Marek ZIELIŃSKI • Jan JADCZYSZYN

IMPORTANCE AND CHALLENGES FOR AGRICULTURE FROM HIGH NATURE VALUE FARMLANDS (HNVf) IN POLAND IN THE CONTEXT OF THE PROVISION OF PUBLIC GOODS UNDER THE EUROPEAN GREEN DEAL

Marek **Zieliński** (ORCID: 0000-0002-6686-5539) – *Institute of Agricultural and Food Economics National Research Institute, Department of Economics of Agriculture and Horticulture Holdings*

Jan **Jadczyszyn** (ORCID: 0000-0003-4921-7609) – *Institute of Soil Science and Plant Cultivation State Research Institute, Department of Soil Science Erosion and Land Conservation*

Correspondence address:
Świętokrzyska Street 20, 00-002 Warsaw, Poland
e-mail: marek.zielinski@ierigz.waw.pl

ABSTRACT: The study aims to identify and characterise the organisational and economic features of agriculture in Poland in areas (communes) with different saturation of agriculture from High Nature Value farmlands (HNVf areas) with exceptionally high natural value. It is also important to determine whether the potential changes in agriculture in communes with a particularly large share of them do not harm the natural environment and limit the possibility of providing society with public goods. The delimitation of the three scenarios of HNVf areas was designated in the country at the request of the Ministry of Agriculture and Rural Development in 2018. HNVf areas of moderate, high, and exceptionally high natural value were designated. To achieve the purpose of the study, data from the Agency for Restructuring and Modernization of Agriculture (ARMA) for 2016 and 2021 and data from the Polish Farm Accountancy Data Network (FADN) for 2018-2020 was obtained. It was established that in Poland, the share of HNVf areas currently ranges from 12.5 (exceptionally high natural value) to 27.1% (moderate-high nature value) of the total UAA. Compared to other areas, HNVf areas with exceptionally high natural value are characterised by agriculture with a high level of extensive production. Farms from these areas obtain, e.g. lower total costs incurred per 1 ha of UAA, often lower productivity of production factors and lower income per 1 ha of UAA.

KEYWORDS: High Nature Value farmlands (HNVf), biodiversity, farms, FADN, organic farming, European Green Deal

Introduction

One of the fundamental challenges for the European Union (EU) is to make even greater efforts to protect the natural environment in the conditions of the progressing intensification of agriculture in areas favourable for its development and, at the same time, to inhibit the phenomenon of local abandonment of the poorest soils (Renwick et al., 2013; Van der Zanden et al., 2017; Secretariat of the Convention on Biological Diversity, 2020; European Environmental Agency, 2019; Zgłobicki et al., 2020; European Parliament, 2020). The circumstances are particularly undesirable in naturally valuable areas, as they are usually accompanied by a large loss of biodiversity and landscape value (Stoate et al., 2009; Lomba et al., 2014; O'Rourke & Kramm, 2012; Plieninger et al., 2013). As a result of the intensification of agricultural production in recent decades, many habitats of particular importance for biodiversity have been degraded, and the population of birds in rural Europe has significantly decreased (Benton et al., 2003; Donald et al., 2001; Gregory et al., 2005; Butler et al., 2010). Threats to the natural environment in agricultural areas require, on the one hand, the definition of protective measures and, on the other hand, an assessment of the impact of agricultural production on the quality of the habitat and biodiversity.

At present, the European Commission (EC) shows a particular will and readiness to implement decisive actions for the protection of areas of high natural value in the environmental, social, and economic dimensions. It is expressed, inter alia, in the thematic strategies under the European Green Deal (EGD), and above all in the EU Biodiversity Strategy 2030 – Bringing nature back into our lives, the Farm to Fork Strategy, the EU Soil Strategy to 2030, the New Strategy on adaptation to climate change, the document Ready for 55: reaching the EU 2030 climate target – on the way to climate neutrality and in the New Forest Strategy to 2030 (European Commission, 2020a; European Commission, 2020b; European Commission, 2021a; European Commission, 2021b; European Commission, 2021c; European Commission, 2021d). In this context, multifunctional agriculture will have an important role to play, as taking care of the condition of agricultural land may provide many public goods not valued by the market, but expected by society, commonly regarded as positive external effects of its activity. They include: 1) maintaining a high level of biodiversity of agricultural areas, 2) tourist, recreational and settlement attractiveness of rural landscapes, 3) good quality of water, air, and soil, 4) inhibiting climate change, 5) high-quality production food, and 6) sustainable development of agriculture and rural areas, considering socio-economic conditions (Roszkowska-Mądra, 2018; Power, 2010; Keenleyside et al., 2014; Lomba, 2014; Sullivan et al., 2017). However, for agricul-

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ture to provide the expected goods in a sustainable and stable manner, appropriate public regulations are usually necessary (Navarro & Pereira, 2015; Schläpfer, 2020). On the other hand, characteristics of farmers are also important, including their knowledge, management skills and professed value systems, which also explains why certain changes aimed at protecting the natural environment take place in one place and not in another under comparable management conditions (Ustaoglu & Collier, 2018).

Generally speaking, the provision of public goods by agriculture from areas with high natural value to the extent desired by society requires the application of appropriate rules (institutions). According to North (1990), the institutions are "rules of the games" in society, and they include both formal institutions, i.e., legal norms and rules, and informal ones, understood as rules and codes of conduct, behavioural norms, traditions and acquired experience. The institutions encourage people to innovate, learn and educate to find better ways to act in problem-solving. For institutions to properly respond to the needs of society, appropriate mechanisms of their enforcement are needed, including voluntary and imposed norms of behaviour (North, 1990; Acemoglu et al., 2004). Therefore, it should be stated that the indicated institutions and the mechanisms of their enforcement have a key impact on the ability of agriculture to respect natural values.

In the EU, for the protection and enrichment of biodiversity, it should be extremely important to preserve agriculture with extensive agricultural production in areas of high natural value (Stoate et al., 2009; Pe'er et al., 2020). There is no doubt that it is, therefore, extremely important to care for the areas of High Nature Value farmlands (HNVf), where extensive farming is associated with high biodiversity and the preservation of a diverse landscape (Benedetti, 2017; Gardi et al., 2016). It is usually carried out in the presence of permanent grassland and in the vicinity of, inter alia, watercourses and reservoirs, wetlands, wastelands, as well as hedges and forests. It should be added that currently, the HNVf indicator – expressed as the share of highly valuable UAA in the total UAA – is one of the indicators used by EUROSTAT to assess the impact of agriculture on the natural environment and the European Commission as a context indicator (common context indicator – C.37) to monitor the effects of the current CAP measures for its protection (Zomeni et al., 2018; European Commission, 2017a; Lomba et al., 2014; Batary et al., 2015; Kleijn et al., 2011).

