and a strong north wind bora (Sln. *burja)* are key factors that determine the water and nutrient content of the soil and thus significantly affect its characteristics and type of vegetation (Fig. 2).

Natural forests covering Kras until a few centuries ago were similar to those that thrive in the high Dinaric karst in inner Slovenia today (Culiberg, 1999). However, due to intensive deforestation and sheep grazing, especially through nomadic pastoralism (transhumance), vegetation was almost completely degraded 200 years ago. In the middle of the 19th century, people began to reforest the bare karstic landscape with black pine *(Pinus nigra)* (Kladnik et al., 2008). In addition to the spontaneous spreading of its stands, the dry stony ground was initially most successfully overgrown with black hornbeam *(Ostrya carpinifolia),* which is not affected by fires, a common occurrence in this region (Culiberg, 1999). After World War II, natural overgrowth of abandoned agricultural land (Kladnik, 2011; Kladnik et al., 2008) has persisted until present day, when forests cover more than 60% of the region (Zorn et al., 2020).

Due to specific geological and climatic factors and distinctive historical land use, the current Kras landscape is a mosaic of rocks, grasslands, shrubs and mixed deciduous woodlands. From the aspect of nature conservation, the most prominent vegetation type in the study area is Eastern sub-Mediteranean dry grasslands (Natura 2000 habitat type 62A0; phytosociological order *Scorzoneratalia villosae),* protected under the EU Habitats Directive (Council Directive 92/43/EEC). It is known as one of the richest plant communities among grasslands (Kaligarič et al., 2006). The order is divided into two alliances, *Chrysopogono-Saturejon* Horvat & Horvatić 1934 and *Scorzonerion villosae* Horvatić 1963, based on their ecological distinctiveness reflected in different floristic composition (Kaligarič, 1997; Kaligarič and Škornik, 2002). The former alliance occurs on extensive semi-natural pastures and comprises sclerophyllous plants, whereas the latter is more mesophyllous and is thus usually connected to extensive unfertilised hay meadows (Kaligarič, 1997; Pipenbaher et al., 2011). The prevalent communities in the study area are *Carici humilis–Centaureetum rupestris* on shallow rocky soil with alkaline pH and dry conditions and *Danthonio–Scorzoneretum villosae* on deeper soil with lower pH, more humus and higher humidity. The adequate management for maintaining a favourable conservation status of both requires extensive mowing (only once a year) without the use of fertilisers (Vreš et al., 2019) or at most extensive grazing (by horses, sheep or goats) on shallow and skeletal soil.

Analysis of data from the Slovenian Integrated Administration and Control System (IACS) database shows that in 2019, 1045 farm holdings were registered in the study area, managing a total of 8677 ha of agricultural land, of which 89.2% were grasslands. Small farms predominated, with 52.3% of farm holdings managing less than 5 ha of

Fig. 2. An example of typical landscape (credits: Tatjana Čelik).

agricultural land and a further 26.0% between 5 and 10 ha. There were only 42 farm holdings (4.0%) larger than 50 ha. As part of the CAP, a voluntary, management-based scheme has been implemented in the study area since 2004 to stimulate extensive management of grasslands. The scheme restricts stocking density per farm holding to less than 1.5 livestock units per hectare and fertiliser input to less than 40 kg per hectare. Mowing and grazing are not allowed until the beginning of June (MAFF, 2015). However, only 1226 ha (15.8%) of grasslands were enroled in 2019.

3. Methods

3.1. Definition of indicator plant species

To develop a set of indicator plant species whose presence and abundance reflect the extensive use and favourable conservation status of the targeted grasslands, we used the vegetation surveys (ie. relevés) in the FloVegSi database (Fauna, Flora, Vegetation and Paleovegetation of Slovenia; Seliškar et al., 2003) of the Institute of Biology ZRC SAZU collected in the last two decades (mostly in the last ten years). We considered only the relevés for the two predominant communities in the study area, i.e. *Carici humilis–Centaureetum rupestris* (CC) and *Danthonio–Scorzoneretum villosae* (DS), which amounted to 84 and 22 relevés for CC and DS, respectively, and 442 plant species (the term "species" also includes infraspecific taxa). Vegetation relevés in the FloVegSi database were made according to the Braun-Blanquet method (Braun-Blanquet, 1964). Extraction of the positive indicator species was performed according to the following criteria:

(1) diagnostic species (character and differential sp.) of two communities and of the order *Scorzoneretalia villosae* (146 species);
(2) species of high conservation value/threatened species (National Red List, nationally protected species; 34 species);
(3) frequency of species occurrence;
(4) ease of recognition for potential users (i.e. farmers);
(5) equal number of positive indicators for both grasslands communities (i.e. CC and DS), treating orchids as special positive indicators (see below).

To determine the frequency of species occurrence in the study area, we used the Central European grid (CEG) for flora mapping with a basic unit (quadrants, qs.) size of 6.4 × 5.5 km (Ehrendorfer and Hamann, 1965). Within the study area, which covered 25 qs. of CEG, we specified five levels of species occurrence: (1) presence in 1–6 qs., (2) presence in 7–12 qs., (3) presence in 13–18 qs., (4) presence in 19–24 qs., (5) presence in all (25) qs. All selected positive indicator species were present in over 50% of quadrants, and ten out of twelve species in each group were present in over 75% of the study area, excluding orchids (Table A1). We included all orchids present in the study area.

Species were divided into three categories based on the difficulty of recognition (based on the experience of the botanists): very easy, easy, and difficult (Table A1). As very easy to determine we selected species that are unique in their habitus, not similar to others, and therefore not possible to be misidentified as other indicator species. Difficult-to-recognise species are likely to be confused with others. Easy to recognise species are an intermediate category between the previous two.

Based on the five criteria described above, we obtained 57 species. Several species of the same genus were pooled into one "species-group" for easier identification of the indicator species in the field by non-specialists. The selected indicator species were divided into the following three groups (Table A1):

(1) 12 indicators of extensive management and a favourable conservation status (FCS) of the CC community (i.e. positive indicators of target grasslands on shallow rocky soil);
(2) 12 indicators of extensive management and FCS of the DS community (i.e. positive indicators of target grasslands on deeper soil);
(3) 17 orchid species-groups as a special category of positive indicators (i.e. "super-positive indicators"), which indicates an exceptionally good state of biodiversity.

