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Mapping of EU Support for High Nature Value Farmlands, from the Perspective of Natural and Landscape Regions

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Abstract: Decoupling economic growth from the exploitation of natural resources, protecting vulnerable ecosystems, restoring habitats and species, and supporting areas used for organic farming are, along with achieving climate neutrality, key tenets of the European Green Deal (EGD)—the EU's new sustainable economic strategy. One direction of activities to implement several of these goals simultaneously is the provision of financial support for agricultural activities aimed at protecting valuable plant and animal habitats and species. This study aims to present research results that include an analysis of the spatial diversification of EU support for nature value habitats in Poland against the background of physico-geographical regions. To date, no such studies have been conducted; instead, analyses of the spatial differentiation in how selected forms of EU funding are taken up in Poland and other European countries have mainly referred to regional or local territorial divisions, and not to regions distinguished based on natural environmental features. Payments from Common Agricultural Policy (CAP) funds to support farms using nature value habitats were selected for the analysis. The analysis employed data from the Agency for Restructuring and Modernisation of Agriculture (ARMA), as a disburser of EU funds for agriculture in Poland; the data related to two packages (No. 4 and 5) of Agri-Environment-Climate Measures (AECM), which constitute one of the measures of the Rural Development Programme (RDP) 2014–2020. The spatial and statistical analyses not only supported a general description of EU support for the protection of nature value habitats in Poland but also allowed a detailed evaluation of the distribution and areal coverage of nature value habitats subsidised by RDP funds to be presented, and a comprehensive assessment of the scale of support for the natural habitats covered by the programme.

Keywords: physico-geographical regions; European green deal; high nature value farmlands; common agricultural policy; rural development program; agri-environmental and climate measures; spatial analysis; Poland

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1. Introduction

In the past, traditional semi-subsistence farming systems ensured the functioning of areas of high natural value. The expansion and intensification of agriculture has been seen to accompany a loss of biodiversity and ecosystem services [1]. As a result, today, the existence of areas of high nature value (HNV) is increasingly dependent on public funding [2,3]. This is also evident in European Union (EU) policy, as is it essential to maintain the extensive farming systems that characterise high nature value farmlands in order to achieve the EU's biodiversity goals [4]. Therefore, pro-HNV activities began to

appear in the EU's horizontal policies at the end of the 20th century [5]. In December 2019, the European Commission published the Communication on the EU Green Deal (EGD), a new growth strategy that aims to transform the EU into a just, prosperous society living in a modern, resource-efficient, and competitive economy [6]. It is an ambitious roadmap to achieve net-zero greenhouse gas (GHG) emissions by 2050, to decouple economic growth from resource use, to move to a clean circular economy, to tackle biodiversity loss, and to reduce pollutant emissions. As emphasised by Jaeger et al. [7], these objectives represent a huge challenge that can be converted into an opportunity, not only in environmental terms but also in social and economic.

One EGD policy area is the protection of vulnerable ecosystems and the restoration of habitats and species. In May 2020, the European Commission adopted a draft EU 2030 Biodiversity Strategy to steer Europe's biodiversity onto a path of recovery [8]. In conclusions adopted in October 2020, EU Member States acknowledged the need to intensify efforts and to address the direct and indirect factors behind the loss of biodiversity and natural resources. They reiterated their call for biodiversity objectives to be fully integrated into the activities of other sectors, such as agriculture, fisheries, and forestry, and for a coherent implementation of EU measures in these areas [9]. The EGD is founded on the "Farm to Fork" strategy that aims at building a just, healthy, and environmentally friendly food system [10,11]. It assumes, among other things, support for areas used for organic farming (OF) so that by 2030 they constitute 25% of agricultural land area. It also points to the need for a new business model, in which farming practices that remove carbon dioxide from the atmosphere and contribute to achieving the goal of climate neutrality should be rewarded under the CAP or other public or private initiatives [12]. The future CAP, based on a new and more ambitious green architecture, will allocate 40% of the total funding to supporting climate goals. However, all direct payments will be subject to more stringent environmental and climate requirements being met [13]. Taking into consideration the fact that they absorb almost 75% of all the CAP budget [14], proposed changes may improve the environmental effectiveness of EU agriculture policy. Concerning Poland, which is one of the biggest beneficiaries (fourth place in 2019) of the European Agricultural Fund for Rural Development (EAFRD; second pillar) [15], which funds Agri-Environment-Climate Measures (AECM) and OF.

The pro-environmental rebuilding of the EU economy proposed in the EU Green Deal sets new tasks for science, including land management research. Agriculture, as it takes on this new dimension, will become a locus of the production of environmental public goods [16,17]. The political role of farmers in adapting to climate change is growing [18]. Increasing this role requires political interventions in line with current needs and evaluations of activities carried out to date [19]. This is particularly important in light of the fact that focusing only on technical interventions for greening farm support, without considering the wider context [20], may downplay the problem and exacerbate existing regional disparities. There is a great need for the identification, diagnosis, and trans-sectoral analysis of agricultural land that meets HNV requirements and of the scope and directions of public support for activities to develop multi-functional, sustainable agriculture [21]. It is, therefore, necessary to search for new, more appropriate tools for reliably evaluating initiatives promoting the rational management of natural resources in the agricultural sector [22]. With regards to this, the authors propose to extend the spatial analysis, which to date has mainly been conducted according to administrative units [23–25], to include units distinguished by environmental features. Recently, a verified physical geographic division of Poland has been adopted that comprises 344 mesoregions as the basic units of spatial research [26]. A physico-geographical region is a compact area marked by a natural border, it differs from neighbouring areas by a set of natural features, and it is distinguished by an internal cohesion resulting from the interconnection of individual features of the natural environment. Regionalisation, understood as the activity and result of dividing the Earth's surface into spatial units of internal consistency and, at the same time, distinctiveness from neighbouring areas, is a basic descriptive and systematising

procedure in many sciences [27]. Therefore, a research hypothesis was adopted that the spatial analysis of selected socio-economic phenomena, within the framework of a physical geographic classification, can broaden the research perspective of the European Green Deal and may constitute a valuable supplement to conventional approaches. Among other things, it will allow the directions of implementation of the EGD objectives to be verified so that they can be adjusted to natural environmental conditions.

This study aims to present research results that include an analysis of the spatial diversification of EU support for nature value habitats in Poland against the background of physico-geographical regions. To date, no such studies have been conducted, and analyses of the spatial differentiation in how selected forms of EU funding are taken up in Poland [28–34] and other European countries [23–25,35–37] have mainly referred to statistical and administrative territorial divisions at the local or regional level (according to the Nomenclature of Territorial Units for Statistics—NUTS), but not to regions distinguished based on natural environmental features. However, it is environmental conditions that determine the occurrence of HNV farmlands [38]. Not only are soil characteristics and differences in humidity extremely important, but so too are terrain, orography, and their share in the breakdown of local landscape. These variables are provided for in the guidelines for the Agri-Environment-Climate Measures (AECM). In order to qualify for AECM support, a farm must, first of all, distinguish itself with the particular nature values that define HNV [39,40].

2. Materials and Methods

In order to verify the adopted research objective to analyse physico-geographical regions, CAP payments to support farms using HNV farmlands were selected. The analysis employed data from the Agency for Restructuring and Modernisation of Agriculture (ARMA), as a disburser of EU funds for agriculture in Poland; the data related to two packages (package No. 4—valuable habitats and endangered bird species in Natura 2000 areas; and package No. 5—valuable habitats outside Natura 2000 areas) of the agri-environment-climate programme, which constitutes one of the measures of the Rural Development Programme (RDP) 2014–2020. In total, the analysis covered 459,500 ha of farmland (taking into account their breakdown according to 11 diagrams representing the directions of uptake of EU funds), which, according to the authors, very accurately reflect the relationship between humans and the natural environment in agriculture and allow their research field to be expanded.

In Poland, under the RDP 2014–2020, AECM is a particularly important pro-environmental CAP instrument [34]. Of the seven packages in this measure, the analysis covered two that concern valuable habitats and endangered bird species in Natura 2000 areas (package 4) and valuable habitats outside Natura 2000 areas (package 5). According to the ARMA data, some 45,600 agricultural producers (i.e., 3.1% of the total number) have entered into five-year agri-environmental commitments in Poland. Because the beneficiary could simultaneously implement several packages or variants of agri-environmental measures on the farm (though for separate agricultural plots), the issue of the number of payments made was omitted from the analysis, and the area of nature value habitats, i.e., 459,500 ha (3.2% of the total area of farms) was taken as a basis. This area is based on the annual average for 2014–2019, as a full analysis of these payments—assuming the nv + 2 rule—will be possible only after 2022.

Treating the uptake of EU funds and the resulting problems and research tasks as an object of spatial analysis required that specific methodological assumptions be adopted. Research involving the interplay of humans (the farmer-beneficiary) and the natural environment (nature value habitats) assumes that the spatial unit is particularly important. Representing, as it does, the least diverse and most homogeneous environmental system, the physico-geographical mesoregions was adopted as the basis for the spatial analysis (with 344 units in Poland). The research was based on a bipartite matrix of spatial information; this includes information on, on the one hand, physico-geographical units (their

area and breakdown by land use) and, on the other, the land area of farms covered by agri-environmental support for the protection of nature value habitats. The areas of 11 habitat types were distinguished, and their spatial systems were characterised using statistical and mathematical methods. For each habitat, the area of subsidised land and their share in the total area of agricultural land in mesoregions were calculated. Analysis of the spatial differentiation of the size and share of the area covered by RDP habitat payments in the mesoregions were carried out, and their results were presented in the figures using GIS software (QGIS 3.18 software).

On the basis of the share of a given habitat in the total area of subsidised habitats, structural types of uptake were identified. The analysis uses the successive quotients method often used in spatial research on agriculture (the d'Hondt method), which allows for an objective study of any distributions [41,42]. This method consists of dividing the absolute values or percentages of individual elements making up the analysed distribution by successive numbers from 1 to n, then the next largest numbers are selected from the obtained set, and a weighting is assigned to the tested element, depending on how many numbers from the series created by the division are included in the new subset. The analysed distributions were spatially delimited based on the adoption of the six largest quotients, conventionally reflecting the share of a given element as: 1 = very low, 2 = low, 3 = significant, 4 = high, 5 = very high, and 6 = total dominance in the distribution.

The article also attempts to synthetically assess the use of the totality of EU funds for nature value habitats in agriculture. With regard to the selected diagnostic features, the standardisation method was used as expressed in equation (1). This procedure makes all variables processed comparable, and their statistical distributions have a mean of zero, as well as variances and a standard deviation of one [43]. Such oriented analysis, in accordance with the Z-scores multivariate comparative analysis method, known in the Polish literature as the Perkal synthetic index [44,45], made it possible to present selected diagnostic features (indicators) as a normalised mean value.

Equations (1) and (2) were used for the necessary calculations of synthetic indicators assessing EU support for nature value habitat protection on farms by sub-provinces and mesoregions. The following diagnostic features were adopted: the number of subsidised habitats in physico-geographical regions, the percentage share of subsidised habitats in the total farm area, and the percentage share of subsidised habitats in the total area of permanent grassland.

$$Z_{ji} = \frac{(X_{ji} - avg.X_i)}{\delta_i}, \quad (1)$$

where: Z_{ji} = normalised value of diagnostic feature "$_i$" in spatial unit "$_j$"; X_{ji} = value of diagnostic feature "$_i$" in spatial unit "$_j$"; $avg.X_i$ = mean value of diagnostic feature "$_i$"; δ_i = standard deviation of diagnostic feature "$_i$".

$$G = \frac{1}{m}\left(Z_{i1} + Z_{i2} + \ldots Z_{ij}\right), \quad (2)$$

where: G = mean normalised value of selected diagnostic features within a given group of features; Z_{ij} = normalised value of diagnostic feature "$_i$" in spatial unit "$_j$"; m = number of diagnostic features.

The analysis was based on a new, modified version of Poland's physical geographic regionalisation, first published in 2018 [26], which was an extension of the previous regionalisations whose main author in the latter 20th century was J. Kondracki [46]. These experiments have been presented in greater detail by Rychling [47] and Solon et al. [26]. A broad discussion on the natural criteria for delimiting physico-geographical regions, among which geological subsoil and land relief are the predominant features, can be found in the monograph by Kistowski et al. [48]. The division was modified at a level of detail of 1:50,000, and the borders of the regions were demarcated by 26 geographers from 14 universities and scientific institutions in Poland using the latest GIS data and software. The previously introduced hierarchical division of regions into provinces, sub-

provinces, macroregions, and physico-geographical mesoregions was maintained, and at the latter level, the number of units was increased to 344 instead of the previously identified 318 mesoregions (Figure 1 and Figure S1).