It is justified to fill the research gap aimed at establishing Poland areas with agriculture from HNVf under the CAP 2014-2020 and its characteristics.

In Poland, in 2018, under the CAP 2014-2020, three variants of HNVf areas were designated in accordance with the EU guidelines (European Commission, 2017b) contained in the document entitled *Working Document. Practices to identify, monitor, and assess HNF farming in RDPs 2014-2020*,

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which result from the concept of delimitation developed in Europe since the early 1990s (Andersen et al., 2003; Paracchini et al., 2008). HNVf areas of moderate, high, and exceptionally high natural value have been established (Jadczyszyn & Zieliński, 2020).

The aim of this study is characteristic of the potential and organisation of agriculture in areas with different saturation with HNVf areas with exceptionally high natural value. It is also important to determine whether the potential changes taking place in agriculture in communes with a particularly large share of them do not harm the natural environment and limit the possibilities of providing public goods to the public, and how big a challenge is to protect them under the conditions of increasing competitive pressure.

An overview of the literature

The concept of separating areas of high natural value for agricultural use (HNVf UAA) in Europe was developed in the early 1990s in response to the growing interest in the protection of biodiversity and the desire to maintain traditional, low-intensive agriculture (European Commission, 2009; Baldock et al., 1993; Beaufoy et al., 1994; Baldock, 1999; Beaufoy, 2008). It includes various types of habitats in Europe that are threatened by agricultural activities, in particular, semi-natural farmland with high biodiversity and low fertilisation intensity and agricultural areas with a large mosaic of use and planting patterns, including semi-natural pastures, meadows, orchards, hedges and forest cover (Baldock et al., 1993; Bignal et al., 1994; Bignal & McCracken, 1996). Spatial identification of HNVf areas at the European level is recommended based on the CORINE Land Cover types data (that are closely related to the semi-natural agricultural elements), Land use / cover area frame survey (LUCAS) and other spatial data from the collection for the needs of the Integrated Administration and Control System (IACS), or, inter alia, the protection of natural resources such as Natura 2000 (Andersen et al., 2003; Paracchini et al., 2008). However, considering different physiographic and climatic conditions on the European scale, individual member states developed their own detailed criteria for the separation and monitoring of HNVf areas (Benedetti et al., 2017). Currently, a uniform and common approach to assessing them on the European scale has not yet been developed (Lomba et al., 2014). In Finland, the HNVf index is calculated as based on information from farms at the field level and includes the sum of three main indicators (strong sub-indicators), which include semi-natural grassland, permanent pasture, and agricultural and environmental areas (under relevant AECM contracts) (Heliola et al., 2009). On the other hand, the second group of weak sub-indicators concerns the edge density, extensive cultivation, and livestock

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production. Whereas identification of HNVf on the island of Cyprus was carried out within 1 km based on spatial data characterising agriculture in terms of the level of fertilisation irrigation intensity and biodiversity diversity (Zomeni et al., 2018). The map of HNVf areas in the Republic of Ireland was developed as based on a cluster analysis of three basic indicators characterising rural areas: semi-natural vegetation, the intensity of use and the indicator of landscape diversification (Sullivan et al., 2017; Beaufoy, 2008). As a result of the delimitation, approximately 33% of the rural areas of the Republic of Ireland obtained the status of HNVf areas, of which approximately 50% overlap with Natura 2000 sites very important for biodiversity (Moran et al., 2021; Matin et al., 2020).

In many publications, HNVf areas are also equated with agricultural marginal lands and the presence of socio-economic problems (Pe'er et al., 2020; Paracchini et al., 2008; Baldock, 1999; European Commission, 2009; Beaufoy, 2008). HNVf areas are characterised by a long-term, stable method of extensive agricultural use with livestock rearing, using labour-intensive cultivation systems adapted to local soil types and the selection of crop plants in rotation to the climate (Keenleyside et al., 2014). Despite the rational assumptions used in the identification of HNVf sites, little is known to what extent they meet important criteria for biodiversity indicators or the presence of rare species of fauna and flora (Gregory et al., 2005).

In addition to the above-mentioned natural factors, HNVf areas in Poland also include rural areas with a fragmented agrarian structure, which are characterised by a small area of farms and a small area of agricultural plots. As a result, a large mosaic of meadows, access roads and crops in the areas limits the intensification of agricultural production and creates a very varied agricultural landscape (Jadczyszyn & Zieliński, 2020). Preliminary results of the research on the assessment of the conditions of agricultural activity in the group of FADN farms in Poland showed a significantly lower soil quality index and lower yields of basic commercial crops such as wheat and maise in areas with a higher share of HNVf (Jadczyszyn & Zieliński, 2020).

The main purpose of identifying HNVf areas is, on the one hand, protecting them against the intensification of agricultural production and loss of biodiversity and, on the other hand, protection against abandonment of agricultural activity and setting aside a significant acreage of agricultural land (Keenleyside et al., 2014). The maintenance of semi-natural habitats used for agriculture creates opportunities for the provision of broadly understood ecosystem services and the provision of public goods related to the accumulation of carbon in the environment, water retention and purity, biodiversity of fauna and flora, maintenance of traditional landscape and cultural resources. Preserving the areas in the current state may significantly contrib-

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ute to maintaining the multifunctional character of rural areas, the stability of economic and social processes, and inhibiting climate change.

Research method

The concept of delineating high nature value agricultural areas (HNVf) in Poland is in line with the EC guidelines (Baldock et al., 1993; Bignal & McCracken, 1996) and is based on two basic assumptions. The first assumption covers rural areas saturated with farms with extensive agricultural production expressed by them in terms of low costs, low stocking density and a low share of permanent and horticultural crops in UAA, and at the same time keeping animals fed with roughage on permanent grasslands.

