

## Changes within permanent grasslands used for agriculture in the West Pomeranian Voivodship

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RECEIVED 28.02.2023

ACCEPTED 04.08.2023

AVAILABLE ONLINE 31.12.2023

**Abstract:** The study of changes in grassland was conducted on the territory of individual counties of the West Pomeranian Voivodship. Based on data collected in the Valorisation of the Agricultural Production Space of Poland and spatial data (an electronic 1:5000 soil and agricultural map) the basic information on the use of agricultural land in the 70s of the 20th century. Changes in use over time were analysed based on data the Statistics Poland (Pol.: Główny Urząd Statystyczny – GUS), General Geographic Database and The Agency for Restructuring and Modernisation of Agriculture Crop Register (Pol.: Agencja Restrukturyzacji i Modernizacji Rolnictwa – ARiMR).

The studies showed that in the West Pomeranian Voivodship, a successive decrease in the share of permanent grasslands (0.9%) and arable lands (1.4%) is observed. There is a spatial variation in the share of permanent grassland in the province's counties, with a distinction between northern and southern counties. The main direction of change in grassland area is arable land, which applies to counties with the highest share of permanent grassland (PG) and counties with a high share of the best soils and forest direction. Land quality was the main factor determining the direction of grassland changes, with the best PG converted to arable land or for investment purposes. In contrast, the weakest were converted to forestry or spontaneously wooded through abandonment. The main reasons for changes in grassland areas in the West Pomeranian Voivodship were: conversion of use to arable land, afforestation of grasslands, land use for urban planning purposes, leaving land fallow and conversion for constructing fishponds.

**Keywords:** agricultural lands, decrease in permanent grasslands share, grasslands share, land use changes, transformation of grasslands

### INTRODUCTION

Agriculture in Poland was the dominant land use until 1990. Nevertheless, according to the Statistics Poland (Pol.: Główny Urząd Statystyczny – GUS), from 1946 to 1990, approximately 1.8 mln ha of agricultural land, or approximately 8.5% of agricultural land, were excluded for nonagricultural purposes, and the main direction of change was an increase in the share of communal (estate) land (GUS, 1990). After 1990, Poland continued to see a successive decline in land used for agriculture due to system changes and the decollectivisation of state farms. This process promoted a decline in farmland and an increase in the fallow and set-aside land, which in 2000 amounted to 1.66 mln ha. According to Roszkowska-Mądra (2020), over the period from 1990 to 2017, the area of farmland decreased by 21.1%,

including arable land, by 24.8%. Simultaneously, the most significant declines were recorded before Poland acceded to EU structures, and the difficult economic situation of agriculture and its marginalisation in economic policy are cited as the reasons. Similar changes also occurred in other post-communist countries, where the transformation from a centrally controlled economy to a free market economy occurred (Stacherzak, Hájek and Heldak, 2019). The economic, social, and political transformations over the past 40 years have significantly impacted the structure of land use. The process of population concentration and the development of urban agglomerations has progressed, the importance of industry in the national economy has decreased, there have been structural transformations in agriculture and an increase in urbanised areas, and for transportation purposes (Roszkowska-Mądra, Przygodzka and Sadowski, 2017; Roszkowska-Mądra,

2020). Similar transformations also occurred in other countries of Central and Eastern Europe after 1990, while as in Poland, there was also an outflow of population from rural areas and a decline in the attractiveness of agriculture in the late 20th century, which decreased in agricultural land and an increase in afforestation, especially of marginal land (Kuemmerle *et al.*, 2016; Bański, 2017; Stacherzak, Hájek and Hełdak, 2019).

Poland's accession to the European Union (EU) has resulted in a much faster change in agricultural and nonagricultural land use. These changes were primarily due to the emergence of new implementation opportunities, most notably the financial resources available under various programs included in implementing the Common Agricultural Policy (CAP) and other funds earmarked, for example, for infrastructure development. These have contributed most to the transformation of the Polish countryside, both in the functional and spatial (landscape) sense (Bański, 2003; Wasilewska, 2007; Roszkowska-Mądra, Przygodzka and Sadowski, 2017; Bottryk, 2020; Roszkowska-Mądra, 2020).

The following are cited as the main factors exerting an influence on land use change in Poland but also in EU countries: urban development and economic activity, conversion of natural and forested land to agricultural land, and internal conversion of agricultural land to reduce its areas, such as for forestry purposes or land under water (Weber, 2007).

According to Eurostat (Eurostat, no date) data, in 2018, forestland in the EU area occupied an average of 41.1%, arable land occupied 24.2%, and grassland occupied 17.4%. Against this background, Poland stands out with a lower share of forestland by approximately 5% and of meadows and pastures by nearly 8%, while simultaneously, the share of arable land is over 12% higher.

In this paper, we pay special attention to meadows and pastures in Poland, detailing the directions of change in the West Pomeranian Voivodship by the county due to their strong area differentiation within the voivodship northern counties partially covering the coastal belt, central and southern counties with different physiography. The area of the voivodship is characterised by a similar share of areas predisposed for grassland as other southern Baltic areas in the country (Pomorskie Voivodship) and in NE Germany (Castanho, Gómez and Kurowska-Pysz, 2019; Gabryszuk, Barszczewski and Wróbel, 2021), although compared to Mecklenburg-Vorpommern there is a slightly smaller share of permanent grassland (PG) in the structure of agricultural land, and the pace of change is faster (Kuemmerle *et al.*, 2016; Schils *et al.*, 2022). The dynamics of agricultural land transformations, including PG in the voivodship, are similar to those in Eastern European countries: the Czech Republic, Bulgaria, Romania, where changes in the structure of agricultural land take place at a much faster pace compared to Western European countries such as Germany, France (Kuemmerle *et al.*, 2016), therefore the obtained data may indicate trends characteristic for this part of Europe. In terms of the area of Poland, the share of PG in the area of agricultural land in the Zachodniopomorskie Voivodship is similar to the lowland areas of western Poland (Gabryszuk, Barszczewski and Wróbel, 2021), and the changes taking place in the analysed area will reflect a similar direction and dynamics for this part of the country. Permanent grasslands are, on the one hand, a fodder base for livestock production (Gabryszuk, Barszczewski and Wróbel, 2021) and, on the other hand, valuable habitats and elements of the ecological network, as well as agricultural land of high natural value (Weber, 2007).