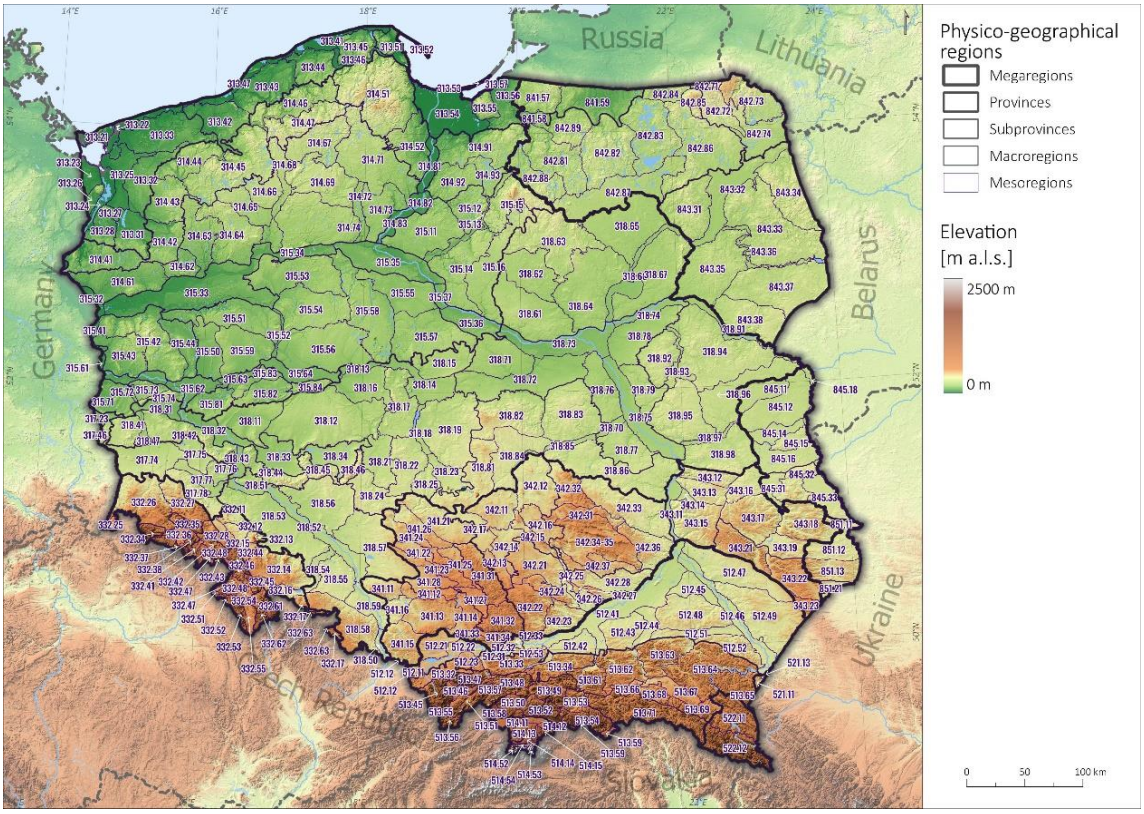

Figure 1. Polish physico-geographical regions (Source: Authors based on [26]).

The research used units at a higher level of aggregation (provinces and sub-provinces) in tabular summaries and mesoregions in cartographic presentations. It should be noted that the number of mesoregions within Poland is highly diverse within individual sub-provinces and provinces—from only two in two sub-provinces (Eastern Subcarpathians and Outer Eastern Carpathians) to 66 within two sub-provinces (Southern Baltic Lake Districts and Central Poland Lowlands). Nevertheless, it should be remembered that the first two sub-provinces lie in the most part outside the country.

3. Results

3.1. General Characteristics of RDP Support for the Protection of Nature Value Habitats

Analysed activities constitute almost 36% of the general grant-aided area and 48% amount of the funds directed on pro-environmental development of agriculture in Poland AECM and OF (averaged from years 2015–2019) [34], which indicates that it is a significant element of this kind of support. On the other hand, taking into consideration the amount of funds spent by ARMA within RDP 2014–2020 (until 31 December 2019)—about EUR 5.9 billion [49]—Agri-Environment Climate Scheme payments constitute only 15.6% of this amount (participation of OF amounted to 5.3%). For comparison, in 2019, only EUR 3.5 billion was spent on direct payment. It shows little importance of habitat payments, which are especially significant in this type of area.

It was found that the size of the area covered by RDP habitat payments is highly spatially diverse—both in the sub-provincial system (from 300 ha in Eastern Subcarpathians to 119,400 ha in Southern Baltic Lake Districts) and according to mesoregions (from no phenomenon in Western Tatra Mts to 20,800 ha in Gorzów Basin). The percentage share of

subsidised areas in total agricultural land area is also highly diversified, reaching over 50% in the Bieszczady Mts and High Tatra Mts mesoregions (Figure 2).

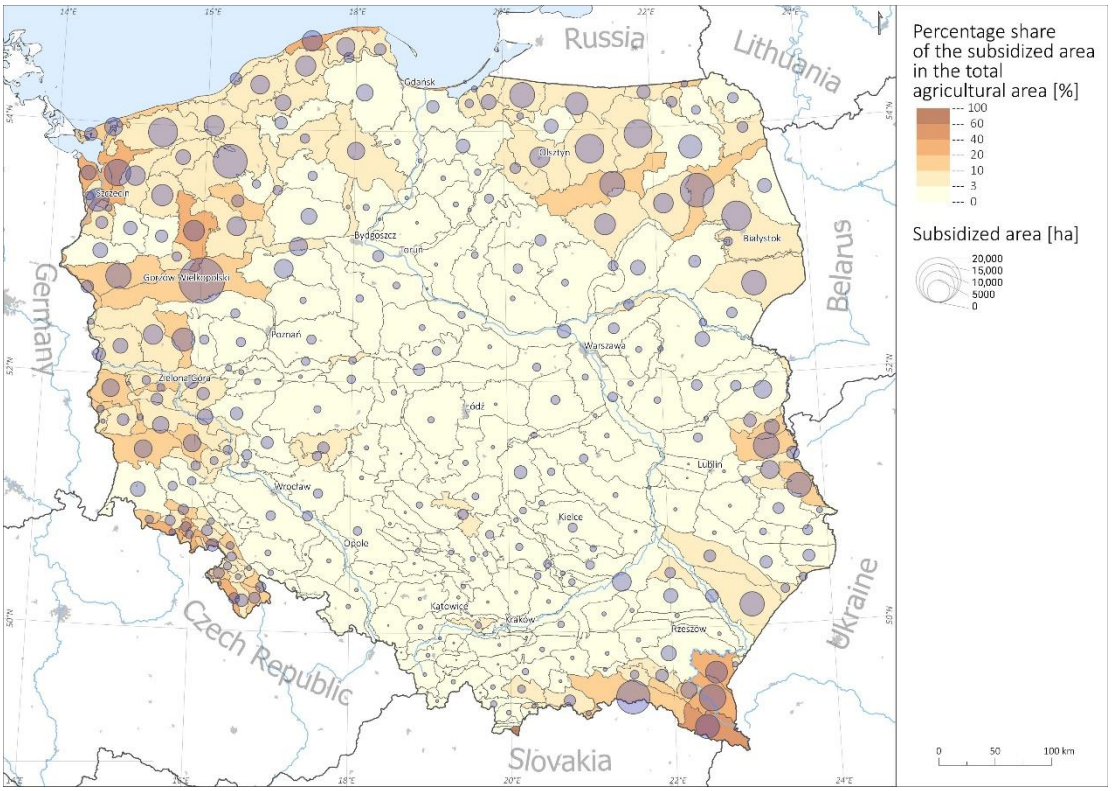

Figure 2. Area and share of agricultural land subsidised under the support of nature value habitats according to the RDP 2014–2020 agri-environment-climate measure in physico-geographical mesoregions (Source: Authors).

The analysis also showed that in the analysed period, payments in the amount of almost EUR 500 million were made for the support of valuable habitats, which resulted from, for example, the differentiation in rates of agri-environmental payments per hectare—from EUR 139.7 for bogs (mandatory requirements; extensive use in SPA special protection areas for birds) to EUR 442.4 for grasslands (Table 1). It should be noted that the implementation of agri-environmental payments is governed by degressivity rules that depend on the area declared for funding, i.e., from 100% (for 0.1 to 50 ha), through 75% (for >50 ha to 100 ha), up to a basic rate of 60% (for >100 ha). The degressivity mechanism does not apply to land within national parks or plots declared for payments under package 4. "Valuable habitats and endangered species of birds in Natura 2000 areas" [50].

Table 1. Support for the protection of nature value habitats under the RDP 2014–2020 agri-environment-climate measure—subsidised area and payment amounts.

Breakdown	Packages and Variants		Area Covered by Payment		Amount Paid
	According to Research Scheme Adopted	According to RDP 2014–2020	ha (Thousands) *	Rate (EUR ha^{-1})	
Habitat total	from I to XI	packages 4 and 5	459,500 ha	x	453,400 EUR
			of which (%)		
Protection of natural habitats (P)			70.2	x	72.5
Variably wet Molinion litter meadows	I	4.1. + 5.1.	2.5	1276	2.3

Table 1. *Cont.*

Breakdown	Packages and Variants		Area Covered by Payment		Amount Paid
	According to Research Scheme Adopted	According to RDP 2014–2020	ha (Thousands) *	Rate (EUR ha^{-1})	
Alluvial Cnidion meadows and salt marshes	II	4.2. + 5.2.	1.1	1043	0.9
Dry grasslands	III	4.3. + 5.3.	2.9	1900	2.7
Semi-natural wet meadows	IV	4.4. + 5.4.	23.1	911	22.2
Semi-natural mesic meadows	V	4.5. + 5.5.	38.5	1083	42.4
Peat bogs	VI	4.6. + 5.6.	2.1	600/1206 **	2.0
Protection of breeding habitats of birds (L)			29.8	x	27.5
Extensive use of grasslands in Special Protection Areas (SPAs)	VII	4.7.	5.9	600	4.1
Protection of breeding habitats of black-tailed godwit, common snipe, common redshank, and lapwing	VIII	4.8.	18.4	890	18.0
Protection of breeding habitats of aquatic warbler	IX	4.9.	1.8	1199	2.1
Protection of breeding habitats of great snipe and eurasian curlew	X	4.10.	2.7	1070	2.6
Protection of breeding habitats of corncrake	XI	4.11.	1.0	642	0.7

* = applies to campaigns from 2015–2019, expressed as annual means; ** = two-part payments were in force—mandatory requirements (EUR 139.7 ha^{-1}) and mandatory and supplementary requirements (EUR 280.8 ha^{-1}). (Source: Authors based on ARMA data).

In addition to determining the total area of subsidised nature value habitats, the article also deals with their spatial differentiation according to selected payment options. A joint approach to packages No. 4 and 5 (concerning the protection of natural habitats) was proposed, so the analysis was based on 11 schemes of subsidised natural habitats (Table 1) [4]. The support for valuable habitats was found to be bipartite—it included six schemes (I–VI) for the protection of natural habitats, constituting the predominant (70.2%) form of aid (the effect of combined coverage of Natura 2000 areas and payments outside these areas) and five schemes (VII–XI) for the protection of bird breeding habitats (29.8%)—the effect of payment only in Natura 2000 areas.

3.2. Description of Individual Packages

The problem of the spatial differentiation of the identified schemes is also discussed. In accordance with the adopted methodology, the analysis took into account the average annual area for the period 2015–2019, which results from the implementation of agri-environmental payments in the form of five-year commitments. The habitats subsidised were highly diversified, as presented descriptively and cartographically below for natural habitats and bird breeding habitats separately.