The second assumption relates directly to the quality of the natural environment adjacent to agriculture with the extensive organisation of agricultural production, which naturally affects the biodiversity of agricultural land and rural landscape. In this context, areas with particularly valuable features for the biodiversity of the soil habitat, flora and fauna and landscape were to be environmentally valuable areas. They include, inter alia, national and landscape parks with their buffer zones, Natura 2000 areas, areas occupied mainly by agriculture with a large share of natural areas (Corine 21), permanent grasslands, organic soils and soils of organic origin, wetlands, areas with excessive fragmentation of farms and ecological corridors constituting communication routes for many species of plants and animals. The listed elements of the environment were valorised and given appropriate proportional weights to the value of nature by authors and other researchers from the Institute of Soil Science and Plant Cultivation State Research Institute in Pulawy that were accepted by the Ministry of Agriculture and Rural Development from Poland. Next, an analysis of the neighbourhood was performed with the use of a movable window in the shape of a circle with a radius of 1 km, as a result of which a layer with the averaged value of the maximum weight with a resolution of 100×100 m (1 ha) was obtained. Three scenarios of HNVf areas were created in relation to communes (including geodetic precincts) saturated with the extensive organisation of agricultural production and differing in natural value in terms of average maximum weight: 3.0-10.0; 3.5-10.0; 4.0-10.0 (Fig. 1). These scenarios of HNVf areas were developed by authors and other researchers from the Institute of Soil Science and Plant Cultivation State Research Institute in Pulawy in accordance with guidelines of the EC and under supervision of the Ministry of Agriculture and Rural Development from Poland. In order to determine the characteristic of agriculture from areas with exceptionally high natural value, further analyses took into account the scenario with the maximum weight (weight 4.0-10.0).

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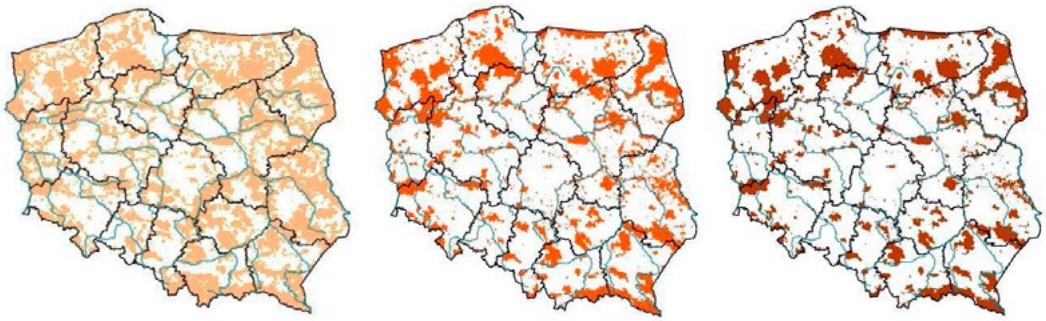

Figure 1. Scenarios of HNVf areas depending on the averaged value of the maximum weight: A) 3.0-10.0; B) 3.5-10.0; C) 4.0-10.0 in Poland

Source: Institute of Soil Science and Plant Cultivation – State Research institute and Institute of Agricultural and Food Economics – National Research Institute study.

To achieve the objectives of this study, scenario (C) with the highest averaged value of the maximum weight (weight 4.0-10.0) was adopted, within which five groups of communes were distinguished depending on the degree of saturation with HNVf areas of extremely high natural value. It should be noted that the scale of their occurrence in the country is large, as it concerns about 1.9 million ha of UAA located in 44.2% of all communes. The first group consisted of 147 communes with at least 75% share of HNVf areas in the total UAA, hereinafter referred to as communes with a particularly high share. The second group consisted of 93 communes with their share in the range <50-75%), hereinafter referred to as communes with a high share of the areas. Whereas the third and fourth, respectively, 219 and 637 communes, where the share of HNVf areas amounted to <25-50%, respectively) and less than 25% of the total UAA. They were conventionally called communes with an average and small share of the areas. The fifth group of communes (1,381 communes) constituting a point of reference for them were those where such UAA was not recorded and was called communes with a lack of HNVf areas (Figure 2).

In the groups of communes, natural conditions of management, as well as the value and diversity of the landscape, were first established. To determine natural conditions of management, the data of the Institute of Soil Science and Plant Cultivation – State Research Institute in Puławy was used regarding the average value of the agricultural production area valorization index (APAV) in communes in Poland and the share of Areas facing Natural or other Specific constraints (ANCs) in the total UAA. The analysis used the latest update of the APAV indicator dated back to 2017 and the delimitation of ANCs areas dated back to 2019 (Zieliński et al., 2022). Then attention was paid to the value and diversity of their landscape. The degree of diversifica-

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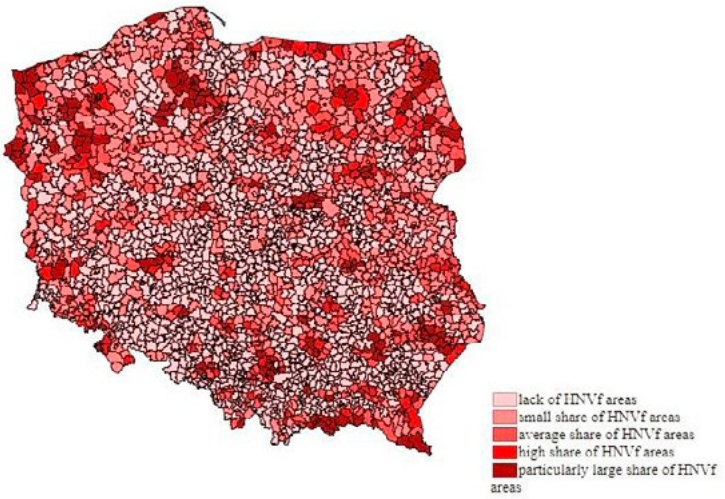

Figure 2. Distribution of communes with different saturation with HNVf areas of exceptionally high natural value in the total UAA in Poland

Source: authors' work based on data from the Institute of Soil Science and Plant Cultivation – State Research institute and Institute of Agricultural and Food Economics – National Research Institute.

tion was determined by the Nature and Tourism Index (NTI), which was used by the Institute of Soil Science and Plant Cultivation – State Research Institute at work on a new delimitation of ANCs affected by specific constraints zone I (naturally valuable) in the country (from 2019). This indicator is the share of the sum of the areas of permanent grasslands, forests, reservoirs, and watercourses, as well as other areas not subjected to strong anthropopressure in the total area of communes (or registration precincts). However, the natural values of the communes are determined not only by the landscape diversity but also by its value, hence the share of Natura 2000 areas in their overall area has also been established.