Permanent grasslands are at risk of fragmentation because of the impact of transportation infrastructure, uncontrolled urban development, changes in species composition due to nitrogen deposition (natural grasslands), conversion to arable land and ponds or wooded and uncultivated areas, e.g., as a result of the abandonment of ruminant farming on small farms (Weber, 2007; Gabryszuk, Barszczewski and Wróbel, 2021). Recently, permanent grasslands, especially pastures, have significantly decreased in Poland, and they play an essential role in maintaining biodiversity, retention, climatic, protective, phytosanitary, and landscape functions (Gabryszuk, Barszczewski and Wróbel, 2021). This study identified changes in agricultural land use, with particular attention to changes and directions in the use of grassland areas in individual counties of the West Pomeranian Voivodship.

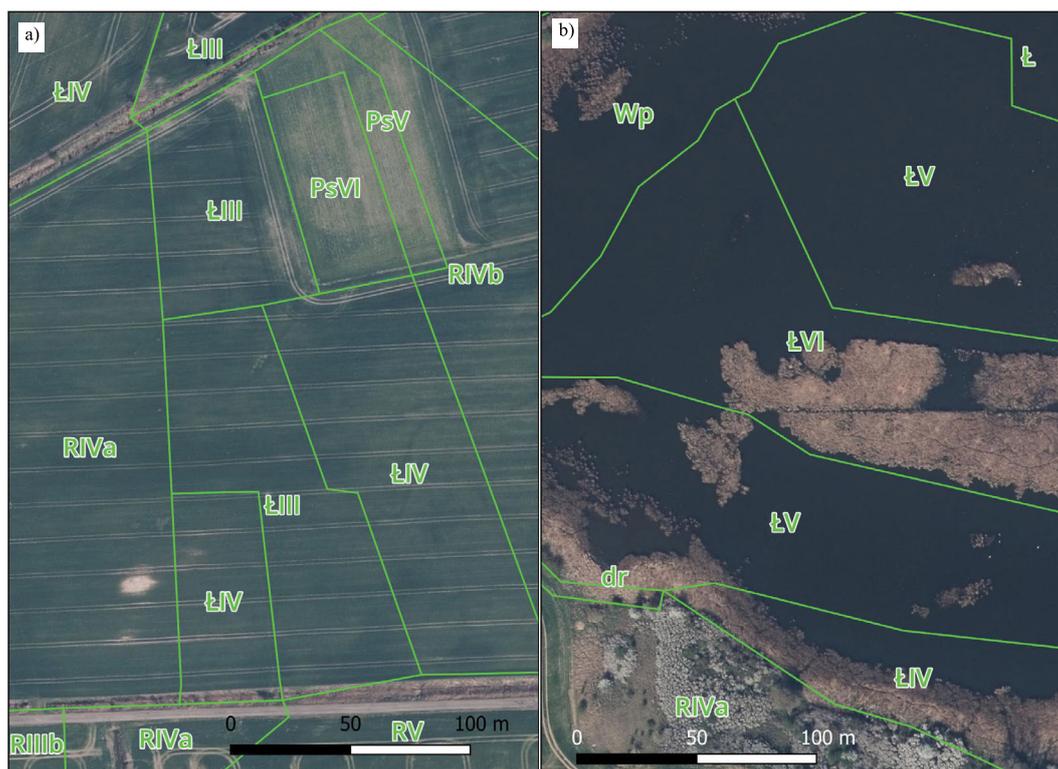
The research hypothesis assumed that the presence of permanent grasslands (PG) in the West Pomeranian Voivodship is varied, and the share of PG in the total agricultural area of the study area is decreasing. The aim of the research was to determine the diversification of PG share in the analysed area and to identify changes in agricultural land use and the reasons for the decrease in PG share in the analysed area. The purpose of this study was also to identify the main directions of PG transformation in the West Pomeranian Voivodship depending on their location.

## MATERIALS AND METHODS

The study of changes in grassland was conducted on the territory of individual counties of the West Pomeranian Voivodship. Based on data collected in the Valorisation of the Agricultural Production Space of Poland (Pol.: Waloryzacja rolniczej przestrzeni produkcyjnej Polski) published by Institute of Soil Science and Plant Cultivation (Pol.: Instytut Uprawy Nawożenia i Gleboznawstwa – IUNG) in Puławy in 1981 (Witek, 1981), which is the basic information on the use of agricultural land, changes in use over time were analysed based on data according to the GUS (no date), General Geographic Database (Pol.: Baza danych obiektów topograficznych – BDOT) (GUGiK, no date) and the ARiMR (no date).

Changes in grassland presented by the GUS are based on the geodetic area of the country identified by the Head Office of Geodesy and Cartography (Pol.: Główny Urząd Geodezji i Kartografii – GUGiK). It should be noted that these data do not always “keep up” with reality, as not every change in the type of land use is automatically reported to the county offices (Fig. 1). This means that the changes presented by the GUS are probably much more minor than in reality. Therefore, three additional sources were used to indicate changes in grassland management in the West Pomeranian Voivodship. The first was an electronic 1:5000 soil and agricultural map vectorised by the Marshal's Office of the West Pomeranian Voivodship. This map is based on a cadastral map that shows the situation in the late 1960s and early 1970s, which provided input information on agricultural land use.