Natural habitats were protected (A)—by maintaining, restoring or preventing their deterioration—via the following schemes:

I—Variably wet Molinion litter meadows, distinguished by high diversity of flora (presence of purple moor grass—*Molinia caerulea*), which makes them one of the most valuable semi-natural communities in Poland and Central Europe, and of great importance in maintaining biodiversity [51]. As part of RDP 2014–2020 in Poland, this type of agri-

environmental support covered only 11,400 ha (2.5% of the total subsidised habitat area). With regard to the distinguished regions, no such habitats were recorded in the Carpathian sub-provinces, and in the system of mesoregions, these habitats were absent from 107 units (31.1% of the total), many (400–500 ha) were located in Gorzów Basin (413 ha) and Gubin Heights (438 ha), and the most (712.3 ha) in the Łęczna-Włodawa Lakeland (Figure 3).

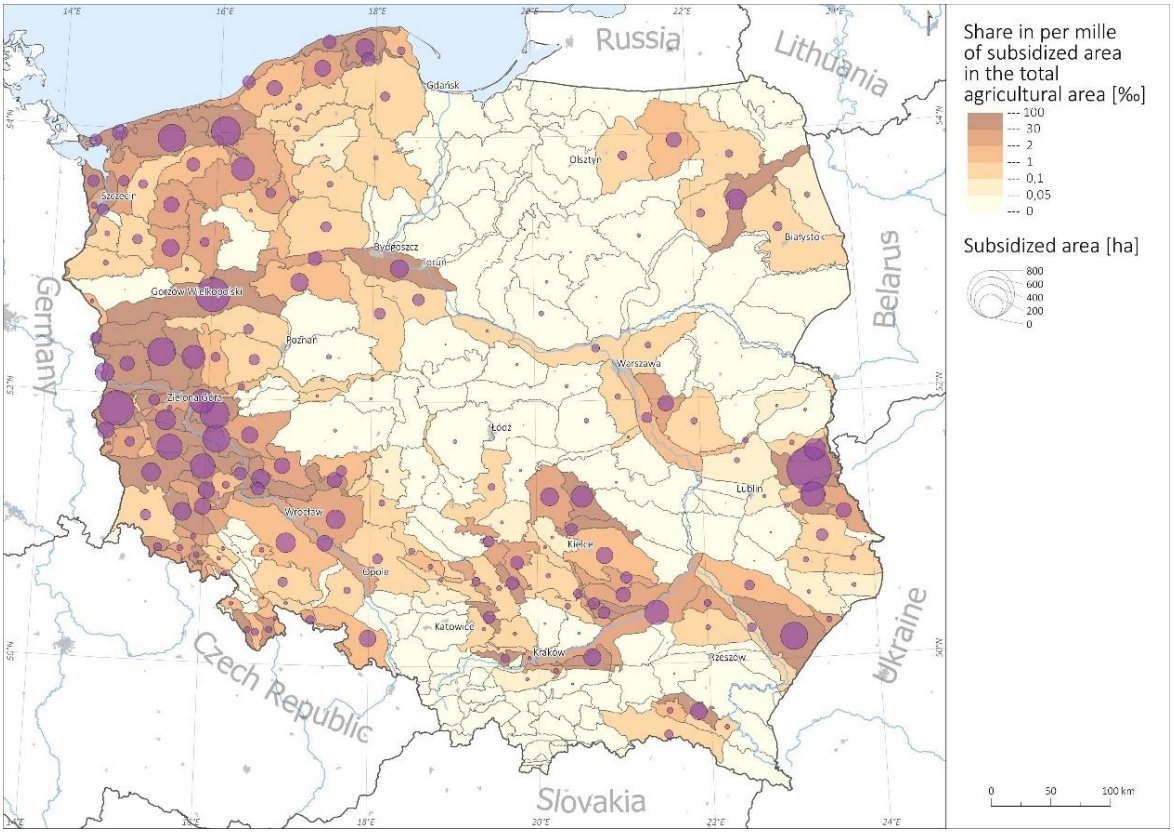

Figure 3. Area of land subsidised in support of protection of Variably wet Molinion litter meadows and their share in the total area of agricultural land in mesoregions (Source: Authors based on ARMA data).

II—Alluvial Cnidion meadows and salt marshes—communities occurring within the range of salty and brackish surface or groundwater, containing a number of specialised, rare species characteristic of saline habitats, occurring mainly on the coast and dispersed in the valleys of large lowland rivers, and constituting a valuable feature protecting their biodiversity [52]. Under RDP 2014–2020 in Poland, this type of agri-environmental support covered 5100 ha—the least among the identified habitats (1.1% of the total area of subsidised habitats). In the sub-province system, no such habitats were found in eight units, and their largest areas, exceeding 1000 ha, as characterised by Southern Baltic Lake Districts (at 1584 ha) and Central Poland Lowlands (at 2451 ha); in the mesoregion system, they were absent from 247 units (71.8% of the total), but large areas were covered in Torzym Plain (302 ha) and in the Wrocław Ice Marginal Valley (334 ha), and the most (465 ha) in the Głogów Ice Marginal Valley (Figure 4).

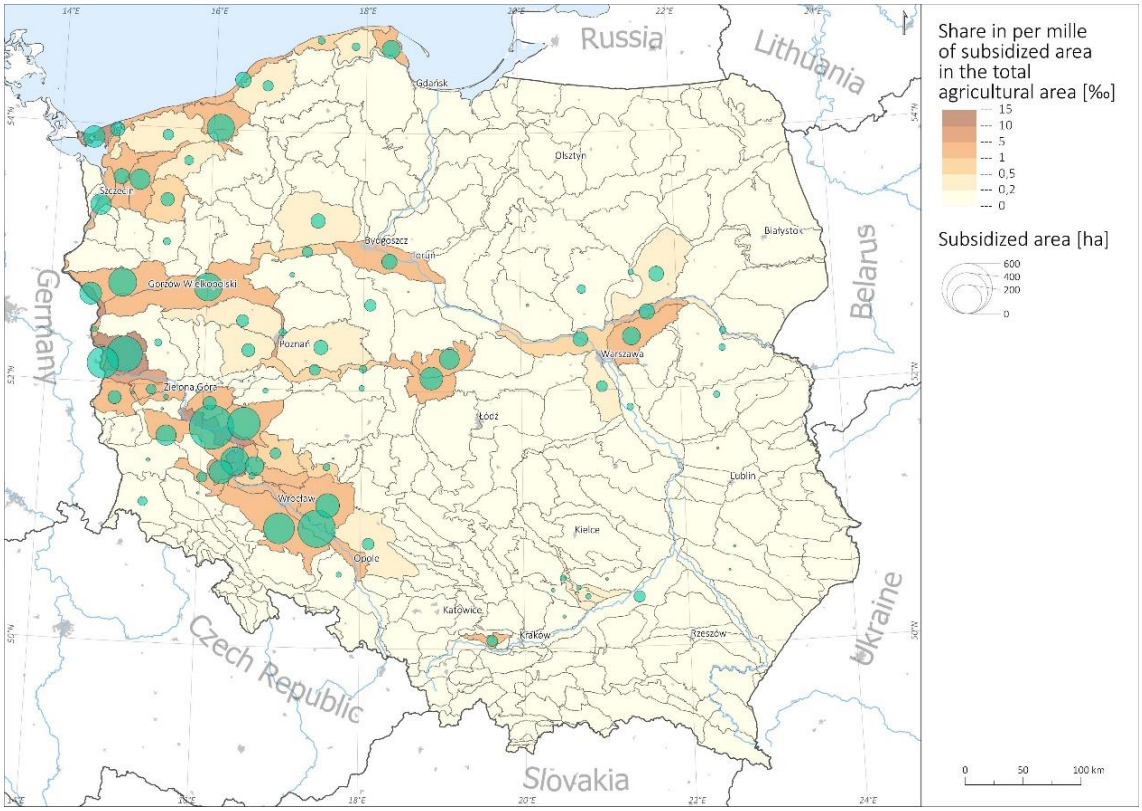

Figure 4. Area of land subsidised to support the protection of alluvial Cnidion meadows and salt marshes, and their share in the total area of agricultural land in mesoregions (Source: Authors based on ARMA data).

III—Dry grasslands—thermophilic steppe-type grass communities, occurring extrazonally in areas rich in calcium carbonate. Ratyńska and Waldon [53] emphasise that for semi-natural dry grasslands and scrubland facies on calcareous substrates and their related disappearing species, monitoring and active protection measures are necessary. We are not always able to predict the directions of changes taking place within grasslands as a result of treatments. Under the analysed schemes of the agri-environment-climate programme, 13,400 ha in Poland were covered by this type of support (2.9% of the total area of subsidised habitats). In the sub-province system, this habitat type occurs in all 18 units, but it is distinguished by a strong territorial differentiation—from approx. 3 ha (Volhyn-Podole Upland and Eastern Subcarpathians) to 3611 ha (Central Poland Lowlands) and 4308 ha (Southern Baltic Lake Districts). By mesoregions, a lack of grassland habitats was found in 71 units (20.6% of the total) and record-high areas of subsidised habitats were found in Dalków Hills (417 ha) and Gorzów Basin (602 ha) (Figure 5).

IV—Semi-natural wet meadows—commonly occurring wetlands in Poland, mainly in river valleys. In Europe, wet meadows have a high nature value because they are the habitat for many valuable and protected plant and animal species [54]. Under RDP 2014–2020 in Poland, this type of agri-environmental support was provided to nearly 106,000 ha (23.1% of the total area of the subsidised habitats—second place in the breakdown). Such meadows occur in all sub-provinces—most of them in the boundaries of the Southern Baltic Coastlands (26,700 ha). In the mesoregion system, such habitats are absent from only 10 units (2.9% of the total; including all four Central Western Carpathian mesoregions). On the other hand, the largest areas—exceeding 3000 ha—occurred within Gryfice Plain (3334 ha) and Damnica Heights (Figure 6).

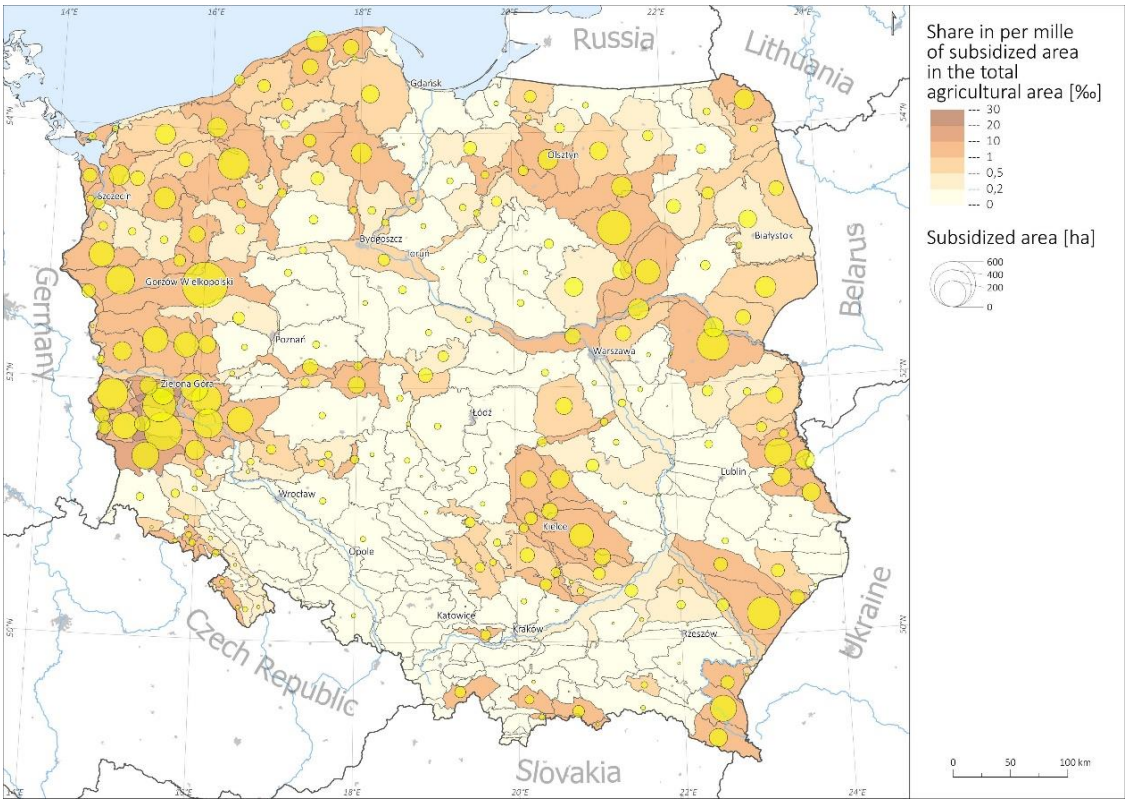

Figure 5. Area of land subsidised to support the protection of dry grasslands and their share in the total area of agricultural land in mesoregions (Source: Authors based on ARMA data).