We also specified three groups of negative indicators, whose presence reflects potential changes in management intensity and quality, i.e. 4 invasive alien species, 12 species-groups for intensification and 12 for abandonment (Table A1).

We quantified the thresholds for result-based payment as a certain number of positive indicator species and their total coverage (i.e. a sum of the coverage of all positive indicator species) in the meadow. The threshold values for the number of positive indicator species were defined based on average, minimum and maximum number of species/relevé in the selected phytosociological relevés of both communities. Similarly, we specified the following threshold values for total coverage, considering the mean total coverage of species/relevé:

A. rare (up to 10% of meadow; mid-value = 5%);
B. sparse (10–30% of meadow; mid-value = 20%);
C. common (30–50% of meadow; mid-value = 40%);
D. very common (more than 50% of meadow; mid-value = 75%).

We proposed two-stepped indicators' and payment rates to reward higher management quality of target grasslands. The threshold value for basic payment was set to four positive indicator species present in the meadow, with total coverage at least of category B (20%). The second threshold indicated a higher degree of biodiversity and was defined at nine positive indicators with total coverage of at least 40% (category C). If farmers were to move down the indicator steps during their five-year contract, they would fall into a lower payment category, whereas if they dropped below the basic threshold value, they would no longer be eligible for payments.

Finally, we designed a leaflet with photographs of all indicator species (Appendix B) and plotted categories of coverage graphically based on their mid-value (Appendix C).

3.2. Interviews and focus groups with experts

We conducted semi-structured interviews and organised focus groups meetings to verify the opinions of various stakeholders and experts regarding the implementation of agri-environmental measures in Slovenia and the proposed result-based scheme (RBS).

Firstly, we interviewed five representatives of nature conservation authorities and research institutions in Slovenia. The interviewees were selected by purposive sampling of experts with experience in planning and implementation of AEM in Slovenia. The aim of the interviews was to garner expert opinions on the current agri-environmental policy and participation of farmers in the AEM as well as on RBSs. The interviews took place in May and June 2018, each lasting 75–120 min.

Next, we conducted five focus groups with public officials and researchers in biology, nature protection, agronomy and economics, and two focus groups with agricultural advisers. In the first two focus groups with researchers, we discussed the ecological, technological, and socio-economic reasons for biodiversity decline in Slovenia and the effectiveness of the current conservation approaches. The remaining focus groups were organised to discuss the potential of RBSs in Slovenia and in Kras in particular.

Focus groups (each with 5–9 participants) lasted for 90–170 min and were organised between November 2018 and February 2019. All conversations were recorded and transcribed, except in one focus group, where extensive notes were taken during the session.

3.3. Survey and interviews with farmers

Farmers' views on grassland conservation, HNV farming perspectives and agri-environmental schemes, and their knowledge of selected indicator species were analysed using quantitative and qualitative data. Data for statistical analysis was obtained through face-to-face interviews, which followed a structured four-part questionnaire: (1) questions on farm characteristics, (2) opinions on grassland conservation in Kras, previous experience with agri-environmental measures and decision-making processes on the farm, (3) views on RBSs and (4) socio-demographics. In the interviews, we also asked farmers, which positive indicator species, presented in the leaflet (Appendix B), they recognised. Before conducting the survey, we tested the questionnaire on a sample of 22 farmers. We encouraged farmers to provide in-depth explanations of their answers to the questionnaire whenever possible and these were then subjected to qualitative analysis. In addition, a summary of the interview experience was written down after each interview.

The population used for sampling included all farms included in the Register of Farm Holdings of the Slovenian Ministry of Agriculture, which means they were eligible for the CAP support. Furthermore, farms had to manage at least 0.3 ha of grasslands in the research area, as defined in the IACS database, and apply for agricultural subsidies in the Public Agricultural Advisory Service's main regional unit. There were approximately 650 such farms, i.e. 62% of all registered farm holdings in the Karst.

The face-to-face interviews took place in March and April 2019. All farmers in the sampling population were invited to participate in the survey. A total of 263 interviews were completed, representing 40.5% of farms in the sampling population and 25% of all Karst farms. Before the interview, each farmer was asked for permission to record the conversation, to which 188 respondents agreed. After the first listening, we selected 62 interviews from these recordings, in which the farmers gave the most in-depth answers and were, therefore, most suitable for qualitative analysis. These interviews were between 25 and 80 min long.

3.4. Sample characteristics

Both the survey sample and the sub-sample for qualitative analysis had comparable farm characteristics in terms of age and gender of farm holder and farm production orientation. However, on average, our sample contained somewhat bigger farms and a higher share of farms enroled in the AEM than the entire Karst farmer population (Table 1).

Almost all respondents in the survey were engaged in agriculture since childhood (87.9%). Most had completed only secondary education (64.3%) and had no formal education in agriculture (66.9%). In most households (72.2%), income from agriculture and forestry accounted for less than 25% of annual income, whereas only 10.6% received (including subsidies) more than half of the income from agriculture. The surveyed farms were predominantly mixed, i.e. 35.7% had mixed plant production or only mowed grasslands and 30.4% mixed livestock and plant production. Among specialised producers, winegrowers predominated (17.9%), whereas some farms were specialised cattle (9.1%) and sheep breeders (3.4%). There were 20.5% subsistence farms, while the remaining farms sold part (28.9%) or most (50.6%) of their crops and livestock. Most farms managed land which was entirely in their ownership (55.5%), whereas 20.9% of farms leased over 50% of managed land. The majority of respondents or their heirs (70.0%) planned to maintain the farm's current size in the next ten years, while 16.7% planned to increase its size. Some respondents (10.6%) would abandon livestock farming, and 3.8% expected to abandon farming altogether.

Table 1
Characteristics of the interviewed farmers and their farms and comparison to the whole Karst farmer population in 2019 (AEM – agri-environmental measure, HAB – management-based scheme for grassland conservation).