Meadows and pastures were labelled with 1z, 2z, and 3z complexes on these maps; hence, they are easy to identify (Bartoszewski *et al.*, 1965; Jadczyzyn and Smreczak, 2017). These maps make it possible to obtain information about the origin of soils broken down into organic and mineral components. In this work, permanent grassland (PG) contours are divided according to the complexity of agricultural soil suitability and the origin of the soil (Tab. 1). Complex 1z includes practically only mineral



**Fig. 1.** Examples of inconsistencies between the land register and the state shown on the orthophotomap on the example of fragments of the Gryfino County: a) in the register meadows and pastures, actually arable land, b) in the register meadows, actually water; R = arable lands, Ł = grasslands, Ps = pastures, Wp = surface waters, dr = roads, descriptions in the designation of R, Ł and Ps roman numerals and letters indicate bonitation classes; source: own elaboration based on GUGiK (no date)

**Table 1.** Division of grasslands on different soils according to soil and agricultural complexes

Division	Comment
1z mineral soils	no division due to the very small share of organic soils in the complex 1z
2z mineral soils	soils of type A (Podzols and Luvisols), B (Cambisols), D (gleyic/stagnic Phaeozems, gleyic/stagnic Chernozems), F (Fluvisols, fluvic Cambisols, fluvic Phaeozems), G (gleyic or stagnic different types of soils) and some soils of type M – shallow mucky soils (Gleysols and histic Gleysols)
3z mineral soils	
2z organic soils	soils in types: E, T and some soils in type M – mucky, deep and medium-deep mucky soils (Histosols, murshic Histosols)
3z organic soils	

Source: own elaboration based on IUSS Working Group WRB (2015) and Kabała *et al.* (2019).

soils (98%) and occupies only 0.24% of the PG in the West Pomeranian Voivodship, which is why it was not divided.

The second source for determining changes in PG land use was the database of topographic objects BDOT 1:10 000 available at their website (GUGiK, no date). This database shows the land cover status from 2011 to 2016. The number of land cover separations from the BDOT database was reduced to five, according to Table 2.

The two layers (soil contours and land cover contours) were then overlaid (Fig. 2) with QGIS software using the product (intersection) module. The area of the resulting polygons was counted for the newly created resulting layer, which was then exported and processed in Excel.

The third source was data from the ARiMR Crop Register (ARiMR, no date), where information from area claims is posted as part of the payments made and is subject to scrutiny, so it is essential information about the use of agricultural land in the country.

**Table 2.** The simplified breakdown of land cover

BDOT symbol	Land cover	BDOT symbol	Land cover
PTKM	built-up lands	PTTR02	farmlands
PTNZ		PTUT02	
PTSO		PTUT03	
PTWZ		PTUT05	lands under forests
PTZB		PTLZ	
PTPL		PTRK	
PTUT01		PTUT04	
PTTR01	grassy lands	PTWP	surface waters

Explanations: BDOT = General Geographic Database (Pol.: Baza danych obiektów topograficznych).

Source: own elaboration based on the BDOT database (Główny Urząd Geodezji i Kartografii, no date).

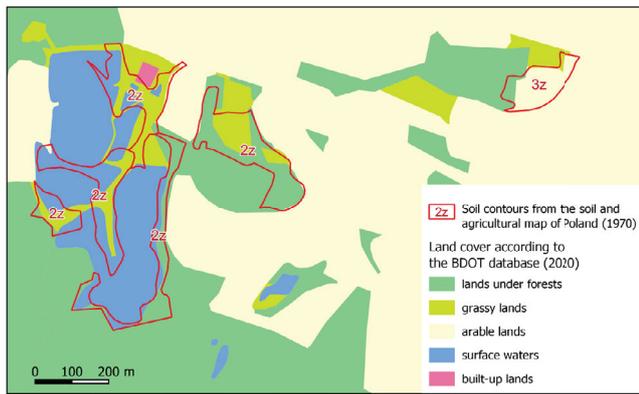


Fig. 2. Example of overlaying two layers: from the soil and agricultural map (red outlines) and the BDOT database (coloured background); source: own elaboration based on GUGiK (no date)

## RESULTS AND DISCUSSION

### LAND USE CHANGES IN POLAND AND THE WEST POMERANIAN VOIVODSHIP

Over thirty years (1990–2020), land use in Poland underwent significant changes; there was a decrease in agricultural land by 21.1%, including arable land by 24.8%, as shown in Table 3.

Table 3. Land use in Poland from 1990 to 2020 (in thous. ha)

Separation	Year			
	1990	2000	2010	2020
<b>Farmlands</b>				
Arable lands	14,311	13,684	10,946	10,757
Orchards	269	257	374	362
Grasslands	2,427	2,503	2,629	2,796
Pastures	1,533	1,369	654	375
Total	18,539	17,812	15,503	14,620
<b>Other</b>				
Forests and forest lands	8,754	9,004	9,329	9,801
Remaining lands	3,975	4,452	7,336	8,291

Source: own elaboration based on data from GUS (no date).