Subsequently, in selected groups of communes, characteristics of the potential and organisation of agriculture were indicated based on data from the Agency for Restructuring and Modernization of Agriculture (ARMA), which was generated on the basis of applications submitted by 1,345.2 and 1,269.5 thousand agricultural farms, respectively – beneficiaries of the CAP 2014–2020 – for granting direct payments under the campaigns for 2016 and 2021 and compiled by communes. Data on the number and density of livestock (cattle, pigs, goats, and sheep) per 1 ha of UAA from the animal identification and registration system (IRS) and additional data from farms conducting organic production under the current CAP in 2016 and 2021 was used. The data made it

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possible to establish, in each group of communes, e.g., the number of farms operating in them, the UAA, including arable land, permanent grassland and permanent crops, as well as those used ecologically, as well as the stocking density expressed in Livestock Units (LU) per 1 ha of UAA. They also allowed determining the share of grains, structure-forming plants and grasses, root crops, oilseeds, fallow plants, including those with honey plants, and other plants in the sowing structure. The Shannon-Wiener index (S-W index) was also used to determine the degree of differentiation of crop species (Magurran, 1996; Matyka, 2017).In the final resultant part of the study, production potential, costs, factor productivity, economic results and possibilities for further development of farms were assessed from communes with a particularly high share of HNVf areas with exceptionally high natural value (weight 4.0-10.0). To determine their production potential, the following categories were taken into account: area of UAA and labour inputs per 1 ha of UAA. Total costs per 1 ha of UAA contain total specific farming overheads, depreciation and external factors costs per 1 ha of UAA. Labour productivity was indicated by the relation value of production per 1 ha of UAA and per 1 Annual Work Unit (2120 hours of paid and unpaid labour input in farm per year = 1 AWU). Moreover, was established income per 1 ha of UAA or per 1 Family Work Unit (2120 hours of unpaid labour input in farm per year = 1 FWU). Net investment rate (%) was indicated as the relation of the value of net investment of fixed assets and depreciation.

The assessment was carried out in a group of farms in general, including dairy cows and mixed plant-animal production with a standard economic size of less than 25,000; (25,000-50,000) and at least 50,000 euro SO (Standard Output) broken down by communes with a particularly high share of HNVf areas (at least 75%) with an exceptionally high natural value in the total UAA in comparison to farms from communes without HNVf areas. For this purpose, accounting data from farms which continuously kept accounts for the Polish FADN in the years 2018-2020 was used. It should be added that when dividing farms according to their type of farming, the belief in their special contribution to the protection of biodiversity and landscape on HNVf areas was followed.

Results of the research

Characteristic of the production potential and organisation of agriculture in areas with different saturation with HNVf areas

In Poland, difficult farming conditions are often an important factor limiting the achieved production and economic effects in many farms. The scope

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of this problem is large, as 58.4% of communes have an average APAV index lower than the national average (66.6 points out of 120 points that can be achieved), including 18.3% of the communes with an average index APAV below 52 points. This means that there are particularly unfavourable natural conditions for agricultural production in the areas, including generally high susceptibility to erosion. The advantage of the areas, however, is usually their great value and diversity of landscape. Due to non-economic aspects, including, firstly, the provision of many public goods, they should therefore be subject to primary care by the agriculture operating in them, meeting the HNVf criteria. Economic and economic characteristics of communes in the country with a high and particularly high share of HNVf areas of exceptional natural value in the total UAA are, therefore, particularly important in such a situation.

Communes with a high and particularly high share of HNVf areas and exceptionally high natural value constitute 9.7% of the total number of communes in the country. Compared to the communes being the reference point, they are characterised by much less favourable natural conditions determined by the average APAV index, where it is 56.5 and 58.0 points, respectively, and 68.5 points for areas without HNVf areas. Such a situation is also confirmed by the share of ANCs in the total UAA. In the communes, the share is the highest and amounts to 81.2% and 85.6%, respectively (Table 1). It should also be noted that the share of ANCs-decreases along with a decrease in the share of HNVf areas, and ultimately in communes without HNVf, ANCs constitutes an average of 49.8% of the total UAA. The strength of communes with an exceptionally high and high share of HNVf areas is, on the other hand, a varied landscape, as evidenced by their average NTI index, amounting to over 50 points per 100 points achievable.[1;2] Moreover, the communes are distinguished by the highest natural value, as evidenced by the large share of Natura 2000 areas in their total area, amounting to 51.6% and 69.3%, respectively (Table 1). The communes are therefore especially predestined to protect the natural environment and provide many valuable ecosystem services and public goods to society. They also have unique predispositions to the development of, among others, organic farming and agritourism (Table 1).

In 2021, in communes with a high and particularly high share of HNVf areas, there were 51.6 and 56.2 thousand farms, respectively, which accounted for a total of 8.5% of the total farms covered by the current CAP. It should be added that in the years 2016-2021, in all the groups of communes, there was

1 This means that more than half of the land in the communes is, inter alia, permanent grasslands, forests, reservoirs, and watercourses, as well as other areas not subject to strong anthropopressure.

2 Average value of the NTI index in communes in Poland is 35.6 points (Zieliński et al 2020).

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a decrease in the number of farms, mainly related to the ongoing process of land concentration and specialisation of agricultural production in the country, although the scale of this phenomenon was slightly greater in communes without HNVf areas (Table 2).

Table 1. Natural conditions of management as well as the value and diversity of the landscape in communes with different saturation of HNVf areas with exceptionally high natural value in the total UAA

Description	unit of measure	Communes with the share of HNVf areas in total UAA:				without HNVf areas
		particularly high	high	average	small	
Number of communes (1)		147	93	219	637	1381
APAV indicator (2)	points	56.5	58.0	59.7	62.4	68.5
The Share of ANCs in the total UAA (3)	%	85.6	81.2	76.7	70.9	49.8
Share of Natura 2000 areas in the total area (4)	%	69.3	51.6	45.0	30.7	8.2
NTI index (5)	points	55.4	51.7	46.7	39.8	31.1

Source: a study based on the data: (1), (2), (3), (4), (5) Institute of Soil Science and Plant Cultivation – State Research institute data for 2018.