	Population (N = 1045)				Survey sample (n = 263)				Qualitative sub-sample (n = 62)			
	%	Mean	SD	Range	%	Mean	SD	Range	%	Mean	SD	Range
Farm size [ha]		10.6	20.51	0.5–271.7		17.2	36.23	1.0–271.7		31.8	55.75	1.5–271.7
- grasslands [ha]		7.4	17.89	0.0–252.9		14.6	30.96	0.3–252.9		28.4	51.12	0.3–252.9
Livestock or mixed farm	53.4				48.7				53.3			
Age of farm holder [yrs]		60.7	14.44	21–95		60.2	14.09	26–95		59.6	15.17	30–95
Gender - male	71.5				68.8				73.3			
Currently in AEM	22.5				41.4				45.0			
Currently in HAB	13.6				23.6				18.3			

3.5. *Data analyses*

Statistical analysis of the farmer survey data included chi-square independence test for categorical variables and the Spearman rank correlation coefficients for measuring correlations. We used *t*-test and ANOVA to compare means and the Bonferroni test for post-hoc multiple-comparisons. We checked for variance homogeneity with the Bartlett's test. The Kruskal-Wallis H test was used as a non-parametrical alternative with the Dunn's test for post-hoc multiple comparisons. To evaluate the recognition of indicator species, we applied the Jonckheere-Terpstra test. This way, we tried to determine whether the difficulty of species recognition and frequency of occurrence of each species in the study area, which were assessed by the experts (see Section 3.1), affected the frequency of recognising those species by farmers. Statistical analysis was performed in STATA (StataCorp, version 16.1) and SPSS (IBM Statistics, version 22). We assumed a significance level of 0.05 in all tests.

Thematic data analysis was used for qualitative analyses (Braun and Clarke, 2006), where codes were developed inductively during the transcription process and over several rounds of reading and listening to the interviews. In this way, we identified and categorised key themes. In the farmer interviews, categories included views on RBSs, indicator species, HNV farming system, motivation to maintain HNV grasslands and previous experience with AEMs. Next, we analysed the patterns, relationships and content links within and between individual themes. A similar process was used in the case of focus groups and interviews with experts. The main categories for analysis were the views on RBS introduction and its suitability in different regions, institutional support to RBS development and approaches to HNV farmland conservation. Both analyses were performed with ATLAS.ti software (Cleverbridge, version 8.4).

4. Results and discussion

Based on the analysis of current result-based schemes (RBSs) in Europe, Herzon et al. (2018) suggested that their effective design requires a clear definition of environmental objectives, the identification of suitable indicators and a favourable socio-economic context. The latter should be reflected in a culture of accountability and trust between stakeholders, a stimulating environment for innovation and risk-taking, and sufficient capacity of authorities in terms of trained staff and knowledge of the local ecological and socio-economic circumstances. We developed a pilot RBS to test whether these conditions were fulfilled in a typical sub-Mediterranean High Nature Value (HNV) farming system in Kras and, therefore, assessed the feasibility of the RBS introduction in similar regions.

4.1. *Most farmers preferred the payment-by-results approach*

After the detailed presentation of both possible alternatives, half of the surveyed farmers would choose the RBS (49.1%) to incentivise extensive use of dry grasslands, 38.0% preferred the MBS and 12.9% said that they would not enrol in the scheme regardless of its design. This result indicates a high preference for RBS, which was also found in previous studies across Europe (Birge et al., 2017; Schroeder et al., 2013; Wezel et al., 2018).

When further inquired on their preferred type of monitoring, 39.5% of farmers chose a "pure" result-based scheme, where only the presence of indicator plant species would be monitored. Interestingly, 32.3% chose a mixed monitoring system in which the result-based monitoring could be supplemented by voluntary keeping of records of implemented farming practices. The present system, where the implementation of prescribed practices translates to monitoring through records and thus mandatory record-keeping, was preferred by only 16.7% of respondents. Qualitative analysis (Table 2) showed that, for most farmers, the primary concern regarding result-based monitoring was fear of losing payments if the situation on their grasslands deteriorated, while others thought that they might not have enough knowledge of the suitable farming practices.

Consistent with results elsewhere (Birge et al., 2017; Matzdorf and Lorenz, 2010; Wezel et al., 2018), risk preferences pertaining to the monitoring system were thus among the key factors explaining farmers' potential opposition to payment-by-result schemes. However, almost a third of surveyed farmers preferred to combine result-based monitoring with a possibility to prove the implementation of recommended practices. We believe that such a mixed monitoring system might be well-received among more risk-averse farmers, who are not (yet) ready to accept "pure" result-based monitoring. However, since most participating farmers in the established RBSs seem to perceive the risks of achieving results as relatively low (e.g. Russi et al., 2016), such system might only be needed in the first years of implementation. A mixed monitoring system might also be used during the transition period for many farmers who are already enroled in the existing AEM for grassland conservation. Statistical analysis showed that these farmers were more likely to prefer the MBS, while those who knew the measure but did not decide to enrol were more likely to opt for the RBS (χ^2 (4) = 26.33, $p < 0.001$).

Farmers saw the greatest advantage of the RBS in its greater flexibility (Table 2). However, this flexibility was not understood as a choice between different farming alternatives (Russi et al., 2016), but rather as a possibility for minor adjustments to established management practice. For example, farmers pointed out that it is hard for them to accept the prescribed date of mowing because it constrains their ability to adapt to weather conditions. The fixed date also hampers the rotation of grazing between pastures, which is required due to hot summers. Furthermore, greater flexibility would enable easier adaptation of management to different soil types and micro-climatic conditions (Chang et al., 2017). In this context, farmers described the differences between the eastern part of the research area, which has somewhat different vegetation types, and the (south)western part, which is closer to the sea.

Farmers' motivation to enrol in RBSs is often connected to their current production system. In Germany, participating farmers most often managed farms that could not be intensified due to their natural and structural characteristics, so their land and farming methods easily met the scheme's requirements. A second group of farmers participating

Table 2
Farmer views on the advantages and risks of the result-based scheme (n = 62).