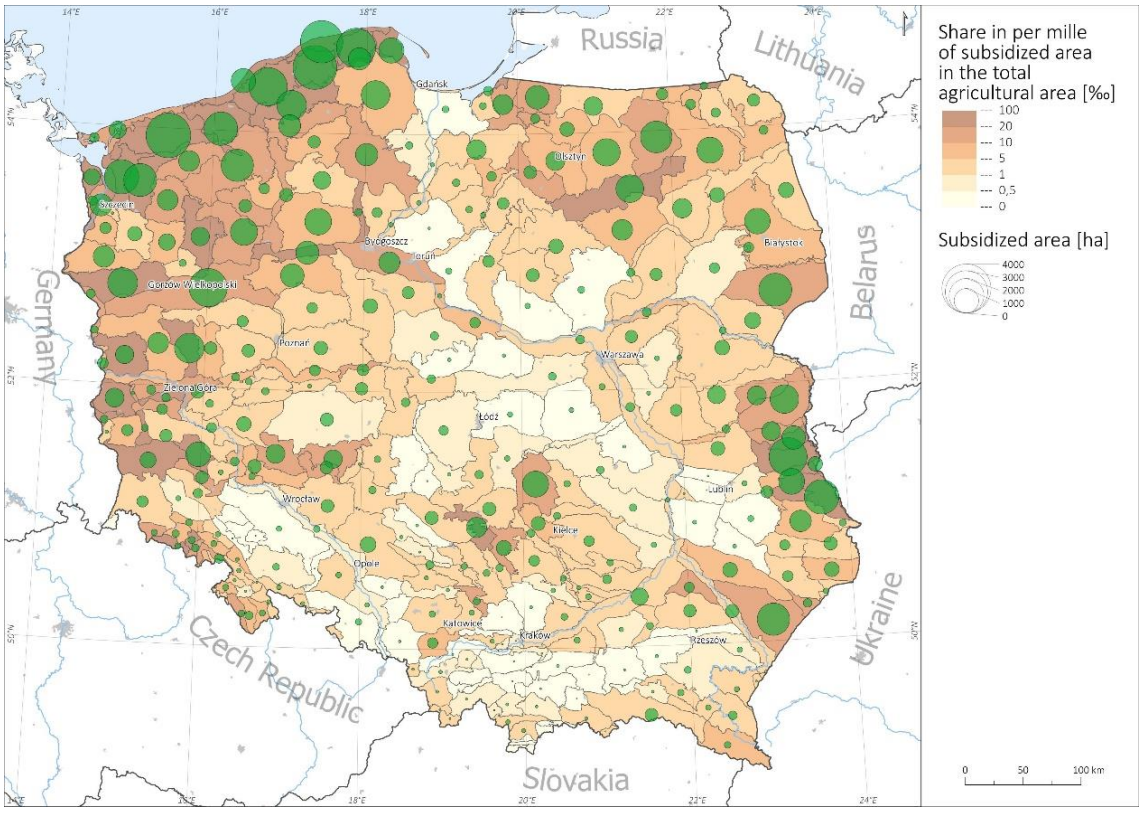

Figure 6. Area of land subsidised to support the protection of semi-natural wet meadows and their share in the total area of agricultural land in mesoregions (Source: Authors based on ARMA data).

V—Semi-natural mesic meadows—grass communities formed after the felling of deciduous forests, usually on clays or clayey sands, which makes them favourable for agricultural use. In the temperate zone, they form a typical landscape structure with high species diversity in relatively small areas [55]. Both the intensification of agriculture and the abandonment of traditional management have caused dramatic losses in the area and quality of these habitats in Europe in recent decades [56]. As part of the agri-environment-climate programme scheme mentioned above, this type of support covered the largest area—176,000 ha, accounting for as much as 38.5% of the total area of subsidised habitats. In the sub-province system, areal coverage ranged from 300 ha (Eastern Subcarpathians) to 34,800 ha (Southern Baltic Lake Districts). According to the mesoregions, these habitats were absent in only five units—Hel Penisula, Racibórz Gate, Opawa Mts, Olza Basin, and Western Tatra Mts, the last of which is the only mesoregion in Poland without subsidised valuable agricultural habitats. In turn, a record-high subsidised area—nearly 10,000 ha—was recorded in Low Beskid Mts (Figure 7).

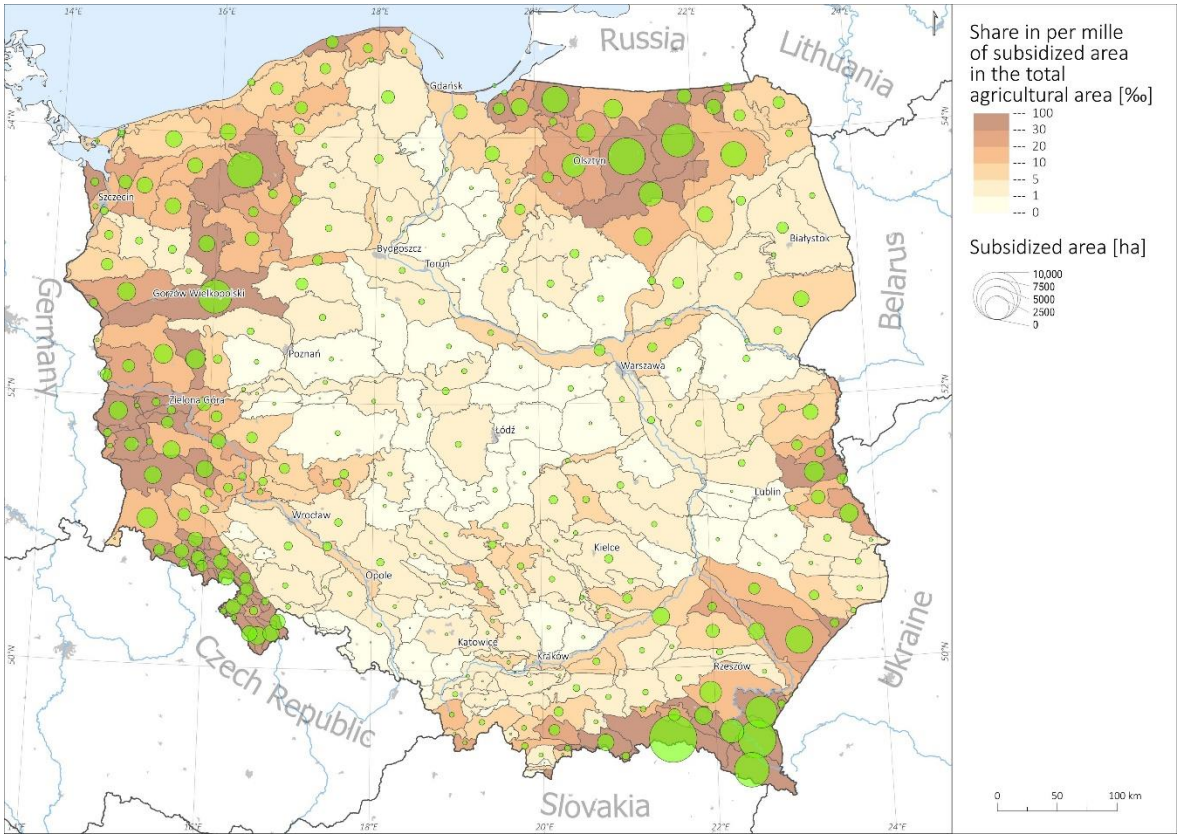

Figure 7. Area of land subsidised to support the protection of semi-natural mesic meadows and their share in the total agricultural area in mesoregions (Source: Authors based on ARMA data).

VI—Peat bogs—raised bog habitats defined mainly by mosses (including peat mosses), shrubs, and herbaceous perennial grasses, characterised by constant high humidity, often acidic [57]. Traditional land management is as agricultural grassland. Payments are associated with the fulfilment of mandatory requirements, mainly including the preservation of environmental value (e.g., prohibitions on peat extraction, afforestation, fertilisation, and liming) and mandatory and supplementary requirements (e.g., the requirement to mow, but not more frequently than every two years, and the obligation to collect and remove mown biomass). In the sub-province system, an absence of subsidised peat bogs was recorded only in Eastern Subcarpathians, and their coverage was greatest in Podlasie-Belarus Heights (4236 ha). By mesoregions, this habitat was not found in 114 units (33.1% of

the total) and record-high areas exceeding 1000 ha of subsidised habitats were characteristic of Białystok Heights (1197 ha) and Biebrza Basin (2249 ha) (Figure 8).

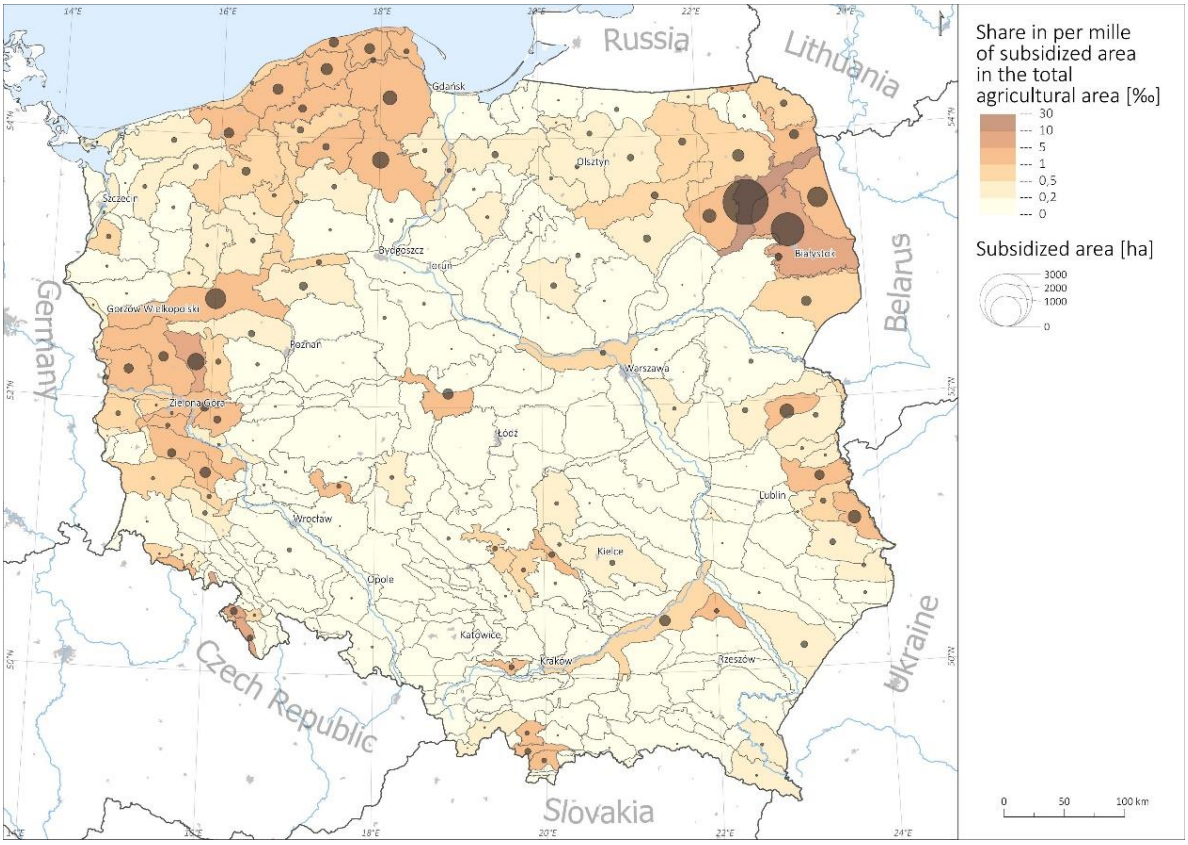

Figure 8. Area of land subsidised to support the protection of peat bogs and their share in the total area of agricultural land in mesoregions (Source: Authors based on ARMA data).