Table 2. Features of the potential and organisation of agriculture in communes with different saturation of HNVf areas with exceptionally high natural value in the total UAA in 2016 and 2021

Description	unit of measure	Communes with the share of HNV areas in total UAA:								without HNV areas	
		particularly high		high		average		small			
		2016	2021	2016	2021	2016	2021	2016	2021	2016	2021
Number of farms	thousand	59.1	56.2	54.2	51.6	126.3	120.1	390.6	370.4	715.0	671.2
Average UAA in a farm	ha	10.2	10.9	10.7	11.2	10.2	10.7	11.6	12.2	10.1	10.7
UAA, including:	thousand ha	602.2	612.5	577.7	579.5	1282	1285.3	4537	4533	7219	7 208
• arable land share	%	64.9	64.3	58.1	58.2	67.5	68.3	75.6	76.7	83.4	84.4
• permanent grassland share	%	32.2	33.9	38.8	39.4	29.1	29.0	20.6	20.2	12.6	11.8
Density of grazing animals	LU/ha	0.31	0.29	0.38	0.37	0.40	0.39	0.36	0.35	0.32	0.32
Total animal density	LU/ha	0.38	0.36	0.43	0.43	0.51	0.51	0.51	0.48	0.46	0.48

Source: authors' work based on ARMA data for 2016 and 2021.

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UAA is the basic factor determining the production potential of agriculture. In communes with a high and exceptionally high share of HNVf areas, the average area of agricultural land on a farm was 11.2 and 10.9 ha, respectively, and was only slightly larger in relation to farms without HNVf areas (Table 2). In other EU countries, much larger differences have been recorded. For example, in Italy, the UAA of HNVf farms was more than twice as large as that of farms without HNVf areas (Keenleyside et al., 2014).

In communes with a high and particularly high share of HNVf areas, the total UAA in 2021 amounted to 579.5 and 612.5 thousand ha of UAA, respectively, of which 39.4 and 33.9%, respectively, were permanent grasslands, the share of which was three times higher than in communes without this type of UAA. At the same time, two and a half times greater share of permanent grasslands was also recorded in the case of communes with an average share of HNVf areas and less than twice as high in communes with a small share (Table 2).

Importantly, in the years 2016-2021, in communes with a particularly high share of HNVf areas, as compared to other communes, the largest increase in UAA was recorded, amounting to 10.3 thousand ha. Their growth was lower in communes with a high and average share, i.e., 1.8 and 3.3 thousand ha, respectively. ha. It should not be ruled out that an important reason for this could be the increase in the rates of agri-environment-climate and ecological payments under the current CAP from 2021, which could encourage a certain proportion of farms from the areas to resume production there. Moreover, in communes with a high and particularly high share of HNVf areas, an increase in UAA was accompanied by an increase in the share of permanent grasslands, which should be treated as a positive tendency from the point of view of further improvement of their biodiversity, landscape diversification and organic carbon sequestration. It is worth adding that in the other groups of communes, there was a decrease in arable land, including the share of permanent grassland (Table 2).

Another important feature of communes with a high and particularly high share of HNVf areas is the density of livestock per 1 ha of UAA, which is one of the basic indicators of the degree of intensity of management carried out in them. It turned out that in the communes, as compared to other communes, it was the lowest the highest share of herbivorous animals (cattle, goats, and sheep). Therefore, it is understandable that in the communes, as compared to the others, permanent grasslands were present to a greater extent (Table 2).

Communes with HNVf areas are especially predestined to implement environmental protection objectives under the EGD strategy, including primarily those relating to the increase in the share of organic farming in the EU to at least 25% of the total UAA by 2030. Reasons for the development in the

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communes, the good condition of biodiversity and landscape should be distinguished in the first place, which may confirm the high health and naturalness of organic products produced in the areas and encourage consumers to consume them to a greater extent. On the other hand, in the areas, it is usually desirable to undertake increased efforts to increase the resources of organic matter on arable land. Under the conditions of functioning on light soils, ecological farming practices should be of great importance for them, the use of which – among all available ones – is the most beneficial for the natural environment, as it allows for the optimal protection of its natural resources, especially soil.

In 2021, in communes with HNVf areas, there were 68.8% (296.4 thousand ha of UAA) of the total UAA with organic production supported under the CAP 2014-2020 in the country.[3] In the communes, as compared to other communes, its share in the total UAA was much higher. It was the highest in communes with a high share of HNVf areas, and it amounted to 4.5%, while in communes without this type of UAA, it amounted to – 1.9%. However, it should be emphasised that in 2016-2021 in communes with a high and particularly high share of HNVf areas, the area of UAA with organic production and its share in the total area of UAA decreased. This situation is extremely worrying because – as mentioned earlier – the communes have a special predisposition to develop ecological agriculture, which is for them not only a significant opportunity to improve farming conditions but also to obtain satisfactory income from agricultural activities and agritourism development due to their great natural values. It is worth adding that in the same period in other communes, there was an increase in of UAA with ecological production supported under the current CAP (Figure 3).

The use of agricultural crop rotation should be another characteristic feature of HNVf areas, which is beneficial – for the maintenance of the ecological balance of agrocenoses, which, especially on light soils with a low natural content of organic matter, is an important method of improving fertility. As a rule, it also carries a lower risk of diseases, weeds, and pests and, as a result, often has a decisive influence on the level of obtained production effects. In 2021, in communes with a high and particularly high share of HNVf areas, as compared to communes being the reference point, the share of grains lowest, and the share of structure-forming plants and grasses in field cultivation highest. It is worth noting that this situation is an important element of the pro-environmental economy and organisation of agricultural production, facilitating the determination of the correct selection and succession of crops, as well as the protection and enhancement of organic matter

[3] In Poland, according to ARMA data for 2021, the area of UAA with organic production supported under the CAP 2014-2020 amounted to 430.4 thousand ha.

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resources in soils. In addition, in the communes, there was also a greater share of fallow land, including the land with honey plants which are extremely important for the protection and growth of biodiversity because, inter alia, they create habitats for birds and small animals and provide valuable feeding grounds for pollinating insects.