	No. of farmers	Example of quotes
Advantages		
Flexibility of management	18	*"There is actually more freedom here, more choice. I wanted to enter the current scheme, but because of the grazing regime I use on that big pasture where I rotate livestock as needed, those* [prescribed] *dates don't work for me."* (interview 13)
Better adaptation to local conditions	11	*"Even on our farm, where we mow 15 or so meadows, I see that each has its own specific characteristics. If the meadow is located closer to woodland, it should be managed in a slightly different way than the one that is located more in the open."* (interview 61)
Less administrative burden	11	*"The way this measure's been organised so far, there's a lot of bureaucracy and this takes up our energy and time. /…/ So if it's possible to only check the situation on the meadow, this solution would be much better from my point of view."* (interview 12)
Payment system is fairer	10	*"Yes, because if the plants are present, then they are present. Otherwise, you are not eligible."* (interview 10)
More freedom of choice	7	*"Just pay the man. pay him well, and the farmer will make a good decision for himself. This cannot be done centrally and administratively."* (interview 11)
Goal of the measure is easier to understand	4	*"If we focus on intensive production, then we look at marketability, but if you want to preserve habitats and these plants, then you should look at this* [presence of indicators]." (interview 8)
Opportunity to learn and innovate	3	*"This way, you can see if you are managing in the right way or not. You have more freedom, and then you can say that this is an example of how we could preserve* [these grasslands]." (interview 13)
Risks		
Farmer not able to prove the presence of indicators due to weather conditions	16	*"The seasons are also a problem. This year, for example, the vegetation has come at least two or three weeks earlier. So these plants will probably all bloom sooner, too."* (interview 60)
Fear of fraud	9	*"I think it is important that* [there are prescribed practices] *otherwise there would be chaos and everyone would do as they pleased. Farmers have difficulty complying with rules as it is, but in the case of* [RBS] *they would absolutely not follow* [recommendations]." (interview 14)
Penalisation due to unclear rules on eligibility	5	*"This* [past negative experience with AEM] *was basically the government's fault because they didn't clearly state the terms of what goes into the measure. But we got the short end of the stick."* (interview 60)
Fear of bureaucracy	4	*"Whatever they come up with, they always complicate it. Completely."* (interview 10)
Insufficient knowledge of farming practices	3	*"If you know what* [the scheme] *is about, then you don't need any prescribed practices. But because we don't know, I think it's better that there are some rules. /…/ Prescribed practices are there to help you. Until these measures came along, we didn't know that mowing after 1st of June is important for these* [species]. *We thought it was better to mow as early as possible."* (interview 48)

in such schemes were those for whom it was (also) meaningful due to their positive attitude towards the environment (Russi et al., 2016). In countries where successful RBSs have been in place for many years, another motive for farmers to participate can also be the desire for a positive image in the local community (Fleury et al., 2015). On the other hand, production-oriented and intensive livestock farms rarely participate in such measures (Russi et al., 2016).

In our study, support for the RBS could be found across the board as farmers' preferences for RBS could not be explained by their farms' structural and production characteristics nor by attitude towards biodiversity conservation or socio-demographics (Table A2). However, natural limitations in the research area largely prevent the emergence of intensive farms, so the results in other regions, particularly lowlands, might be different, because farmers have a broader choice of management practices (cf. Vainio et al., 2019).

4.2. Identified plant indicators are well-known among local farmers

In the RBSs, farmers are expected to implement agricultural practices that will provide conservation results, so they should possess sufficient knowledge and understanding of the required indicators (Herzon et al., 2018). Indicators should be consistent with ecological goals, easily monitored and adopted by both farmers and the authorities. Furthermore, the achievement of conservation outcomes should be closely linked to farmer's management efforts (Burton and Schwarz, 2013; Matzdorf et al., 2008).

The list of plant indicators in our study seems to be adequate in terms of ease of species recognition. In the identification exercise for 40 positive indicator species (including orchids), respondents identified 14.6 indicators on average (SD = 7.71), i.e. 36.5% (Fig. 3). Only one farmer did not recognise any species from the leaflet. Almost all respondents (95.4%) were able to roughly assess which of their parcels were covered by the indicator species. According to their estimates, this included 69.7% (2679 ha) of grasslands managed by their farms, i.e. 10.67 ha on average (SD = 24.49, range 0–206).

We found a significant trend of higher frequency of recognition for species, which were considered easily recognisable by the authors ($T_{JT} = 117.0$, $z = -3.406$, $p < 0.01$). Furthermore, the frequency of recognition increased proportionally to the level of species' occurrence in the study area ($T_{JT} = 474.0$, $z = 4.164$, $p < 0.001$). We assume that only two species-groups among the positive indicators (excluding orchids) could be confused with other plant species. The species-group *Ranunculus bulbosus/R. illyricus* (positive indicator for deeper soil), which was identified by as many as 72% of the farmers, could potentially be confused with other species of this genus, e.g. negative indicators from the species-group *Ranunculus acris/R. repens.* The danger of confusion with negative indicators (e.g. *Taraxacum* spp.) also exists for the species-group *Scorzonera austriaca/S. villosa* (a positive indicator of deeper soil), which was identified by 26% of farmers.

Therefore, although farmers probably made some mistakes while identifying indicators, our results indicate that a large majority of local farmers could easily recognise at least the minimum required number of plant indicators on their grasslands. Nevertheless, additional training would probably still be needed. Farmers may also have been overly optimistic in identifying suitable grasslands, but we could not verify their estimates due to the lack of data. However, experience from the established schemes shows that once farmers get used to the system, the level of error is relatively low (Matzdorf and Lorenz, 2010; O'Rourke and Finn, 2020).

In the qualitative analysis, we investigated how farmers recognised and estimated the incidence of plant indicators. Most farmers knew how different farming practices affect the presence of indicators, especially in terms of intensification. In addition to fertilisation and changes in mowing regimes, they also pointed out overgrazing, which can occur due to inadequate grazing regimes. When describing the plants, the interviewees most often associated them with management and soil type.