Bański (2017), Stacherzak, Hájek and Hełdak (2019), and Roszkowska-Mądra (2020) cite the difficult economic situation of agriculture and its marginalisation in economic policy in the period after 1990 because of the transformation from a centrally controlled economy to a free market economy as the reasons. Such a situation persisted until Poland acceded to the EU when agriculture gained support in various forms. However, simultaneously, there was still a successive decrease in agricultural land, although for different reasons, including development and government support of housing, changes in local government spatial planning, and development of economic activities (Castanho, Gómez and Kurowska-Pysz, 2019; Bołtryk, 2020). When considering grasslands, it is worth noting the increase

(15.2%) in grasslands and a well-marked (75.5%) decrease in pastures caused by the cessation of use of these lands for grazing purposes as the result of commodification of production and the reduction of cattle breeding on individual farms and was also associated with the increase in the share of concentrates in animal nutrition – total mixed ration (TMR) (Wasilewska, 2007; Burczyk *et al.*, 2018; Gabryszuk, Barszczewski and Wróbel, 2021). A significant decrease in pastures and a slight increase in the share of meadows means that, overall, the area of permanent grassland in Poland is successively decreasing (Burczyk *et al.*, 2018; Gabryszuk, Barszczewski and Wróbel, 2021). Similar trends to the nationwide trends continued in the West Pomeranian Voivodship. There was a successive decrease in the share of permanent grassland from 10.5 to 9.6% and arable land from 38.6 to 37.2% between 1995 and 2021 (Fig. 3).

The reasons for the decrease in the acreage of permanent grassland in the province are similar to those for the country as a whole: the decline in cattle in the province from 1995 to 2021 amounted to 44.5% (GUS, no date), and only from 2002 to 2021, the area of permanent pasture decreased by nearly 12% and permanent grassland by 4.8%. The country's total agricultural area from 1990 to 2020 fell to 46.8% (by 8.1%), while arable land fell to 34.4% (by 12%), and these are the lowest rates in the period under review. These declines occurred mainly until Poland acceded to EU structures in 2004; in following years the loss of arable land was already relatively small. During the analysed period, the area of other lands, which includes settlement land, communication, road areas, water and other areas (fossil land, wasteland), and the area of forests and forestland, increased by nearly 12%, which can be associated with the implementation of the Law on Allocating the Weakest Agricultural Land for Afforestation (Ustawa, 2003), and the increase in the share of protected areas (Weber, 2007; Kuemmerle *et al.*, 2016; Stacherzak, Hájek and Hełdak, 2019). In the case of land occupied by forests and forestland in the West Pomeranian Voivodship, a similar direction of change was observed; the share of land increased by 2.6 to 36.8% in 2021 compared to 1995 (Fig. 3).

Despite the generally small area of orchards in the West Pomeranian Voivodship, a noticeable decrease in their area was observed in 1995–2021 by nearly 41%, and their share in 2021 was only 0.19% of the voivodship's area. In the case of other provinces, a different trend of change was shown in the Lubelskie, Łódzkie, Mazowieckie, and Świętokrzyskie Voivodships, where an increase in the share of orchards in the total area was recorded, with the share of orchards in Świętokrzyskie Voivodship increasing by nearly 65% in 2020 compared to 2002 (Głębocki and Kacprzak, 2020).

### GRASSLANDS IN THE COUNTIES OF WEST POMERANIAN VOIVODSHIP

The West Pomeranian Voivodship is one of the voivodships with an average amount of grassland concerning the total area of agricultural land. However, meadows and pastures are unevenly distributed throughout the province (Figs. 4, 5). Most grasslands are concentrated in the northern part of the voivodship, especially in the coastal counties and those lying around Szczecin Lagoon. This is due to extensive wetlands around the lagoon and the reasonably wide bottom of the Pomeranian proglacial valley running parallel along the Baltic coast.