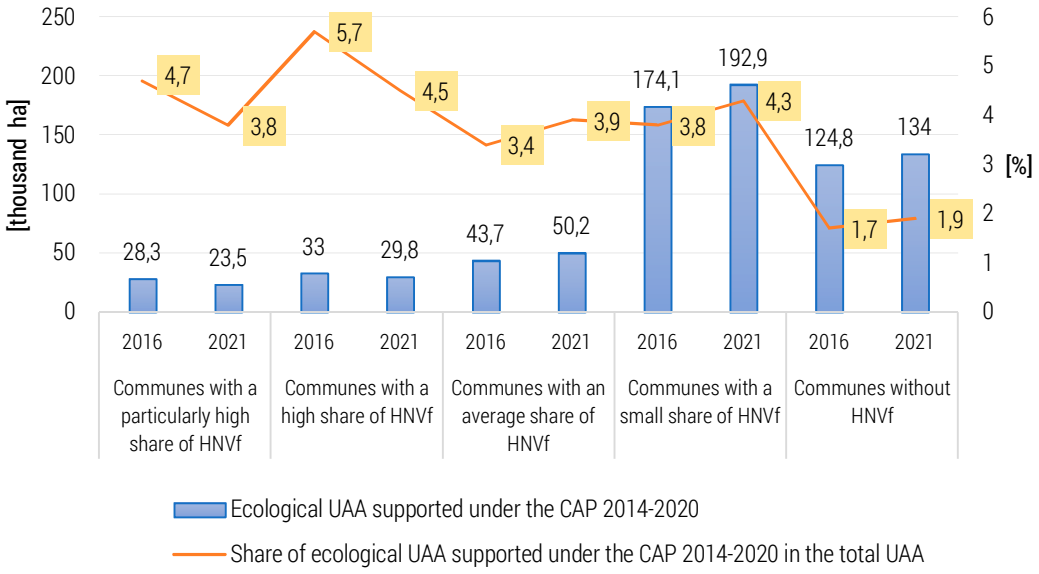

Figure 3. UAA with organic production (thousand ha) supported under the CAP 2014-2020 and its share in UAA in communes with different saturation of HNVf areas with exceptionally high natural value in 2016 and 2021

Source: authors' work based on ARMA data for 2016 and 2021.

On the other hand, they had a smaller share of root crops, which generally require better quality soils for their proper growth and development. It should be added, however, that the smaller variety of cultivated plant species, which was indicated by the lower value of their S-W index, was an important weakness of the communes, as compared to other communes, from the point of view of the differentiation of the crop structure. One of the most important reasons for this situation was probably related to their worse natural conditions, which made the cultivation of many species of crops with higher soil requirements economically unjustified (Table 3, Figure 3).

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Table 3. Structure of crops and the value of the Shannon-Wiener index in communes with different saturation of HNVf areas with exceptionally high natural value in the total UAA in 2021

Description	unit of measure	Communes with a share of HNVf areas in the UAA in total:				without HNV UAA
		particularly high	high	average	small	
Share of grains in arable land	%	67.8	68.3	72.8	71.7	73.0
Share of structure-forming plants and grasses in arable land	%	14.1	15.6	13.1	11.6	8.7
Share of root crops in arable land	%	2.9	2.6	3.1	4.0	5.1
Share of oil plants in arable land	%	9.0	8.0	7.0	9.4	10.0
Share of fallow lands, including those with honey plants in arable land	%	2.9	2.8	2.2	1.7	1.4
Share of other plants in arable land	%	3.3	2.7	1.8	1.6	1.8
Shannon-Wiener index	point	2.24	2.33	2.39	2.44	2.34

Source: authors' work based on ARMA data for 2021.

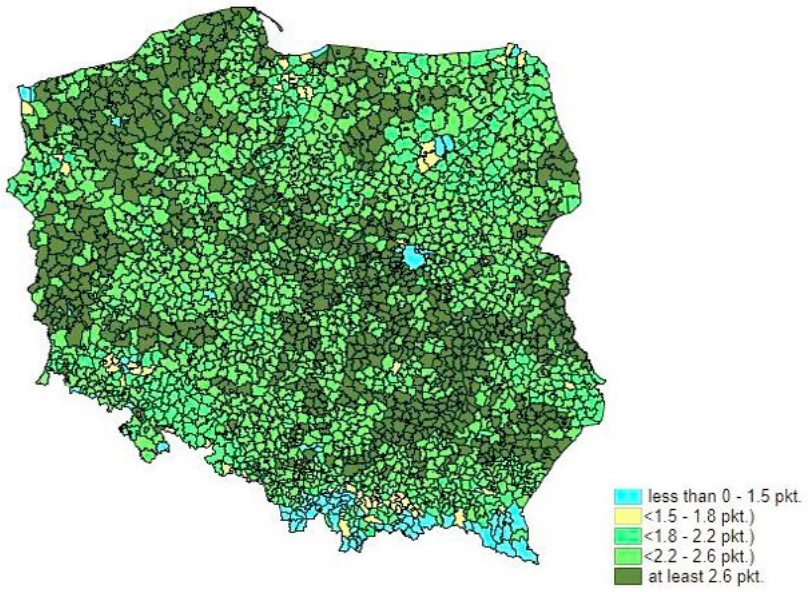

Figure 4. Value of the Shannon-Wiener index by communes in Poland in 2021

Source: authors' work based on ARMA data for 2021.

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Characteristic of farms in areas with particularly high saturation of HNVf areas based on the FADN database

Results of analyses of data from Polish FADN farms from communes with a particularly high share of HNVf areas with exceptionally high natural value showed that they had a larger average UAA as compared to analogous farms from communes without HNV areas. In addition, they incurred lower labor inputs per 1 ha of UAA, which decreased with an increase in economic strength. This tendency probably resulted from the increase in the technical equipment of work, which allowed them to limit its use (Table 4).

It is noteworthy that farms with a particularly large share of HNVf areas, as compared to similar farms used for comparisons, incurred lower total costs per 1 ha of UAA. The disproportion in this respect was visible both in the group of farms in general and in the group of farms with dairy and mixed cows. It should be noted that on the farms, lower costs incurred per 1 ha of UAA were reflected in lower land productivity. However, in the case of labour productivity, the direction of the differences was ambiguous. It turned out that on farms in total and with dairy cows with an economic size of 25-50 thousand EUR SO, as compared to similar farms from other farms, it was higher. This means that lower labour inputs were an important reason for this situation – in the situation of achieving lower land productivity (Table 4).