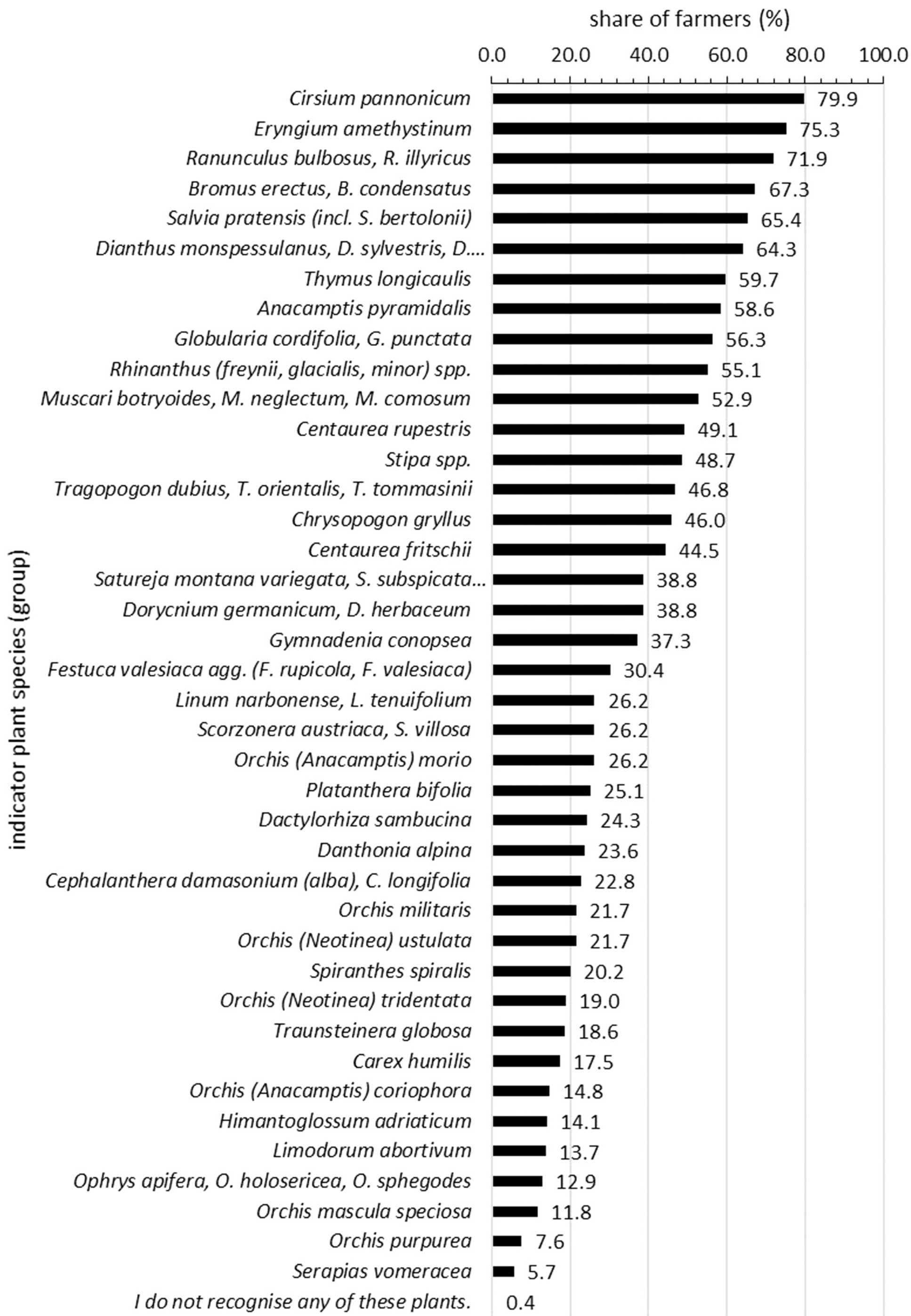

Fig. 3. Recognition of positive indicator plant species for Eastern sub-Mediterranean dry grasslands (order *Scorzoneratalia villosae)* (n = 263).

"This [points at the indicator species, *Carex humilis*] is plentiful on pastures, but not on meadows. It is low, so it does not grow as much in height. It is one of the first to start growing on pastures in early spring. Later, when mowing, I can rarely see it, because it is already overgrown with grasses. Then this [points at the next indicator species, *Stipa* spp.], I have a lot of these on my pastures, but I don't have them on meadows." (farmer interview 62)

Flowering or seeding of some species was often described as a traditional sign to start mowing. Certain plants also have a unique cultural or aesthetic value for farmers in Kras due to their ornamental value and use in local customs. Finally, some farmers highlighted ecosystem services that these plant species provide, most notably as medicinal herbs and forage for bees and wild pollinators (cf. Vitasović Kosić et al., 2017). It is important to note that the respondents often described plant species using their local names, which is relevant for communication and advisory support. Interestingly, those who were employed at public agricultural services and authorities recognised only a few more indicators than other farmers ($t = -1.81$, $p = 0.071$), whereas education ($F_{(260,2)} = 0.82$, $p = 0.440$) and age ($r_s = -0.009$, $p = 0.888$) had no statistically significant impact. Women recognised more indicators than men ($t = -6.27$, $p < 0.001$).

4.3. *Lack of institutional capacity for RBS implementation*

In principle, all interviewed experts and public officials were in favour of introducing RBSs. However, focus group discussions revealed several challenges to their large-scale implementation related to limited institutional capacity.

4.3.1. Data and research

Poor spatial targeting of measures was highlighted as one of the existing AEM's critical weaknesses in Slovenia, which is also supported in the literature (Kaligarič et al., 2019). This was attributed mainly to the lack of spatial data on species and habitat distribution, which are needed to determine eligible areas. For example, some Natura 2000 sites have not yet been subject to detailed mapping of habitat types, and many have only been mapped once, sometimes a decade or more ago (Court of Audit RS, 2017). The farmland outside the Natura 2000 network is even less researched. A similar lack of monitoring and ecological data for detailed planning of conservation measures, often due to limited financial resources, is evident in many EU Member States, particularly in Central, Eastern and Southern Europe (Fenu et al., 2017; Sutcliffe et al., 2015). In addition, a lack of biologists and volunteers trained for data collection on biodiversity was highlighted for all taxonomic groups except birds.

The interviewed experts saw RBSs as an interesting approach in this regard because farmers could also be included in selecting eligible meadows (cf. Burton and Schwarz, 2013). However, leaving these decisions and responsibility to farmers alone without the active involvement of qualified supervisors and data support might lead to errors, for which farmers would then be penalised through discontinuation of payments. Furthermore, such a system could discourage risk-averse farmers from participating (Burton and Schwarz, 2013). Therefore, experts in focus groups suggested that a lack of resources and data could be effectively overcome by means of sequential mapping of farmland habitats with which each target Natura 2000 site in Slovenia would be mapped at least once per EU programming period, i.e. every seven years. If conducted with a standardised methodology for habitat monitoring, data could then also be used for RBS implementation and evaluation.