The protection of bird breeding habitats was implemented by improving the living conditions of endangered bird species nesting in meadows and pastures, mainly by extensifying agricultural use. This relates to schemes VII–XI, which can be implemented only in areas of special bird protection within the European Natura 2000 ecological network Natura 2000. They are dedicated to selected meadow and pasture areas distinguished by the presence of endangered bird species listed in Annex 1 to Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds [58], and the conservation measures consist in reducing doses of fertilisers applied, reducing the number of mows or intensity of grazing, and, above all, delaying the first mow to enable meadow birds to hatch their broods. The following schemes were included in the analysis:

VII—Extensive use of grasslands in Special Protection Areas (SPAs). As part of the scheme mentioned above, this type of support covered 28,100 ha (5.9% of the total area of subsidised habitats). In the sub-province system, areal coverage ranged from only 11 (Eastern Subcarpathians) to 5500 ha (Central Poland Lowlands). By mesoregions, the absence of these habitats was found in 85 units (24.7% of the total number). Meanwhile, the largest subsidised areas were recorded in Drawsko Lakeland (1280 ha) and Goleniów Plain (1282 ha) (Figure 9).

VIII—Protection of breeding habitats of black-tailed godwit, common snipe, common redshank, and lapwing. The above-mentioned scheme is the largest in the breakdown of the area of subsidised bird habitats in Poland—83,800 ha (18.4% of the total—first place in terms of protection of bird breeding habitats and third place in terms of area of all subsidised

habitats). In the sub-province system, subsidies for these habitats were absent only from Eastern Subcarpathians, while the largest subsidised areas were in Southern Baltic Lake Districts (27,600 ha). By mesoregions, such payments were absent in 98 units (28.8% of the total) and record-high coverages of subsidised habitats were found in Białystok Heights (3200 ha), Biebrza Basin (3900 ha), and, above all, Gorzów Basin (8600 ha) (Figure 10).

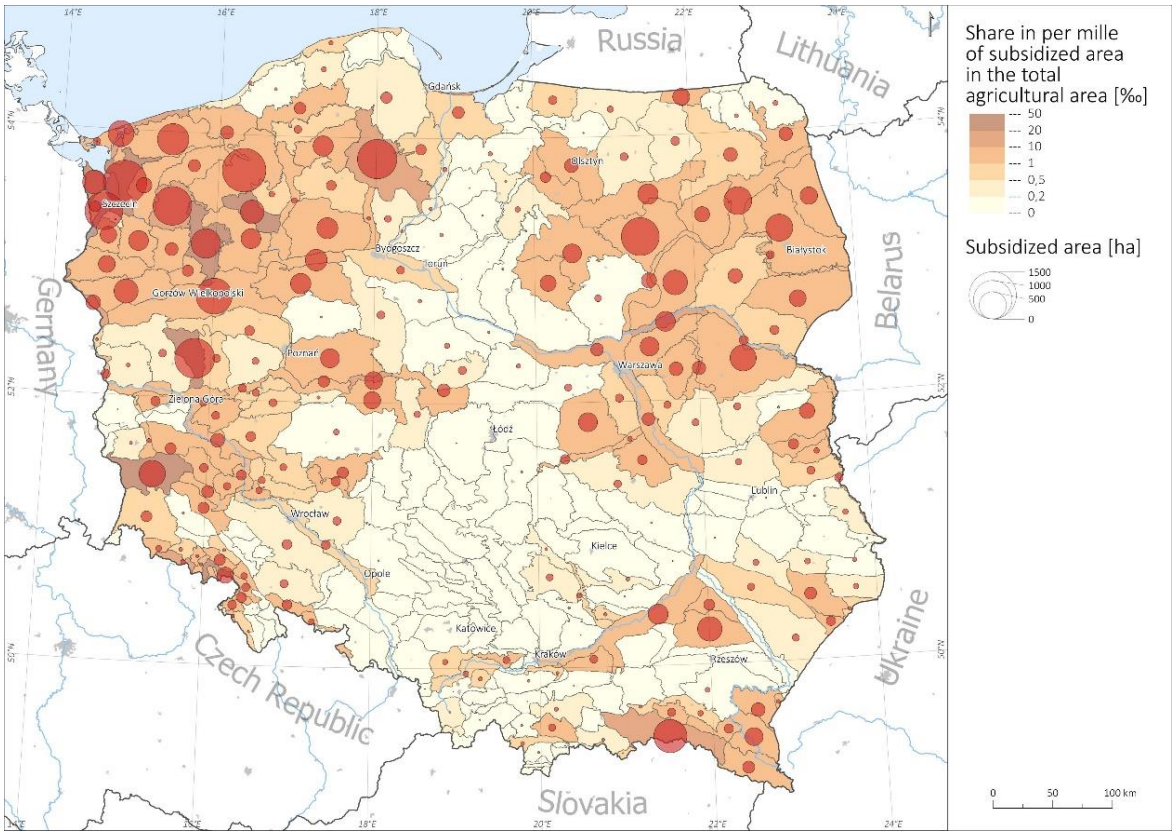

Figure 9. Area of land subsidised to support bird breeding habitats in special bird protection areas (SPAs), and their share in the total agricultural area in mesoregions (Source: Authors based on ARMA data).

IX—Protection of breeding habitats of the aquatic warbler. Subsidies for aquatic warbler breeding habitats as part of the agri-environment-climate measure were found to cover 8100 ha (1.8% of the total) in Poland. Such support was provided in only six sub-provinces. Most (over 1000 ha) were in Polesie (1900 ha) and, above all, in Podlasie-Belarus Heights (4900 ha). By mesoregions, the above-mentioned payments were found only in 47 units (13.7% of the total number), with the most (over 1000 ha) in Białystok Heights (1031 ha) and Biebrza Basin in particular (3291 ha) (Figure 11).

X—Protection of breeding habitats of the great snipe and Eurasian curlew. As part of AECM, 12,600 ha were covered by subsidies for great snipe or common curlew breeding habitats in Poland (2.7% of the total). Such support was provided in 12 sub-provinces. Most (over 2000 ha) was in the Southern Baltic Coastlands (2100 ha), Podlachia-Belarus Heights (2300 ha), and, above all, Southern Baltic Lake Districts (4800 ha). By mesoregions, these payments were found in 139 units (40.4% of the total number), including by far the largest number (2224 ha) in the Gorzów Basin (Figure 12).

XI—Protection of breeding habitats of the corncrake. As part of the protection of bird breeding habitats, the EU financial support also covered 4400 ha of corncrake habitats (1% of the total subsidised area). The area was highly spatially diversified, both by sub-provinces (from an absence of habitats in Małopolska Upland to 1400 ha in Southern Baltic Coastlands) and by mesoregions (from an absence of habitats in 158 units (45.9% of the total) to 200–300 ha in five mesoregions: Lower Odra River Valley (232 ha), Goleniów Plain

(234 ha), Ińsko Lakeland (241 ha), Trzebiatów Coast (243 ha), and Gryfice Plain (297 ha)) (Figure 13).

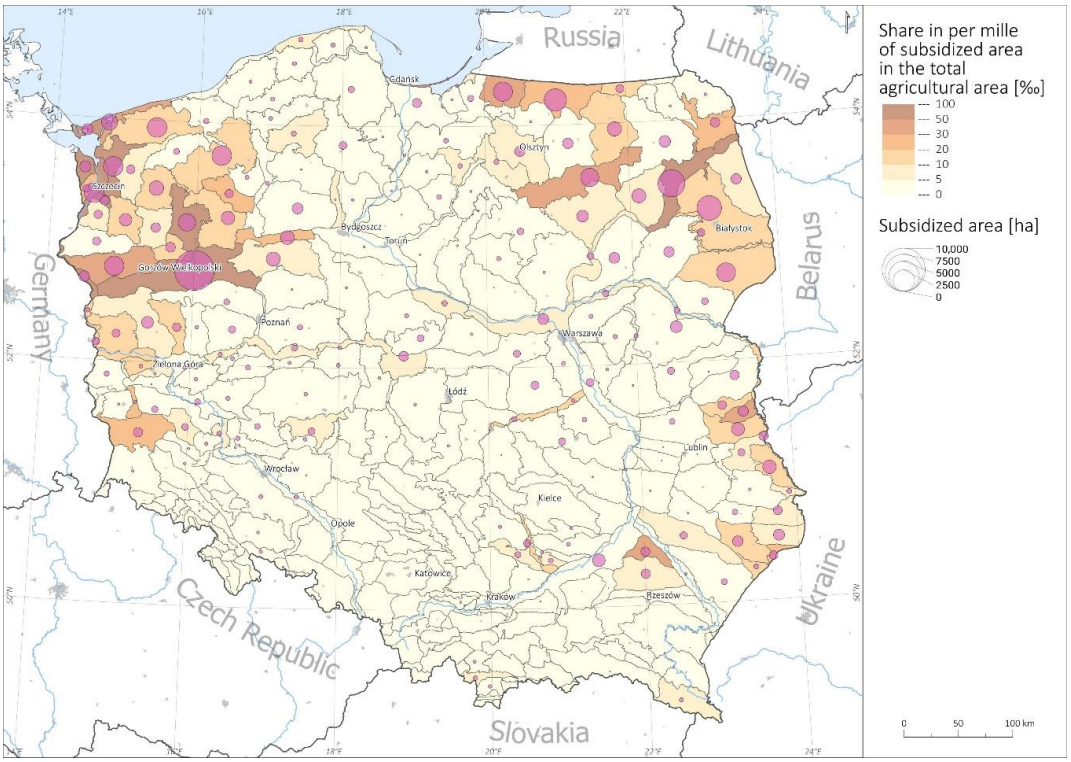

Figure 10. The area of land subsidised to support breeding habitats of black-tailed godwit, common snipe, common redshank, and lapwing, and their share in the total agricultural area in mesoregions (Source: Authors based on ARMA data).

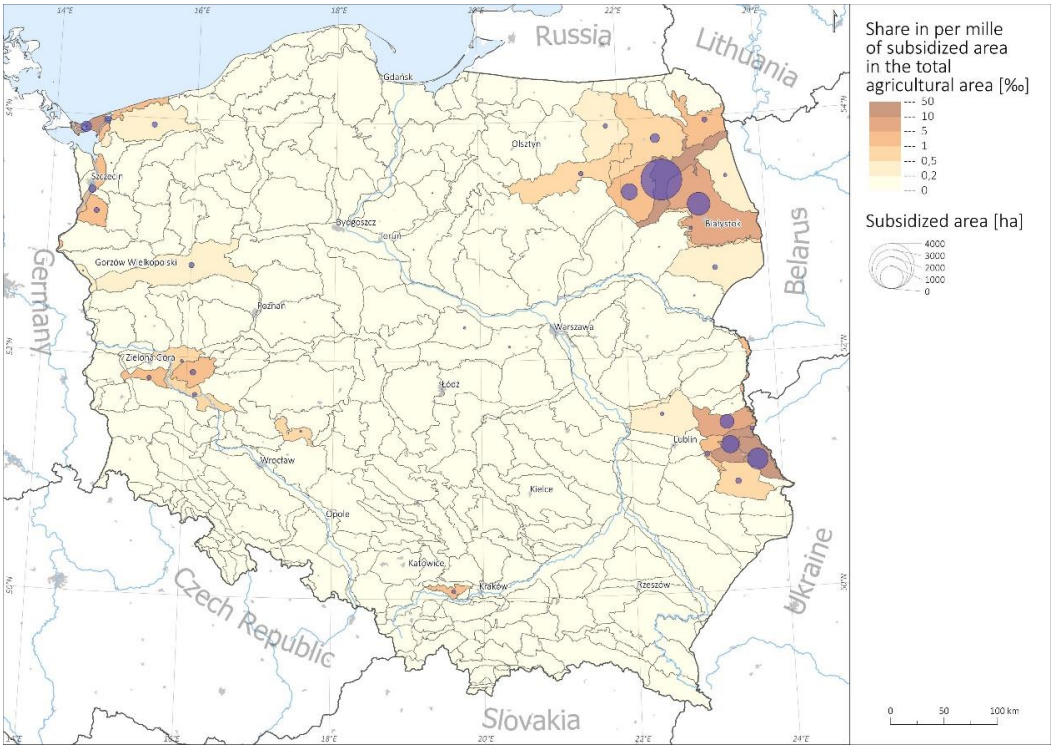

Figure 11. Area of land subsidised to support breeding habitats of the aquatic warbler and their share in the total agricultural area in mesoregions (Source: Authors based on ARMA data).