Farms from communes with a particularly large share of HNVf areas, as compared to the analogous farms used for comparisons, had a lower income per 1 ha of UAA. This income was also achieved to a greater extent, thanks to operating subsidies. Without the subsidies, the difference would therefore be even greater to their disadvantage. On the other hand, the opposite situation often occurred in their income per own work unit of the manager and his family members (Family Work Unit). This income on farms in total and with dairy and mixed cows of the economic size of 25–50 thousand EUR SO was higher than on other farms. The greater scale of agricultural production, which in their case financially compensated for the lower unit income obtained in worse farming conditions, was an important reason for this situation. It should be added that the assessment of the previous results of the RICA-FADN farm base (2003-2005) showed a decrease in income on HNVf farms in Italy by as much as 44%, as compared to farms located outside the HNVf areas (Trisorio and Borlizzi, 2011; Keenleyside et al., 2014).

On farms in total and with dairy cows with a size of at least 25 thousand EUR SO and mixed of at least 50 thousand EUR SO from communes with HNV areas, the income obtained from agricultural activity allowed them to obtain payment for the owner's own labour and his family members at a supra-parity level corresponding to the average annual net remuneration in the national economy in the country. In 2018-2020, this fee amounted to an aver-

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age of PLN 39.2 thousand PLN (Abramczuk et al., 2020; Abramczuk et al., 2021)). This favourable situation was reflected in their propensity to make new investments, which was large enough to allow them to obtain often a positive net investment rate, defined as the relation between net investment and depreciation. It should be added that it was also often higher than in the corresponding other farms, where, by the way, there was often stagnation in terms of investments in fixed assets. In the communes, only farms in total below 25 thousand EUR SO were in a bad situation in terms of the scale of implemented investments., where there was a negative net investment rate (-9.0%) (Table 4).

Table 4. Characteristics of farms from communes with a particularly high saturation of HNVf areas with exceptionally high natural value compared to farms from communes without HNVf areasthis type of UAA for 2018-2020 – according to the FADN findings, groups of farms smaller than 15 units cannot be analysed

	Communes with the share of HNVf areas in total UAA:					
	particularly large			without HNVf areas		
	up to 25 thousand EUR SO	25-50 thousand EUR SO	over 50 thousand EUR SO	up to 25 thousand EUR SO	25-50 thousand EUR SO	over 50 thousand EUR SO
Farms in total						
Number of farms	136	92	135	1875	1483	1743
UAA (ha)	16.0	34.0	74.9	13.7	26.8	60.9
Labor inputs per 1 ha of UAA (hour)	201.4	106.0	54.7	215.1	139.9	73.8
Total costs (PLN / ha)	4473	5079	6064	5265	6487	8605
Land productivity (PLN / ha)	4946	5802	7452	6265	8363	11498
Labor productivity (PLN thousand / AWU)	40.8	107.1	226.4	52.5	101.3	244.5
Income (PLN / ha)	1970	2302	2925	2222	3355	4319
Income less subsidies (PLN / ha)	336	711	1380	797	1823	2914
Income (PLN thousand / FWU)	20.9	53.0	122.3	20.7	44.6	117.2
Net investment rate (%)	-9.0	17.0	34.0	-16.0	-3.0	26.0
including: farms with dairy cows						
Number of farms	12	18	51	113	301	458
UAA (ha)	-	24.4	42.7	11.8	20.1	42.0
Labor inputs per 1 ha of UAA (hour)	-	149.4	100.8	292.8	192.0	108.5
Total costs (PLN / ha)	-	6340	7297	5196	6558	8505
Land productivity (PLN / ha)	-	7476	9438	6169	8889	12476
Labor productivity (PLN thousand / AWU)	-	106.9	191.7	42.8	94.0	231.8

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Income (PLN / ha)	-	3439	3867	2570	4110	5577
Income less subsidies (PLN / ha)	-	1421	2185	854	2274	4007
Income (PLN thousand / FWU)	-	51.6	79.7	17.7	44.9	109.9
Net investment rate (%)	-	6.0	29.0	-37.0	-12.0	40.0
including: mixed farms						
Number of farms	38	20	22	518	390	384
UAA (ha)	14.5	29.3	55.5	12.7	24.9	54.6
Labor inputs per 1 ha of UAA (hour)	236.8	115.8	67.2	238.7	143.9	76.9
Total costs (PLN / ha)	4798	4703	6101	5114	5807	7041
Land productivity (PLN / ha)	4947	4961	6448	5551	6603	8480
Labor productivity (PLN thousand / AWU)	38.2	87.1	202.8	47.7	93.7	231.3
Income (PLN / ha)	1539	2012	2072	1711	2292	2936
Income less subsidies (PLN / ha)	-125	249	354	238	720	1433
Income (PLN thousand / FWU)	12.9	38.1	73.1	15.4	32.9	87.9
Net investment rate (%)	5.0	11.0	5.0	-34.0	-0.3	27.0

Source: authors' work based on FADN data for 2018-2020.

Taking the above into account, it should be emphasised that farms from communes with a particularly large share of HNVf areas are able to achieve satisfactory income from agricultural activity, which they then allocate for further development. Nevertheless, this favourable situation is possible – thanks to the received operating subsidies.

Discussion

The ongoing global expansion of agriculture and, as a result, changes in land use is the main cause of biodiversity loss (IPCC, 2019). On the other hand, agricultural activity does not have to take place at the expense of other dimensions of sustainable development, including the natural environment. Moreover, improvement of its productivity is not always associated with an increase in the consumption of production factors, as it may also result from substituting them. In this context, it is also inadvisable to abandon the used agricultural land with unfavourable farming conditions and often of high natural value, which may lead to negative consequences for the natural environment, such as loss of biodiversity and an increase in the number of invasive species, and to limiting the possibilities of providing public goods society

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(DeBoe et al., 2020). What is more, to feed the growing number of the world's population, exclusion of this land from production could be simultaneously accompanied by production intensification in other areas with more favourable natural conditions for agriculture, which in turn would likely lead to an increase in the negative effects for the natural environment. This situation requires prudent institutional support to support agriculture meeting the HNVf criteria, which is otherwise generally located in areas with difficult and particularly difficult farming conditions. The existence of this circumstance may motivate agriculture from the areas to an even greater extent to create behaviours desired by society. Currently, the ecological and agri-environment-climate measures under the CAP 2014-2020 have a lot to offer to agriculture from the areas, which can support them in coping with the growing competitive pressure, forcing the growth of specialisation and intensification of agricultural production. However, it should be emphasised that the optimal policy for the areas should consider a wider context, including the need for synergy of environmental protection with economic and social goals, to contribute not only to the improvement of biodiversity, soil health, and water and climate quality, but also to facilitate the continuation of agricultural production. It should be emphasised that in HNVf areas, it is desirable to maintain a compromise between caring for the natural environment and providing public goods and the possibility of obtaining agricultural income that would ensure a satisfactory standard of living for farmers and their families members.