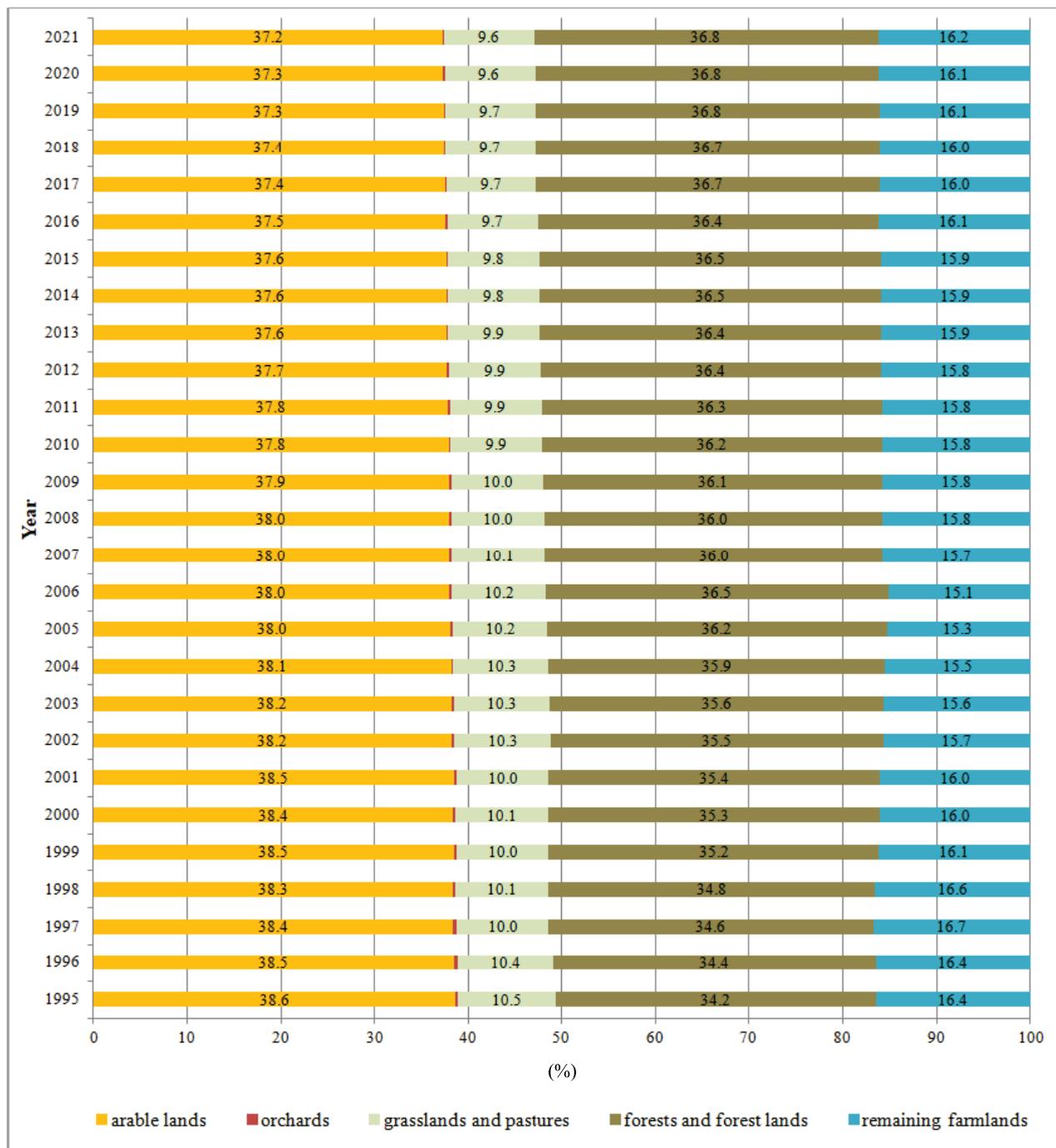
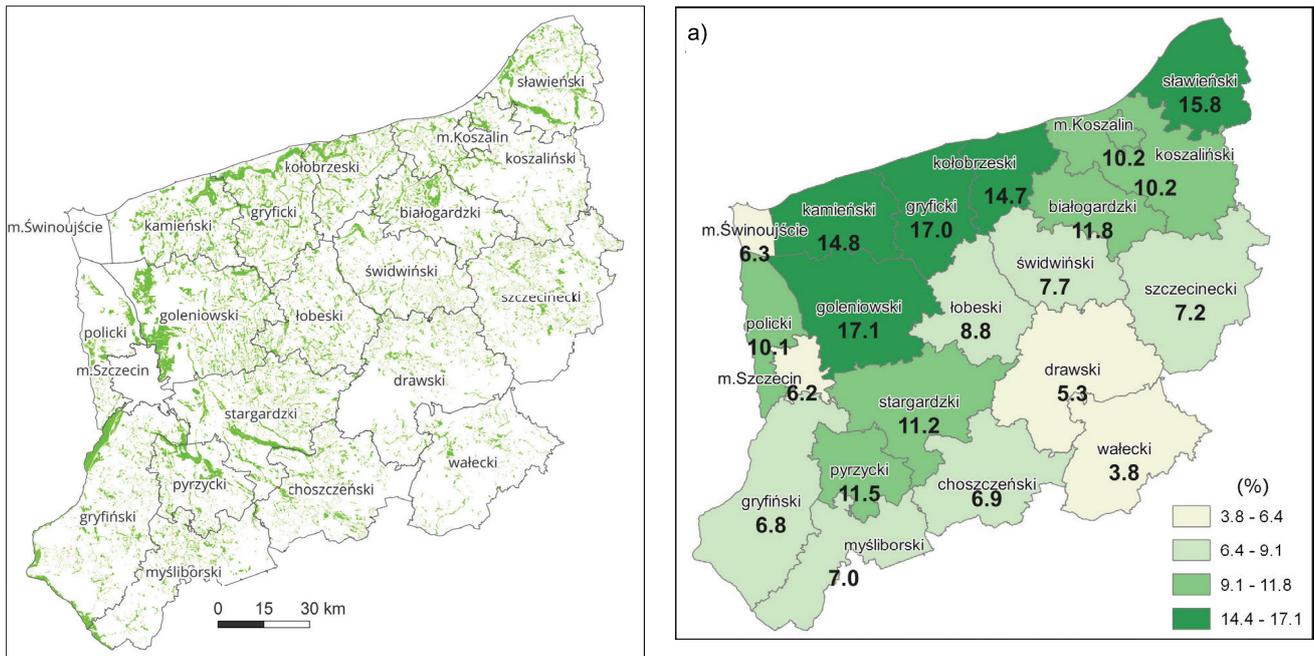


Fig. 3. Changes in land use in the West Pomeranian Voivodeship from 1995 to 2021; own elaboration based on data from GUS (no date)

A particular case is the county of Świnoujście, where the share of permanent grasslands (PG) in the total area of agricultural land exceeds 70%, which is an exceptional situation. However, this is due to the minimal agricultural land on poor sandy soils on the Polish part of the island of Uznam and the western part of the island of Wolin, which are also waterlogged in many places. However, the smallest share of PG is recorded in the southern part of the province (Wałcz County – 3.75% of the county's area and 10.9% of the agricultural land area), where quite varied relief dominates.