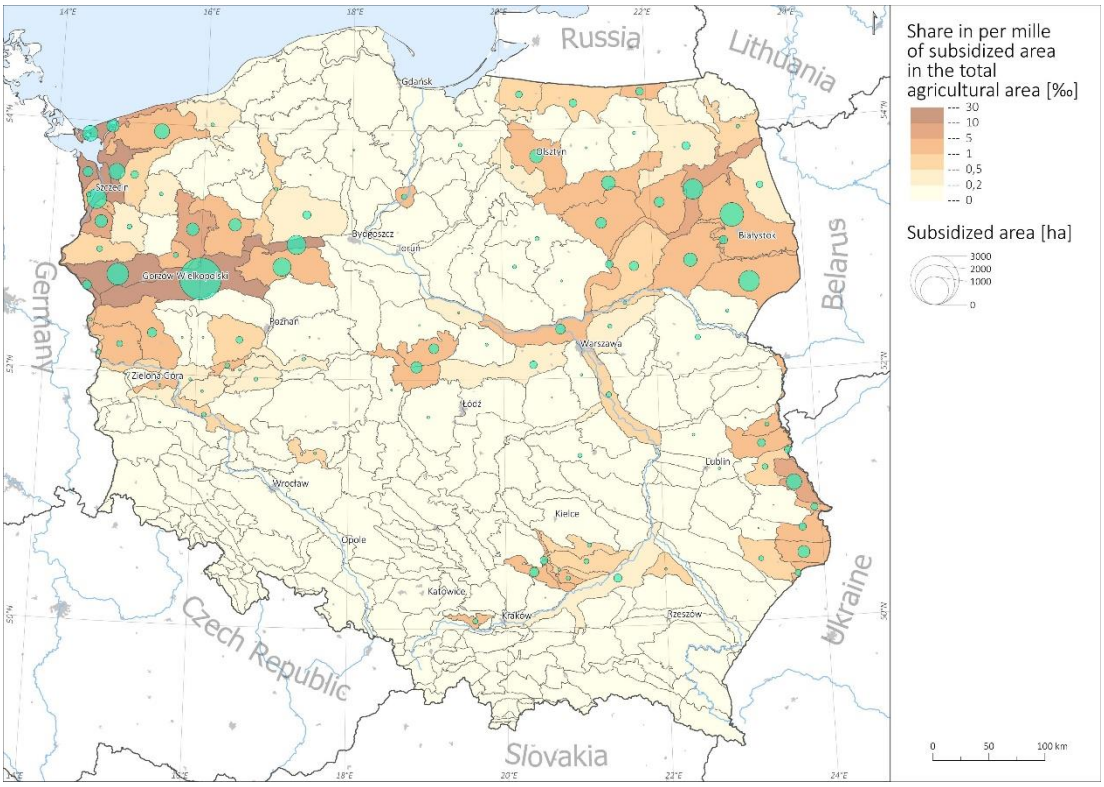

Figure 12. Area of land subsidised to support breeding habitats of the great snipe and Eurasian curlew, and their share in the total agricultural area in mesoregions (Source: Authors based on ARMA data).

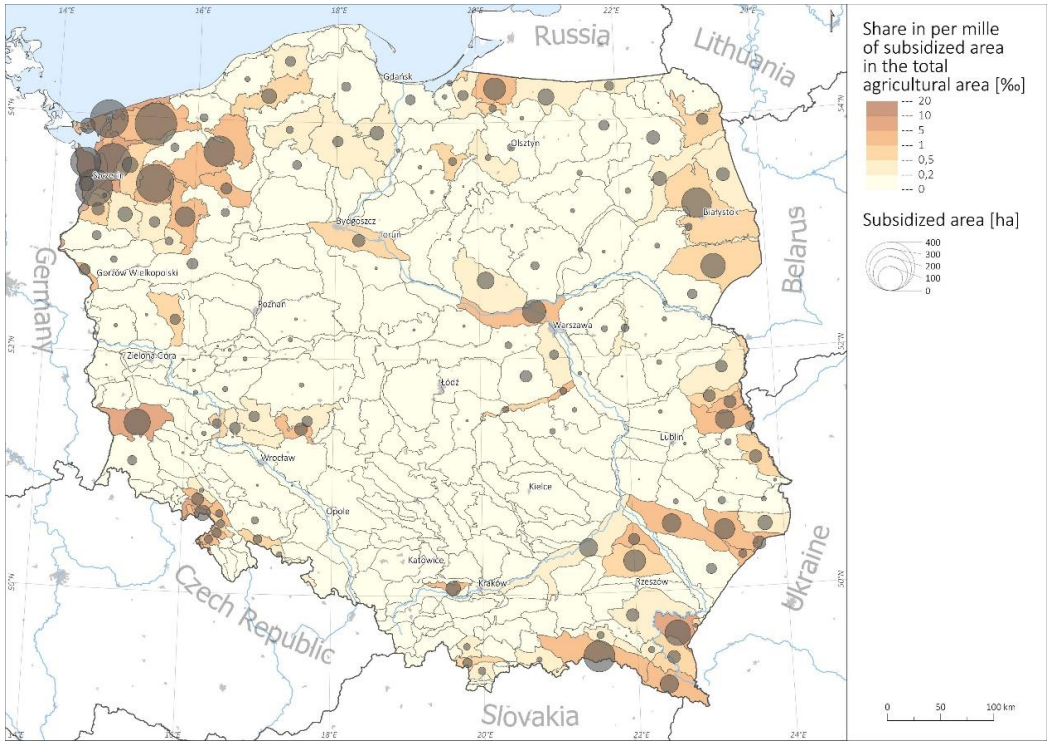

Figure 13. Area of land subsidised to support breeding habitats of corncrake and their share in the total agricultural area in mesoregions (Source: Authors based on ARMA data).

3.3. Breakdown and Significance of Area of Nature Value Habitats Subsidised by RDP 2014–2020

In the distinguished physico-geographical regions, the largest category of land use by area on farms is arable land (averaging 46.1% across Poland). Its share in the total area of regions was diversified. In the sub-province system, it ranged from less than 15% in Outer Eastern Carpathians (12.4%) and Central Western Carpathians (14.7%) to nearly 60% in Lublin-Lviv Upland (58.1%) (Table 2). Meanwhile, by mesoregions, this variability is from 2.6% (Hel Penisula) to about 80% (Zamość Basin, Kościan Plain, Zbąszynek Basin) (Figure 14).

Table 2. Environmentally valuable habitats—breakdown of farmland subsidised under the RDP 2014–2020 agri-environment-climate measure.

Physico-Geographical Units		Total Area (thousand ha)	Of Which, Area of Arable Land on Farms		Area of Subsidised Nature Value Habitats (thousand ha)	Breakdown According to Successive Quotients Method		
Province (7 Units)	Sub-Province (18 Units)		(Thousand ha)	(% of Total Area)		Protection of Natural Habitats	Protection of Bird Breeding Habitats	Breakdown Type by Largest Payment
Poland—total		31,238.3	14,402.3	46.1	459.5	4	2	V
Central European Lowland	Southern Baltic Coastlands (25) *	1760.7 **	772.0	43.8	64.0	4	2	IV
	Southern Baltic Lake Districts (66)	7941.5	3758.9	47.3	119.4	4	2	IX
	Saxony-Lusatia Lowlands (7)	390.8	129.4	33.1	9.2	5	1	V
	Central Poland Lowlands (66)	8407.2	4522.2	53.8	50.6	4	2	IX
Czech Massif	Sudety Mts and Sudety Foreland (32)	943.3	432.9	45.9	21.6	6	0	V
Polish Uplands	Silesia-Kraków Upland (18)	1094.1	351.9	32.2	2.3	6	0	IX
	Małopolska Upland (21)	1770.2	755.5	42.7	10.5	6	0	IV
	Lublin-Lviv Upland (12)	953.4	554.1	58.1	4.5	4	2	IX
Western Carpathians and Western and Northern Subcarpathians	Northern Subcarpathians (20)	1492.4	548.2	36.7	17.3	5	1	V
	Outer Western Carpathians (28)	1653.8	457.1	27.6	27.7	6	0	V
	Central Western Carpathians (8)	109.6	16.2	14.7	0.9	5	1	V
Eastern Carpathians and Eastern Subcarpathians	Eastern Subcarpathians (2)	8.8	3.1	34.8	0.3	6	0	V
	Outer Eastern Carpathians (2)	221.2	27.4	12.4	12.8	6	0	V
Eastern Baltic-Belarus Lowland	Eastern Baltic Coastland (3)	278.9	144.7	51.9	11.8	3	3	VIII
	Eastern Baltic Lake District (13)	1757.3	664.2	37.8	41.4	5	1	V
	Podlasie-Belarus Heights (8)	1593.2	804.5	50.5	35.3	2	4	VIII
	Polesie (9)	658.3	330.4	50.2	26.3	5	1	IV
Ucrainian Uplands	Volhyn-Podole Upland (4)	203.5	129.6	63.7	3.5	2	4	VIII

* = number of mesoregions in sub-province shown in brackets; ** = area of part of region located in Poland (Source: Authors based on ARMA data).

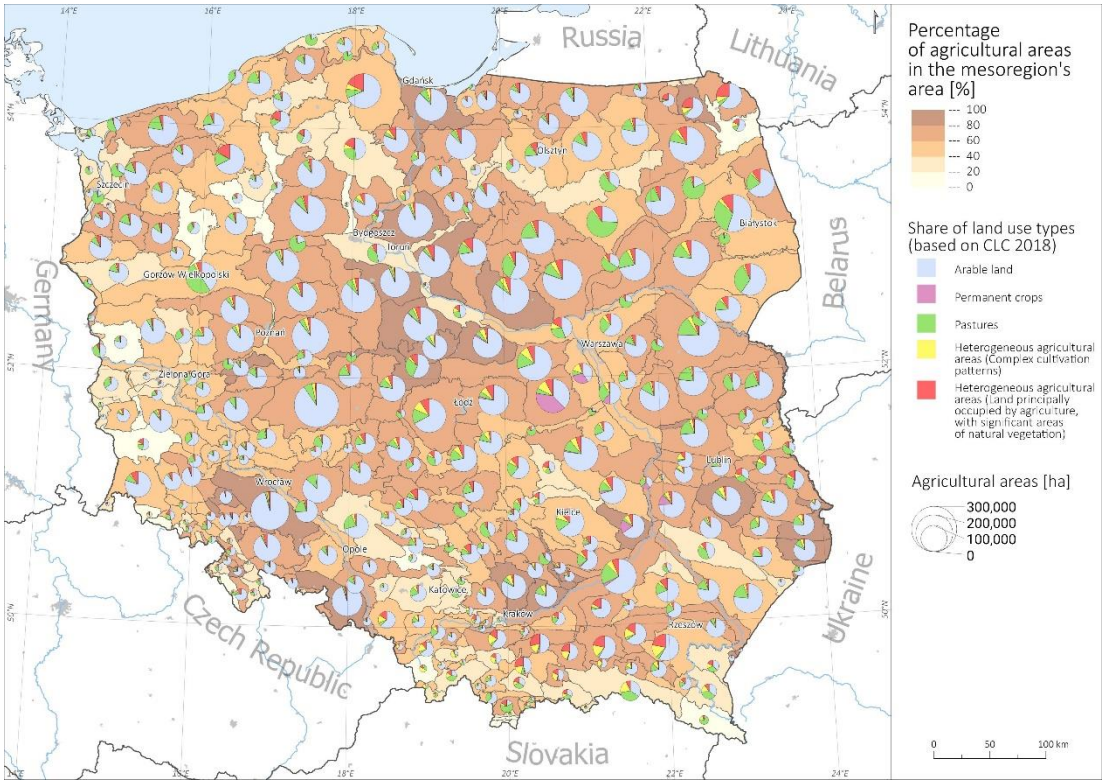

Figure 14. Percentage share of agricultural lands and their breakdown by mesoregions (Source: Authors based on CORINE Land Cover 2018).