Another issue that arose was the knowledge of suitable conservation practices. Both researchers and local agricultural advisors pointed out that economic and production changes in agriculture have been leading to the gradual abandonment of small farms and traditional farming systems. However, it has not yet been sufficiently researched what kind of management is necessary for keeping the individual grassland types in favourable conservation status (cf. Babai and Molnár, 2014). This knowledge is valuable because the present state of grasslands is usually a product of several centuries of traditional management and might exhibit long lag times in responding to some management changes (Helm et al., 2006). The knowledge gap was even larger in terms of what management regimes and economic models would be suitable for the new, larger livestock farms that are expected to farm much of the remaining Karst farmland in the future.

> "Basically, we don't even know how to maintain these grasslands to make them appropriate for biologists, agronomists and farmers. We should make some sort of experiment, where we would test different grazing and management regimes, and only then could we say, okay, this is appropriate and this is inappropriate." (focus group with agricultural advisors 2)

4.3.2. Monitoring agency and advisory support

Both researchers and agricultural advisors estimated that neither the monitoring authorities nor the public agricultural advisory service is currently adequately equipped with the knowledge required to verify plant indicators and offer advice to farmers. This finding applies to the national monitoring authority as well as to other organisations that could potentially be recruited to operate at the local level, as is often the case with RBSs (e.g. O'Rourke and Finn, 2020). In some areas, including Kras, it might be possible to involve protected area administrations, but these are often understaffed to implement such tasks. Therefore, the introduction of RBSs would probably only be feasible in a few pilot areas in Slovenia, while implementation on a large scale would require a longer period of systematic recruitment and training of staff.

At present, the farm advisory service in Slovenia is organised as a public service, and is, in most part, available to farmers free of charge or for a small fee. The great majority of farmers are in personal contact with their local advisor at least once a year, when they come to submit their annual application for CAP payments. In addition, specialised advice is offered and several educational events on various topics are organised yearly at the local level. Still, researchers felt that advisory support to farmers in the field of agri-environment and biodiversity conservation should be strengthened. Furthermore, the current system of knowledge transfer within the AEMs was assessed to be insufficient and in need of reform. Farmers who enter AEM are obliged to attend annual lectures, which were described as too long, too standardised due to the ministry's requirements and insufficiently motivating – a sentiment strongly echoed by agricultural advisors and farmers, as well.

> "In these lectures, the AEMs aiming at biodiversity conservation were presented as well. /…/ Maybe it was also poorly organised because three-quarters of that four-hour lecture was all other stuff, and then maybe in the last 20 min, this content came along. /…/ Also the approach itself … I think it would be better if these things were presented by experts who know these topics well and deal with them in the field. /…/ They dully recited the slides and that was it." (interview with researcher 3)

It was suggested that the reformed knowledge transfer system should be based on working with farmers individually or in small groups and that training should take place in the field whenever possible to demonstrate best practices (e.g. O'Rourke and Finn, 2020). Furthermore, improved knowledge transfer was also recognised as necessary to change farmers' attitudes towards biodiversity conservation, since such changes take place very slowly (cf. Cusworth, 2020).

> "A: In the end, the farmers would be a little more [educated] as well. If they knew these plants were important. they would look at things differently. They would become more aware of nature conservation than they are now because most farmers now /…/ they basically look at nature in the way of maximum efficiency whereas they don't care much about other things. However, if farmers were educated to know the importance of these plants, they would also have a slightly different attitude towards the environment.
>
> Q: So if there are prescribed practices, there is basically no connection to why we are doing this?
>
> A: Of course. If they looked [for the plants] themselves and we showed them in the field [during training] … but I see that this transfer of knowledge is going very slowly. These subsidies started in 2004, some even earlier, in 2000, and it is still the same. It goes slowly, slowly. It has been 20 years, but some [farmers] still ask for an explanation when you say 'agri-environmental measure'." (interview with agricultural advisor)

Based on the positive experience from various conservation projects in recent years, several experts suggested that knowledge transfer could be improved by strengthening cooperation between nature conservation organisations and the agricultural advisory service. Such connections might be particularly important because it was often evident from the conversations that – similarly to farmers – many local advisors have not really adopted the idea that AEM support to grassland maintenance is primarily aimed at biodiversity conservation. Instead, a higher value was placed on prevention of overgrowth and to fodder production. Thus, the landscape was still mostly valued based on its potential for food production (cf. Włodarczyk-Marciniak et al., 2020).

4.3.3. Institutional environment

Both researchers and advisors believed that the introduction of RBSs in Slovenia would be a long and complex process. In particular, they doubted that nature conservation and agricultural authorities would be sufficiently motivated to develop measures ambitious enough to ensure a favourable conservation status of grasslands. Many also expressed concern that the outcome would be too bureaucratic, in part because of the government's fear that farmers would abuse the system.

> "This distrust of ours bothers me immensely because I think it makes it extremely difficult for us [in Slovenia] to make the whole system more effective. /…/ The key problem here will be on the side of the authorities, i.e. if they are willing to believe that this [result-based] system is adequate as far as control is concerned." (focus group with researchers 5)

Distrust in RBSs, particularly by the monitoring authorities, has been noted many times in countries with little or no experience with payment-by-results approaches (e.g. Birge et al., 2017), so one solution would be to increase communication and dissemination of best practices (Herzon et al., 2018). It is evident that several recent initiatives to promote RBSs in Europe (e.g. Allen et al., 2014), including high-level events hosted by the EU institutions, have begun to bear fruit in Slovenia. Most researchers, public officials and agricultural advisors had already known the payment-by-results approach, although they often asked for clarifications on different aspects of the schemes' design during the focus groups, such as monitoring and selection of indicators. However, since our study mostly included researchers and officials responsible for biodiversity conservation, the level of awareness among other experts and officials might still be relatively low, so further investment in communication at the EU and national level is needed.

However, the reasons for mistrust between actors and anticipation that national administration may not be able to develop effective locally-based and flexible schemes go beyond the problem of insufficient knowledge on RBSs. In many post-socialist countries, nature conservation and rural development authorities have historically had insufficient capacities and experience to operate at the local level and to lead a participative and knowledge-based policy-making process that would include a diverse set of actors, including those outside the traditional set of agricultural stakeholders (Gorton et al., 2009; Kluvánková-Oravská et al., 2009; Kowalczewska et al., 2018). Consequently, the integration of biodiversity and agricultural policy has been slow both at the strategic level (Šumrada et al., 2020) and on the ground, where the inability to achieve sustainable rural development is perhaps most evident in protected areas (Farkas and Kovács, 2021; Rac et al., 2020).