To verify the active maintenance of permanent grassland in the counties of the West Pomeranian Voivodeship, data from the area and agri-environmental applications of the ARiMR (no date)

were used (Tab. 4), in which agricultural producers declare the maintenance of the area of permanent grassland, and these declarations are subject to inspection. According to the crop register, the area of agricultural land in the West Pomeranian region in 2022 was 922,348 ha, which accounted for nearly 82% of agricultural land according to the land and building register, while permanent grassland was 174,200 ha, which accounted for 79% of meadows and permanent pastures according to the Land Registry of Statistics Poland (GUS, no date). According to the ARiMR database, the area of PG in 2022 amounted to 7.6% of the total voivodship area and was 2% lower than, according to the GUS. A similar situation can also be observed in the case of almost all counties except the Drawsko County, where according

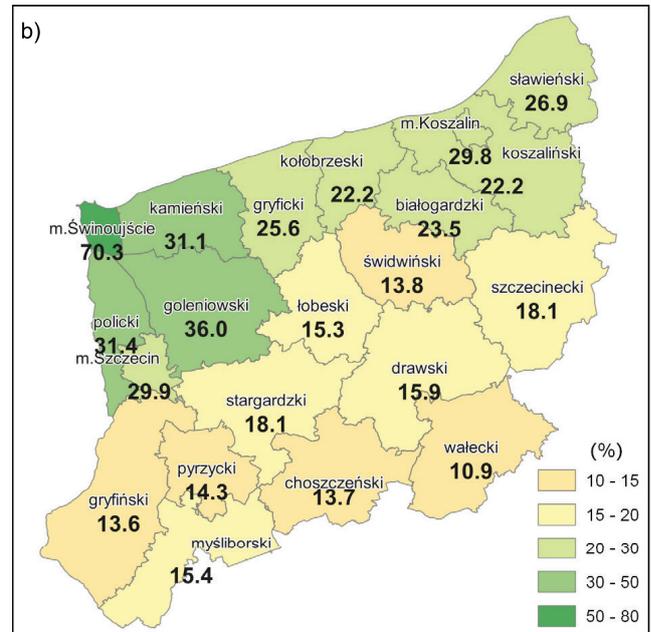


**Fig. 4.** Distribution of grasslands in the West Pomeranian Voivodship in the 70s of the 20th century according to soil and agricultural maps; source: own elaboration based on soil and agricultural maps for counties (GUGiK, no date)

to the land and building register (GUS, no date), grassland occupies an area of 5.3%, while according to ARiMR, it is declared at 7.6%. The indicated discrepancies between the GUS and ARiMR data are due to the delay or complete failure to update agricultural land use in the land registry, the partial abandonment of production on permanent grassland, or the ineligibility of the area for payment or its failure to declare. Interestingly, the share of grassland in the total area of agricultural land in some counties, according to ARiMR, is higher than the data from the Statistics Poland. It applies to the counties of Świnoujście, Świdwin, Szczecin, city of Szczecin, Police, city of Koszalin, Goleniów, and Drawsko. This state of affairs may indicate the positive effects of programs to protect grasslands under the subsidy program, which obliges the maintenance of environmentally valuable PG in Natura 2000 areas and the maintenance of PG areas nationwide at a level concerning their area established in the 2015 reference year.

#### CHANGES IN GRASSLAND MANAGEMENT IN THE WEST POMERANIAN VOIVODSHIP IN 1970–2022

Due to their multifunctionality (including biocenotic, climatic, hydrological, protective, phytosanitary, and aesthetic functions), permanent grasslands are a critical element of the agricultural landscape (Weber, 2007; Gabryszak, Barszczewski and Wróbel, 2021). An essential aspect in determining changes in the directions of PG use is the quality of soils on which PG occur. Detailed identification of the directions of changes in the use of PG on land of different quality can significantly help in their protection and can also have a broader application of reducing emissions (e.g., CO<sub>2</sub>, NO<sub>x</sub>) to the environment (Vertès *et al.*, 2007). Table 5 shows the direction of change in permanent grasslands over 40 years. They show that one-third of the area of the PG has been converted to other uses. Among them, arable



**Fig. 5.** Share of grassland of the West Pomeranian Voivodship by county in 2022: a) in the total area, b) in the agricultural area; source: own elaboration based on GUS (no date)

land (mainly arable) and forests dominate. The direction of conversion of PG to forests can be considered environmentally benign, as some beneficial functions of these areas (e.g., carbon sequestration, emission reduction, retention, or climate function) are maintained and even deepened (Vertès *et al.*, 2007; Burczyk *et al.*, 2018). Alternatively, it should be borne in mind that forest cover in permanent grassland areas may not be the result of intentional afforestation but the abandonment of cultivation in these areas. Permanent grasslands require human intervention consisting of mowing or grazing, to function in the landscape and not succumb to succession (Gabryszak, Barszczewski and Wróbel, 2021).

The magnitude of change varies depending on the soil's agricultural suitability complex and the origin of the soil. It can

**Table 4.** Permanent grasslands (PG) in the counties of the West Pomeranian Voivodeship included in the applications for area payments in 2022

County	Agricultural area (ha)	Share of agricultural area in county area (%)	Area of PG (ha)	Share of PG area in agricultural area of county (%)	Share of PG area in total county area (%)
Białogardzki	34,588.3	40.9	7,860.6	22.7	9.3
Choszczeński	57,531.9	43.3	7,340.3	12.8	5.5
Drawski	48,729.1	27.6	13,386.2	27.5	7.6
Goleniowski	60,831.0	37.7	24,062.4	39.6	14.9
Gryficki	56,032.4	54.9	12,797.9	22.8	12.5
Gryfiński	80,206.5	42.9	9,813.8	12.2	5.3
Kamiński	38,287.2	38.0	11,343.1	29.6	11.3
Kołobrzeski	38,954.2	53.5	6,849.6	17.6	9.4
Koszaliński	59,525.3	36.0	11,376.9	19.1	6.9
Koszalin	1,411.5	14.4	433.3	30.7	4.4
Łobeski	52,240.5	49.0	6,524.2	12.5	6.1
Mysłiborski	45,969.4	38.9	5,741.8	12.5	4.9
Policki	13,447.5	20.2	5,806.4	43.2	8.7
Pyrzycki	53,724.3	74.0	4,712.2	8.8	6.5
Ślawieński	47,991.5	46.0	9,544.0	19.9	9.1
Stargardzki	77,410.2	50.9	12,773.1	16.5	8.4
Szczecin	1,502.3	5.0	959.8	63.9	3.2
Szczecinecki	58,276.4	33.0	11,035.4	18.9	6.3
Świdwiński	50,737.5	46.4	7,432.0	14.6	6.8
Świnoujście	1,588.5	7.9	1,571.6	98.9	7.8
Wałecki	42,244.5	29.9	3,610.6	8.5	2.6
West Pomeranian Voivodeship	922,347.9	40.3	174,200.3	18.9	7.6