Taking the above into account, it is worth noting that the EU is currently meeting challenges even greater than ever in the protection of biodiversity. As mentioned in the introduction, in 2019, it announced the EGD strategy and in 2020–2021, its thematic strategies. In the biodiversity strategy until 2030, the European Commission emphasised that the EU is ready to demonstrate even greater ambition to reverse the process of biodiversity loss, including in areas of high natural value, ensuring a significant contribution to the restoration and adequate protection of global ecosystems. The postulates are complemented by its Soil Strategy to 2030, which additionally emphasises that all soils in the EU should be in good condition. However, this will require decisive actions for their even more excellent protection and sustainable use, as well as rehabilitation of previously degraded areas. Greater care for the state of biodiversity also creates better opportunities to adapt the EU, especially its agriculture, to climate change. It is therefore worth emphasising the importance of another element of the EGD strategy, which is the New Strategy for Adaptation to Climate Change. Its aim is to strengthen the activities of the European Commission for greater resilience to the effects of the changes while increasing synergy with other areas of tasks, such as,e.g., the protection of biodiversity. It is also essential to protect and restore forests

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more than ever before and to take up additional practices in the framework of sustainable forest management in the EU. Hence, in the New Forest Strategy until 2030, the European Commission also indicates several actions contributing to ensuring their good condition.

Therefore, it should be emphasised that agriculture that meets the HNVf requirements should, in the first place, make efforts to protect biodiversity. The more so as it may bring him several additional benefits, including an increase in resistance to climate change and the further development of organic farming and tourism. There is no doubt that this will require the presence of an appropriate institutional framework dedicated to them.

Conclusions

EU agriculture is currently facing several development challenges which will increasingly determine its effectiveness in the conditions of increasing competitive pressure on the international arena. One of the most significant challenges will be increasing care for the natural environment, the improvement of which will undoubtedly contribute to strengthening the vitality and stability in the conditions of more and more frequent sudden changes in agricultural markets and the progressive effects of climate change. To meet the challenge, in 2019, the European Commission announced the European Green Deal strategy, and then in the years 2020-2021, a series of complementary strategies emphasise the need to protect the natural environment in the EU more than ever before.

In the EU, protection of the natural environment and providing the society with public goods is not possible without ensuring the good condition of areas with high natural value, including areas with agriculture meeting the HNVf criteria. In Poland, the share of HNVf areas currently ranges from 12.5 to 27.1% of the total UAA. This proves the significant share of domestic agriculture that takes particular care of the natural environment. Their weakness, however, is often tricky conditions for agricultural production, resulting from a large share of light soils with an unfavourable texture and a low content of organic matter. As a result, this situation for farms from the areas is often associated with negative economic effects and increases the risk of their owners and their family members seeking non-agricultural sources of income, with a loss to their care for the condition of the natural environment. Therefore, it should be emphasised that, especially in their farming conditions, the achievement of acceptable agricultural income requires the presence of a solid institutional framework that would reduce the uncertainty of their functioning and would permanently direct it to economic activity, bringing it and the society the expected benefits.

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In the summary of the assessment, it should be stated that farms in HNVf areas compared to other farms in Poland:

On the basis of point 4.1, it should be stated that farms from communes with HNVf areas with exceptionally high natural value compared to farms from communes without HNVf areas in Poland:

- manage land with a much lower production potential and belonging to a greater extent to Natura 2000 areas, which is reflected in a greater share of fallow land, including honey-bearing plants, and an increased value of the natural value index (NTI). Their strength is, to a greater extent, the development of organic farming, where currently 68.8% of the total ecological UAA supported under the CAP 2014-2020 in the country is located,
- have a much greater share of permanent grassland in the UAA, even three times greater. This share increases with the increase in the saturation of HNVf in communes.

On the basis of point 4.2, it should be stated that farms from communes with a particularly high share of HNVf areas with exceptionally high natural value compared to farms without HNVf areas in Poland:

- are characterised by lower labour inputs and lower total costs per 1 ha of UAA, which results in a lower intensity of production, which undoubtedly has a positive impact on biodiversity and diversification of the rural landscape. In their case, however, lower production intensity is generally associated with lower labour and land productivity. In addition, farms in the total HNVf areas and in the types of products selected for analysis, including economic sizes (up to EUR 25,000, EUR 25,000-50,000 and over EUR 50,000), obtain lower income per unit of UAA. In the case of the group of economically weaker mixed farms, even a negative income was found without subsidies, and in the economically more robust farms, this income was recorded at the minimum level of 249 and 354 PLN/ha, respectively. It is optimistic that despite the existing limitations, farms from HNVf areas are still able to maintain development opportunities, although this favourable situation generally applies to farms with greater production potential and economic strength.

It is worth emphasising that the economic stimulus strengthening the current character of agriculture in HNVf areas and the maintenance of public goods provided to the society may be increased payments under the agri-environment-climate and ecological measure or/and the establishment of additional payments aimed solely at biological diversity protection in HNVf areas under CAP 2023-2027. At the same time, for the preservation and sustainability of agriculture, it is important to have not only a formal framework that economically rewards taking actions to protect the environment but also informal ones, those that are the product of an individual, i.e., rules and codes

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of conduct, cultural patterns, fixed ways of thinking, norms of behaviour and traditions that they should cultivate. In such a context, it is also important to monitor the changes taking place in the sphere of agriculture and, as a result, its pressure on the natural environment in the HNVf areas in the long term, as well as to systematically assess the impact of the CAP on the socio-economic development of the areas.

The contribution of the authors

Marek Zieliński: conceptualisation, methodology, literature review, data collection and analysis, formal analysis, work administration.

Jan Jadczyszyn: methodology, literature review, data collection and analysis, formal analysis, visualisation.

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