Furthermore, much of the discourse in the agricultural institutional environment is still connected to food production and self-sufficiency, so nature conservation is often seen as a threat to the achievement of production and economic goals. In our study, it was often evident that biodiversity conservation was not well-adopted by agricultural institutions, since many officials and agricultural advisors perceived it as something external to agriculture, often envoking the production-oriented maxim that "*agriculture should primarily produce food, not flowers and butterflies"* (focus group with agricultural advisors 2). Thus, nature conservation policy was seen more as an imposed (and somewhat irrational, unrealistic and even fanciful) requirement, than a developmental solution for HNV farmland (cf. Grodzinska-Jurczak and Cent, 2011).

Compared to Western and Northern Europe, agriculture in this part of Europe is still developing, marked by lagging productivity, value-added and organisation of supply chains (Bojnec and Latruffe, 2013; Rac et al., 2020). Thus, it is understandable that any restriction on production, which is often associated with nature conservation, is accepted negatively. However, due to natural constraints and high land fragmentation that hamper the development of more productive agriculture, it seems that no feasible alternatives for rural development in Kras and similar HNV regions have been developed, either. Therefore, some experts felt that any intervention preventing overgrowth, even if justified with biodiversity conservation, would be welcome.

> "Well, that's the point of this story. These are regions that are actually on their way to being totally lost, so whatever you do on them is actually positive for the agricultural sector." (focus group with researchers 5)

4.4. AEMs do not address some fundamental reasons for HNV abandonment

The effectiveness of the payment-by-results approach should also be assessed in a broader socio-economic context of HNV farming systems (McGinlay et al., 2017). In particular, we tried to explore whether the RBSs can successfully address the specific needs of small farms, representing the majority of the current farm structure in Kras, and the rapid abandonment of HNV grasslands (Kaligarič and Ivajnšič, 2014).

4.4.1. Small farmers

Due to a lack of successor, advanced farmholder age or other socio-economic factors, many small farms in Kras are in a slow process of abandonment, which first manifests itself in the cessation of livestock rearing and investments in farm development. Farmers explained they now lease much of their land to neighbours and have often already completely abandoned using more remote or less productive land. However, some were ready to continue mowing their grasslands for as long as they are physically able, usually to keep the family tradition and prevent overgrowth.

> "To be frank, we are 'cleaners' now. We preserve the landscape so that it does not [disappear]. Karst has already overgrown a lot. In the village where I live, livestock used to be quite common, but now no one rears animals. One neighbour has 15 sheep. But 15 sheep, you know … you should have 200 to make this look like something. So that is why I decided to keep going." (farmer interview 8)

The activity of small farmers is thus still essential for maintaining HNV grasslands, although their numbers are likely to decline further in the coming years. Moreover, due to the traditional farming methods, their meadows are often among the best-preserved in the region from a conservational point of view (Erjavec, 2019).

Although it would usually not require any change to their current management practice, small farms in Kras were on average less likely to adopt the current MBS for grassland conservation ($F_{(260,2)} = 5.62$, $p < 0.01$). Many justified their decision with negative experience with AEMs or were afraid they might not be able to keep their contracts due to their advanced age and potential health deterioration. Furthermore, they felt their obligations were disproportionate to the payment they received in the AEMs because the compulsory training sessions and much of the transaction costs are the same for all farms no matter their size.

> "There are many very small farms in Slovenia. Some have only one hectare of meadows or half a hectare – they are here in Kras as well. But we have to keep records as if we were … if I have two cows in the barn, I have to keep the records as if I had 30 or 50 or 100 /…/ Okay, [livestock evidence] has to be. I understand that. But I will not go to a lecture somewhere far away for [AEM payment I receive for] two cows. /…/ Many decided not to enrol in [the AEM], because they than have all this administration and records and controls." (farmer interview 19)

Our study indicates that RBSs could potentially attract many small farms (see Section 4.2). However, as the payment would still be area-based, they believed that disproportionally high transaction costs per payment received would not significantly improve in the RBS, despite the potentially lower administrative burden. Thus, it is not surprising that farmers, who indicated that they would not enrol in the AEM no matter the scheme's design, were on average older than other respondents and managed smaller farms (Table A2).

The EU's Common Agricultural Policy direct payments and rural development measures are often criticised as poorly adapted to small and semi-subsistence farms (Davidova, 2011; Sutcliffe et al., 2015; Thomson, 2014). Based on our results, we argue that RBSs might not be considerably better equipped to address this issue either. Instead, an administratively simplified scheme for small farmers, which integrates farm income support and management payments for HNV farming systems or Natura 2000 sites might be a more appropriate policy instrument in the HNV farmland with a high share of small farmers (Dwyer, 2014; Peters and Gregory, 2014). To some extent, the issue of administrative costs within the AEM could partly also be mitigated by offering a flat rate payment for certain costs rather than them being proportionate to the area enroled.

In addition, smaller farmers in Kras felt they were less familiar with different CAP policy instruments ($r_s = 0.256$, $p < 0.001$) and sometimes complained that they had less interaction with agricultural advisers than their peers with larger and more professional farms (cf. Vesterager and Lindegaard, 2012; Wilson, 1997). Nevertheless, when they make decisions on whether to enrol in the AEMs, smaller farmers valued their local advisor's recommendations higher than other respondents ($t = 2.32$, $p < 0.05$). A targeted voluntary and individually-based advisory service for small farmers should thus also be considered (Dwyer, 2014).

4.4.2. Access to land

Access to a sufficient amount of land and the consequent achievement of adequate farm income seemed to be among the crucial drawbacks to the further development of larger, economically viable farms in Kras. The study area is characterised by high land fragmentation, with numerous land owners who are no longer engaged in agriculture or have moved abroad or to urban centres (Buzan and Pallavicini, 2014). Another problem is a relatively slow structural change because of some people's attachment to land, so it is sometimes hard for other farmers to convince them to sell or lease their land.