Source: own elaboration based on Agencja Restrukturyzacji i Modernizacji Rolnictwa (no date).

**Table 5.** Percentage of each land cover in the West Pomeranian Voivodship

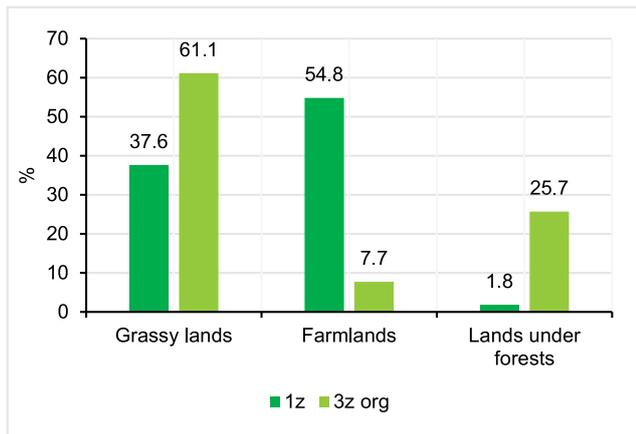
Land use	Soil and agricultural complex					Total
	1z	2z min	2z org	3z min	3z org	
Grassy lands	37.56	60.32	75.45	55.37	61.06	66.21
Farmlands	54.80	25.45	12.01	14.57	7.69	15.64
Lands under forests	1.78	10.41	9.82	24.68	25.75	14.33
Built-up lands	2.52	2.39	0.84	3.00	0.85	1.55
Surface waters	3.34	1.43	1.88	2.38	4.66	2.27

Explanations: 1z = 1z mineral soils, 2z min = 2z mineral soils, 2z org = 2z organic soils, 3z min = 3z mineral soils, 3z org = 3z organic soils.

Source: own elaboration based on Główny Urząd Geodezji i Kartografii (no date) and Mapa glebowo-rolnicza w skali 1:5000 (1970).

best be seen from the two extreme separations (1z and 3z org – Fig. 6). Only 37.6% of the PG remained on the soils of the best complex (1z), more than half of these soils were converted to arable land, and less than 2% were afforested or subjected to self-cropping. These changes are the typical trend for permanent

grasslands on mineral lands with regulated water and air relations and lead to the elimination of meadows and pastures from the agricultural landscape because of their conversion to arable land with less natural functionality and ecological stability (Harasim, 2015; Burczyk *et al.*, 2018).



**Fig. 6.** Changes in the use of permanent grasslands over 40 years in the West Pomeranian Voivodship, using complexes 1z and 3z on organic soils as an example; source: own study

On the other hand, on organic soils of complex 3z, i.e., the weakest soils, as much as 25.7% have been afforested or self-wooded, and only less than 8% have been turned into arable land. It is also dictated by soil quality and the tendency to afforest agricultural areas on the weakest soils (Bański, 2017; Stacherzak, Hájek and Hełdak, 2019). Generally, some regularities can be observed in the change in TUZ land use, as shown in Figure 7.

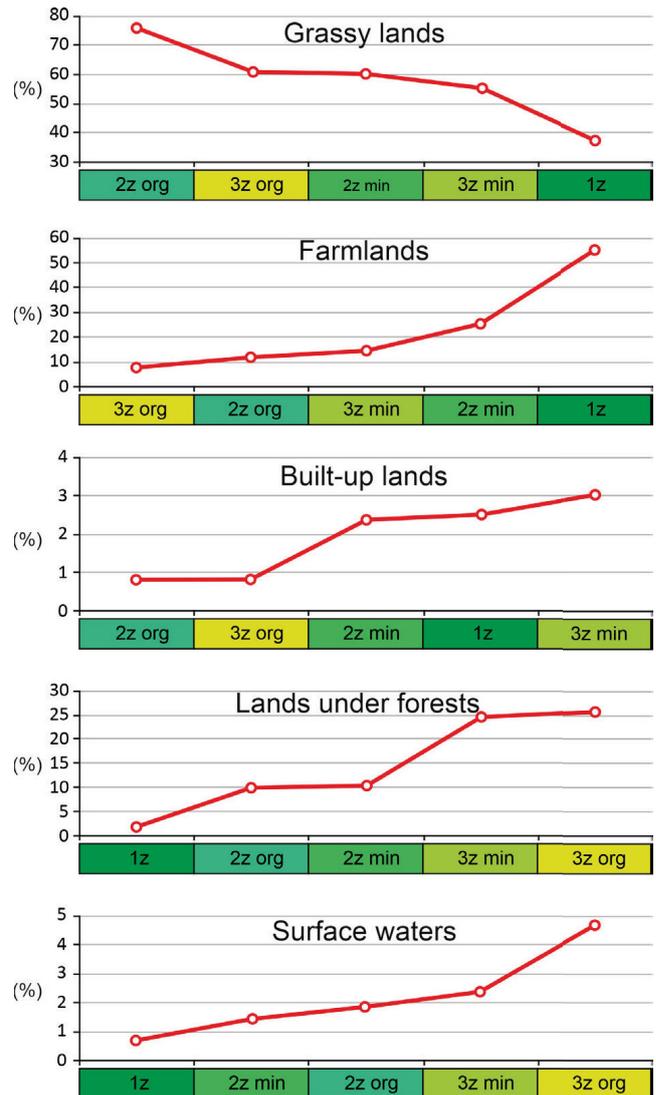
The results of the study show that the decrease in PG is least in the first place on organic soils, especially better soils (2z), and most significant on mineral soils of complex 1z (Fig. 7). An increase in the proportion of arable land in PG areas occurs as the origin, and then the complex increase occurs first. Permanent grasslands on mineral soils, often with regulated water relations, which can be valuable investment areas, are being developed (Głębocki and Kacprzak, 2020), with all complexes to a similar extent. The situation is different for organic soils, which, due to their location (valley land), are only slightly subject to development.