The breakdown of area of subsidised habitats was also analysed. For this purpose, the successive quotients method was used to differentiate the relations between protected habitat types: natural habitats (P) and bird breeding habitats (L). Adopting the criterion of the largest supported area, a breakdown of subsidy types for nature value habitats was established. The analysis by habitat types showed the following highly numerically variable dependencies (the analysed distributions were spatially delimited based on the adoption of the six largest quotients, conventionally reflecting the share of a given element as: 1 = very low, 2 = low, 3 = significant, 4 = high, 5 = very high, and 6 = total dominance in the distribution):

- A: L6—exclusive support for the protection of bird breeding habitats; occurs only in one mesoregion (Bukowe Hills), 0.3% of the country by area;
- B: P1, L5—very high support for bird breeding habitats and very low support for natural habitats; 10 mesoregions, 2.9%;
- C: P2, L4—high support for bird breeding habitats and low support for natural habitats; 20 mesoregions (typically of two sub-provinces: Podlasie-Belarus Heights and Volhyn-Podole Upland), 5.8%;
- D: P3, L3—significant support for bird breeding habitats and equivalent support for natural habitats; 41 mesoregions (typical of Eastern Baltic Coastland sub-province), 11.9%;
- E: P4, L2—low support for bird breeding habitats and high support for natural habitats; 42 mesoregions (typical of four sub-provinces, average relation for Poland), 12.2%;
- F: P5, L1—very low support for bird breeding habitats and very high support for natural habitats; 52 mesoregions (typical of five sub-provinces), 15.1%;
- G: P6—exclusive support for natural habitats; 177 mesoregions (typical of six sub-provinces), 51.5% (Figure 15).

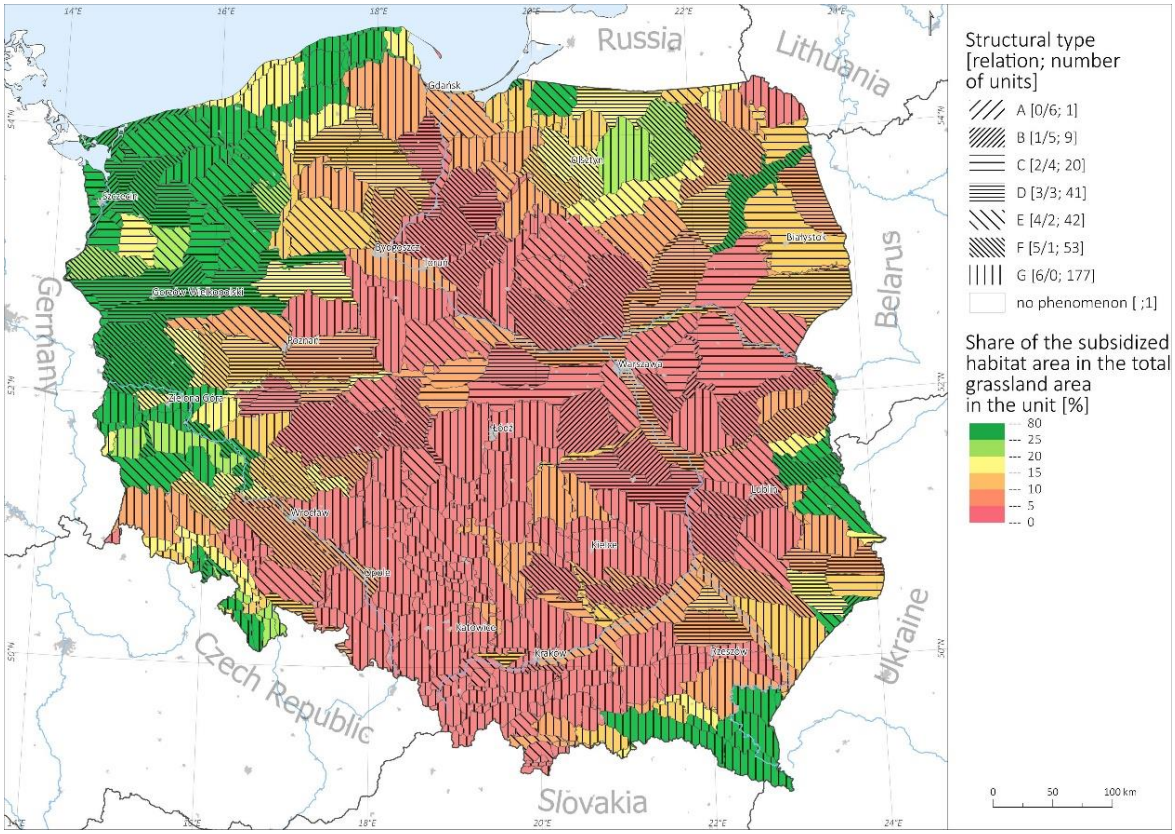

Figure 15. Relationship between natural habitat types subsidised under RDP 2014–2020, and percentage share of subsidised habitats in the total area of permanent grasslands (Source: Authors based on ARMA data).

Adopting the criterion of the highest number of quotients (of the 11), 9 structural types of natural habitats subsidised under RDP 2014–2020 were also distinguished, indicating the areas that led in terms of protection support:

I—Variably wet Molinion litter meadows—three mesoregions: Głubczyce Plateau, Garwolin Plain, and Liswarta Depression;
II—Alluvial Cnidion meadows and salt marshes—one mesoregion: Poznań Gap of the Warta River;
III—Dry grasslands—two mesoregions: Złoczew Heights and Ostrzeszów Hills;
IV—Semi-natural wet meadows—94 mesoregions, characterised by an average breakdown in three sub-provinces: Eastern Baltic Coastland, Małopolska Upland, and Polesie;
V—Semi-natural mesic meadows—178 mesoregions, characterised by an average breakdown for Poland, and in eight sub-provinces mainly in north-eastern and south-western Poland as well as in the Carpathians and uplands;
VI—Peat bogs—do not predominate in any mesoregion;
VII—Extensive use of grasslands in Special Protection Areas (SPAs)—three mesoregions: Tuchola Forest, Lower Bug River Valley, and Węgrów Depression;
VIII—Protection of breeding habitats of the black-tailed godwit, common snipe, common redshank, and lapwing—47 mesoregions, characterised by an average breakdown in two sub-provinces: Podlasie-Belarus Heights and Volhyn-Podole Upland;
IX—Protection of breeding habitats of the aquatic warbler—do not predominate in any region;
X—Protection of breeding habitats of the great snipe and Eurasian curlew—one mesoregion: Grudziądz Basin;
XI—Protection of breeding habitats of the corncrake—do not predominate in any mesoregion (Figure 16).

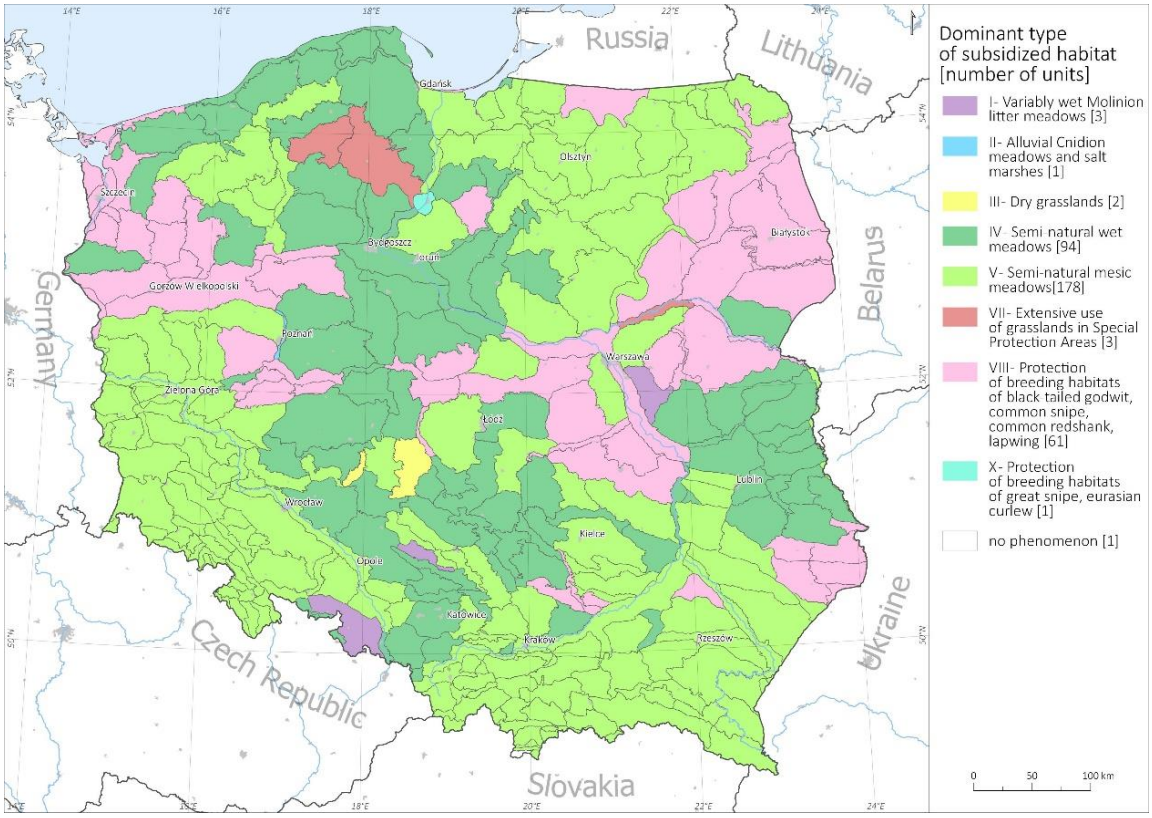

Figure 16. Dominant subsidised habitat types in mesoregions (Source: Authors based on ARMA data).

In 52 mesoregions, an equal share of several habitats was observed. This breakdown is characteristic of four sub-provinces: Central Poland Lowlands, Southern Baltic Lake Districts, Silesia-Kraków Upland, and Lublin-Lviv Upland. The absence of the phenomenon, i.e., of subsidised natural habitats in agriculture, was recorded only in the Western Tatra Mts mesoregion.

3.4. Comprehensive Assessment of Natural Habitats Covered by RDP 2014–2020 Support

In addition to determining the size and breakdown of EU fund uptake, the analysis also considers the problem of a synthetic approach to supporting the protection of natural habitats. Three diagnostic features were adopted as the basis for this targeted analysis, i.e.,:

(1) –Number of subsidised habitats in physico-geographical regions (Poland = 11). Significant territorial differentiation was shown at the sub-province level—from 5 (Eastern-Subcarpathians) to 11 (6 sub-provinces), and more so by mesoregions–from 1 or 2 (23 mesoregions, including 11 distinguished by the presence of only one habitat type) to 11 (16 mesoregions included all analysed habitats) (Table 3);

(2) –Percentage share of subsidised habitats in the total farm area (3.2% on average for Poland). Significant territorial differentiation was shown at the sub-province level—from less than 1% (Silesia-Kraków Upland and Lublin-Lviv Upland) to nearly 47% (Outer Eastern Carpathians), and more so by mesoregions—from 0.02% (Strzegom Hills and Racibórz Gate) to 58.3% (Bieszczady Mts) (Table 3, Figure 2);

(3) –Percentage share of subsidised habitats in the total area of permanent grassland (average 11.8% for Poland). Significant territorial differentiation was shown at the sub-province level—from 2.1% (Silesia-Kraków Upland) to 50.5% (Outer Eastern Carpathians), and by mesoregions—from less than 0.1% (Reglowe Tatra Mts and Sub-Tatra Depression) to 72.9% (Toruń-Eberswalde Ice Marginal Valley) (Table 3, Figure 15).

Table 3. Units of the physical and geographic division of Poland—selected evaluation criteria and synthetic evaluation of support for the protection of nature value habitats subsidised under RDP 2014–2020 agri-environment-climate measures.