> "You have, say, 100 owners per hectare. Find them if you can. The land is fragmented. For example, I have [rented my land] from the municipality, because the agrarian community, where I have pastures, gave [about 120 ha] to the municipality. /…/ My brother [rented land] from two agrarian communities. Then one of our neighbours, again, [rented land] from an agrarian community from the fourth village. It's a big space and you get along [with the owners]. If they are interested, it will go fast. Everything else is privately owned and to get that ... No. You could never put it together." (farmer interview 62)

Access to land thus represents one of the key reasons for HNV abandonment in Kras and similar regions in post-socialist countries with fragmented farm structure, e.g. Western Balkan countries and Poland (Hartvigsen, 2014). Updating the land register and introducing policy instruments that would facilitate reactivation of agricultural use on the abandoned land, or even land reform, are thus arguably a necessary way forward. However, this task clearly exceeds the usual scope of biodiversity conservation and agri-environmental policy.

Large-scale structural changes in agriculture have often been linked with intensification of land use and increased field sizes (Tryjanowski et al., 2011). Furthermore, land consolidation projects may lead to removal of landscape features and biodiversity loss due to landscape homogenisation (Clough et al., 2020; Denac and Kmecl, 2021). Care should also be taken to consider the social implications of such policies. Many small farms in the study area are still active (see the section above), and while for some farming may be a lifestyle preference, these farms can also represent an important income source to some, particularly socially disadvantaged, rural households (Davidova et al., 2012; Szumelda, 2019).

Obviously, no policy programme or project can single-handedly deal with all the described issues. Nevertheless, better integration of nature conservation and different rural policies is needed to prevent HNV abandonment and promote biodiversity-friendly farming models. This would require a strategic and holistic approach to development on HNV farmland in remote rural areas, in which AEMs would be but one of the necessary instruments (Fischer et al., 2012; Roose et al., 2019).

5. Conclusions

Over the last two decades, various new designs of agri-environmental measures have been tested in European and other countries to improve their effectiveness and efficiency in achieving environmental goals (Herzon et al., 2018; OECD, 2013, 2010). Measures that have so far mostly been based on the implementation of prescribed management practices are thus evolving into more results-oriented and targeted schemes, which has also been encouraged by the European Commission (2020). Among these new policy approaches, result-based schemes (RBSs), where payments are directly related to the achievement of environmental outcomes, have been among the most researched and implemented instruments with promising results in biodiversity conservation (Fleury et al., 2015; O'Rourke and Finn, 2020; Russi et al., 2016).

Our study explored the attitudes of farmers in a typical sub-Mediterranean High Nature Value (HNV) farming system towards RBSs for grassland conservation and its results show that they would generally prefer RBSs to existing management-based schemes (MBSs). The introduction of RBSs, where applicable, was also supported by most interviewed researchers, agricultural advisors and public officials. However, our case study indicates that large-scale implementation of RBSs in Slovenia, and potentially also in other countries in the region with a similar history and socio-economic situation, would require a significant increase in the capacity of national and local institutions for knowledge transfer, monitoring and collection of data on biodiversity. To address these issues, we argue that decision-makers should systematically invest in closing the existing data and research gaps as well as in increasing the capacity of key institutions to address biodiversity conservation issues. Within the EU, these efforts could be supported by increasing the share of the CAP resources for technical assistance and by supporting the biodiversity projects within the instruments, such as the European innovation Partnership (EIPs). Other EU structural funds and the LIFE programme can be utilised as well (Kettunen et al., 2017). These instruments can be used to supplement national budgets and might be particularly valuable in the regions of high conservation priority and with substantial knowledge gaps (Hermoso et al., 2017; Orlikowska et al., 2016; Sutcliffe et al., 2015). In addition, research initiatives that develop EU-wide and regional databases and monitoring guidelines, provide knowledge sharing and pilot new measures in several Member States should be promoted.

Despite their advantages, RBSs alone do not seem to be considerably better suited than the current MBSs to address some of the critical challenges facing HNV farmland, particularly the specific needs of small and (semi-)subsistence farmers (Davidova, 2011) and access to land in areas with highly fragmented land ownership (Hartvigsen, 2014). Therefore, although the payment-by-results approach would probably often represent a superior policy alternative to MBSs (Herzon et al., 2018), its introduction might still not be enough to ensure successful conservation of HNV grasslands and farming systems in the remote rural areas.

Based on our results, we argue that future research should primarily address the development of sustainable farming models for HNV grasslands that could achieve both nature conservation objectives and adequate farm incomes (Dengler et al., 2014; Roose et al., 2019).

Examples include low intensity, transhumant pastoralism and extensive silvopastoral systems (Kerven and Behnke, 2011), where farms are well connected and integrated in order to increase value-added of products and to improve market valorisation of the ecosystem services provided, e.g. through tourism and collective marketing of products (Rac et al., 2020). These new approaches might need to be quite innovative and designed to revitalise mosaic and extensive grassland management at the landscape level, particularly in areas where it is difficult to recruit enough farmers due to negative demographic trends and the inability to establish economically viable grassland management (McGinlay et al., 2017). Result-based schemes can play an important role here both by promoting more result-oriented planning of policy instruments and by linking payments directly to conservation outcomes (Herzon et al., 2018).

Finally, our results indicate that the understanding of agroecology and the importance of biodiversity policy integration are still lagging in public authorities, research institutions and the knowledge transfer system, which is likely manifesting in a lack of institutional, research and data support to developing innovative conservation policy instruments. This institutional gap is often underestimated by decision makers at the EU and national levels (Kowalczewska et al., 2018), but without bridging it, there is unlikely to be a rapid change in this European region of still-high, but rapidly declining biodiversity (Sutcliffe et al., 2015).

CRediT authorship contribution statement

Tanja Šumrada: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Branko Vreš:** Methodology, Writing – original draft, Writing – review & editing. **Tatjana Čelik:** Methodology, Writing – original draft, Formal analysis, Writing – review & editing. **Urban Šilc:** Methodology, Writing – review & editing, Supervision. **Ilona Rac:** Data Collection, Writing – review & editing. **Andrej Udovč**: Writing – review & editing, Funding acquisition, Project administration. **Emil Erjavec:** Conceptualization, Methodology, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.landusepol.2021.105749.

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