Physico-Geographical Units		Average Number of Habitats Subsidised	Area of Nature Value Habitats Subsidised		Synthetic Evaluation Index of EU Support for Protection of Nature Value Habitats on Farms (Normalised Average)
Province (7 Units)	**Sub-Province (18 Units)**		**% of Agricultural Lands in Farms**	**% of Total Permanent Grassland by Area**	
Poland—total		7.0	3.2	11.8	0.00
Central European Lowland	Southern Baltic Coastlands	8.2	8.3	26.6	0.77
	Southern Baltic Lake Districts	8.3	3.2	17.1	0.31
	Saxony-Lusatia Lowlands	7.9	7.1	26.1	0.66
	Central Poland Lowlands	7.7	1.1	4.7	−0.18
Czech Massif	Sudety Mts and Sudety Foreland	5.6	5.0	14.2	−0.03
Polish Uplands	Silesia-Kraków Upland	3.7	0.7	2.1	−0.77
	Małopolska Upland	6.6	1.4	5.0	−0.30
	Lublin-Lviv Upland	6.8	0.8	6.5	−0.27
Western Carpathians and Western and Northern Subcarpathians	Northern Subcarpathians	5.3	3.1	7.3	−0.33
	Outer Western Carpathians	4.5	6.1	12.7	−0.16
	Central Western Carpathians	3.4	5.3	4.3	−0.54
Eastern Carpathians and Eastern Subcarpathians	Eastern Subcarpathians	5.3	10.5	28.2	0.53
	Outer Eastern Carpathians	7.0	46.7	50.5	2.99
Eastern Baltic-Belarus Lowland	Eastern Baltic Coastland	9.0	8.1	23.8	0.79
	Eastern Baltic Lake District	8.2	6.2	14.5	0.36
	Podlasie-Belarus Heights	9.5	4.4	11.0	0.36
	Polesie	9.7	8.0	20.2	0.78
Ucrainian Uplands	Volhyn-Podole Upland	8.3	2.7	13.9	0.19

(Source: Authors based on ARMA and Statistics Poland data).

The variability in the synthetic indicator assessing EU support for nature value habitat protection on farms by sub-province (calculations use the average number of mesoregions per sub-province) ranges from −0.77 (Silesia-Kraków Upland) to 2.99 (Outer Eastern Carpathians) (Table 3). By mesoregions, this variability ranges from −1.20 (Reglowe Tatra Mts, SubTatra Depression, and Racibórz Gate) to 3.12 (Toruń-Eberswalde Ice Marginal Valley) and 3.56 in Bieszczady Mts. A very low assessment index for EU support (below −0.75) was found in 54 mesoregions (Figure 17).

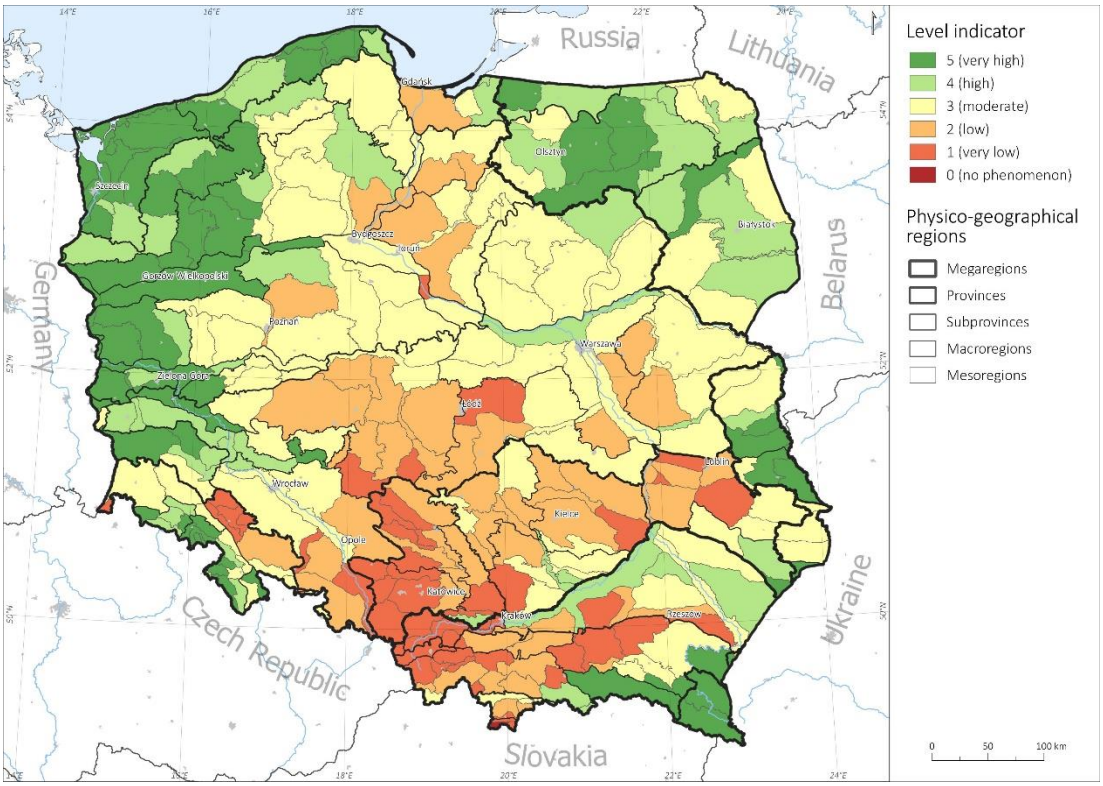

Figure 17. Synthetic evaluation index of EU support for nature value habitat protection on farms in Poland (Source: Authors based on ARMA and Statistics Poland data).

Regions in western, northern and south-eastern Poland have a high or very high rate. These are mainly regions with a significant share of area forms of nature protection, in particular those designated as European Natura 2000 protected areas and national parks. It should be noted that the areas of northern and western Poland were formerly under the Prussian partition and Germany in the interwar period, and after World War II, these became an area of strengthened state agriculture, and after 1990—as agriculture was privatised—saw the creation of a group of large-scale private farms run as both family farms and commercial law companies [59]. Those farms are often characterised by above-average size by area and very low human labour inputs. They are mostly crop-oriented, and their managers are characterised by an above-average level of education. However, a high level of use of funds was also noted in areas with low levels of agricultural development (e.g., in south-eastern Poland) operating in areas with specific environmental conditions unfavourable to agricultural development, which translates into the country's lowest agricultural intensity and productivity [60].

A low or very low rate of EU support for nature value habitat protection on farms is mainly recorded in the mesoregions of central Poland, which have a very high share of agricultural land in their total area, often exceeding 75% [61]. There are various types of farming in this area. On the one hand, there is comprehensively developed agriculture (e.g., 318.12, 315.55, 315.11, 315.59), which constitutes strategic areas of agricultural production in Poland, and, on the other hand, traditional agriculture (e.g., 318.81, 342.11, 342.12), where we see a low percentage of farms producing mainly for the market (with the majority engaging instead in subsistence production) [60]. Jadczyszyn and Zieliński [62] determined that farms in communes with a high proportion of HNV farmlands have, for example, a smaller area of agricultural land, lower labour inputs, lower value of capital (including machines and equipment), and lower-income per ha of agricultural land, which limits their growth potential.

4. Discussion

AECM activity is a particularly important pro-environmental CAP instrument being implemented under RDP. Five-year agri-environmental commitments have been made in Poland by 45,600 agricultural producers. It was found that the size of the area covered by RDP habitat payments is highly spatially diverse—both in the sub-provincial system (from 300 ha in the Eastern Subcarpathians to 119,400 ha in the Southern Baltic Lake Districts) and according to mesoregions (from no phenomenon in the Western Tatra Mts to 20,800 ha in the Gorzów Basin).

The analysis showed that in the analysed period, payments in the amount of almost EUR 500 million were made for the support of valuable habitats. However, it is a small amount, which is confirmed, on the one hand, by the low participation of these kinds of payments in the general subsidies intended for the rural areas and agriculture development, on the other hand, by natural potential and the sustainable-pronatural development of Polish agriculture potential. The studies of Mądry et al. [63] show that HNV farmlands are on almost 1000 communes (44% of the country area). In these conditions, it is the correct assumption of EGD concerning the implementation of stricter environmental rules within the direct payment. It has a significant meaning for Poland because the displacement scale of funds from the second (rural development) to the first pillar (direct payments) was one of the highest in UE [14].

Support for valuable habitats was divided into two parts. It included six schemes (I–VI) for the protection of natural habitats, constituting the predominant (70.2%) form of aid (the effect of combined coverage of Natura 2000 areas and payments outside these areas) and five schemes (VII–XI) for the protection of bird breeding habitats (29.8%), which is the effect of payment only in Natura 2000 areas. Not only was a strong spatial differentiation of the subsidised habitats shown, but so too the relationships between types of protected habitats were shown to be highly differentiated.

A high level of diversification is noticeable at the sub-province level, and especially at the mesoregion level, not only in the number of subsidised habitats but also in their percentage share in the total farm area (average for Poland, 3.2%) and in the total area of permanent grassland (average for Poland 11.8%).

In mesoregions in central Poland, which often have the country's highest share of agricultural land in the total farm area (exceeding 75%) and the presence of high-intensity agriculture, the rate of EU support for the protection of nature value habitats on farms was low or very low. A high or very high rate of EU support for the protection of nature value habitats on farms is mainly typical of regions in western, south-western, northern, and south-eastern Poland, which have a significant share of area forms of nature protection, and especially Natura 2000 areas and national parks. The presence of these forms of nature protection is closely related to the natural conditions of these areas, namely: Southern Baltic Coastlands and Southern Baltic Lake Districts (in the west and north of the country), Sudety Mts and Sudety Foreland (south-west), and Polesie and Outer Western Carpathians (south-east). These are areas with a diversity of landscape types, a topography of highly variable elevations (especially mountain ranges and foothills), and the presence of numerous lakes and watercourses (e.g., Southern Baltic Lake Districts and Polesie), as well as forest areas. Generally speaking, these areas are attractive to tourists, having both natural and cultural value. The agriculture of these areas is also diversified. On the one hand, there are large-scale farms focused on crop production, for which pro-environmental activities may, thanks to the relatively high level of subsidies, constitute a lucrative source of income. On the other hand, there are small farms practising extensive farming in difficult environmental conditions, for which engaging in pro-environmental activities is an attractive direction for development and operation. Given the future development of these areas, including tourism, the support and protection of HNV farmlands are of great value.

Despite the methodological differences and changes in AECM mechanisms, the received in-study spatial distribution, including distribution of the main "focus" of the valuable habitat support (northern and western part of the country), alludes to and con-

firms the results of previous AECM studies in that area concerning both the perspective 2004–2006 [64], 2007–2013 [65,66], and 2014–2020 [67].

The visible dichotomy in the level of support for nature value habitat protection on farms results from the diversification of the natural environment in individual mesoregions (which determines the possibility of obtaining support) and past and present human activity expressed in the spatial diversity of agriculture. Therefore, the variety of support offered (11 schemes) should be assessed positively since it must meet the various needs of farms and farmers. Nevertheless, there is a need to revise the criteria for the distribution of public support in the 11 schemes above. As we know, financial objectives are the most common justification for accepting or rejecting AECM by agricultural producers [4,22,68]. On the other hand, environmental issues are ranked lower among the determinants influencing the decision to participate in AECM. It also happens that farmers choose instruments that do not require too much financial expenditure, bring profit but are not always valuable from the point of view of protecting HNV [69]. For the AECM instruments to be effective, it is, therefore, necessary to consider the expectations of farmers (inc. economic ones) and directions of activities to protect the biodiversity of the areas constituting farms [70]. The leading role here is played by the contextualisation of pro-ecological undertakings. Local conditions, including features of the environment and the natural and landscape regions, should be considered when designing a nature management program in agriculture. As previous studies showed, management of the program and monitoring its implementation requires estimating the location of HNV and changes in their area. The classification must be adapted to the physico-geographical and landscape diversity of the given area [71–73]. This approach guarantees the definition of more specific and tailored pro-development activities, as well as the rationalisation of the distribution of EU financial instruments. Only proper spatial suitability (support corresponding to the area needs) enables effective usage of CAP funds [74]. Given the diversity of European contexts, it is, therefore, required to identify geographic regions with similar structural features [75]. This is an essential step towards the inclusive and place-based development, which are the guidelines of EGD [76].

5. Conclusions

The results presented in the paper constitute an innovative approach to spatial analyses of EU support for nature value habitats, which had previously been conducted mainly within administrative division units. Doing this analysis using the physical geographic regionalisation, which is the basic descriptive and systematising procedure in many sciences, broadens the research perspective on the implementation of the European Green Deal and its policies, including in the field of sustainable agriculture and the protection of sensitive ecosystems. It also allows the implementation of activities in this area to be verified, taking into account environmental conditions and the development of sustainable, pro-environmental agriculture.

This approach is the key to inclusive socio-economic development, including in agriculture and tourism in rural areas, which reflects the objectives of the European Green Deal. The pursuit of these objectives, in turn, is a starting point for building rural resilience, is understood as the ability of the socio-ecological system to cope with and adapt to social, political and environmental disruptions [77].

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/agriculture11090864/s1. Figure S1: Polish physico-geographical regions (Source: Authors based on [26]).

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