The increase in afforestation depends most on the PG agricultural suitability complex, while the origin of the soil influences it only to a small extent.

The share of surface water increases depending on the complexity and origin of the soils; the weaker the complex and the more organic the soil, the greater the share of water, which is related to the predisposition of areas of permanent grassland to flooding, the presence of nearby watercourses and the retention of water in the area. It should be noted that the chart excludes a relatively large water reservoir created near Połczyn Zdrój in the Świdwin County. Its area occupies more than 81% of the area of the entire 1z complex in this county and is the only such case at the scale of all other districts.

The situation presented is slightly different in individual counties, which is generally the result of local natural conditions. The decline in grassy areas in former grasslands is observed in all counties but not to the same extent. For example, in the counties of Gryfino, Łobez, Stargard, Świdwin, Drawsko, and Wałcz, less than 60% of the PG remains, and in the counties of Kamień, Goleniów, Gryfice, and Sławno, more than 71% (Fig. 8).

In half of the districts, the main direction of land use change was arable land, especially in districts such as Pyrzyce and Sławno, and in the other half, the dominant direction was forestry, especially in the districts of Łobez and Białogard (Fig. 9).

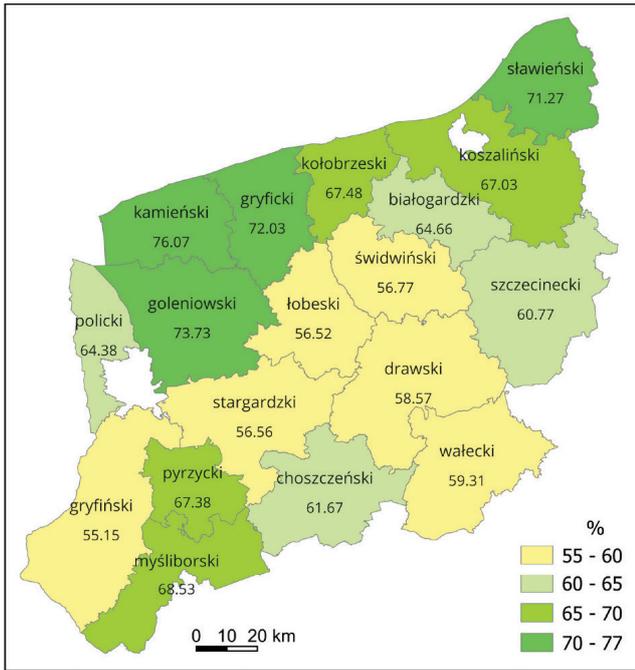


**Fig. 7.** Changes in the use of permanent grasslands in 1970–2021 in the West Pomeranian Voivodship, depending on the segregated soil and complex; 1z, 2z min, 2z org, 3z min, 3z org as in Tab. 5; source: own study based on GUGiK (no date)

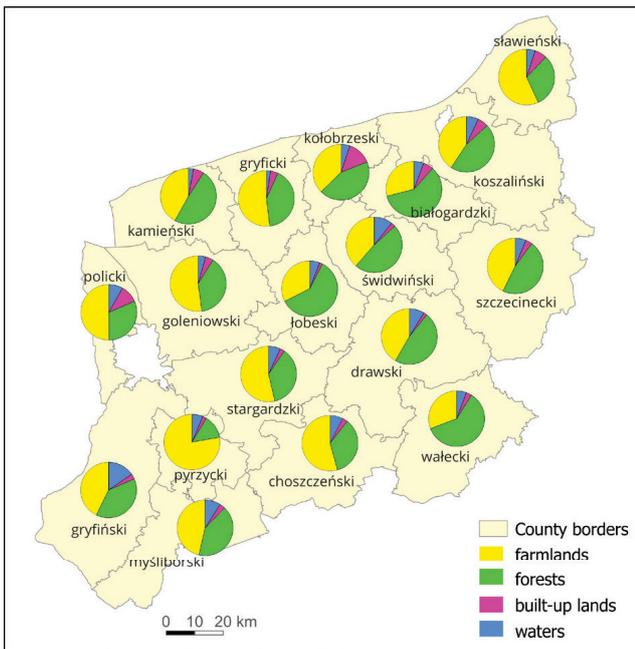
The following districts also stand out: Gryfino and Świdwin districts, with a relatively large share of surface water, and Police and Kołobrzeg counties, with a reasonably large share of built-up land within the former grasslands, which is the result of the suburbanisation process mainly for economic and social reasons (Mróz, 2020) in the Police County – the municipalities of Dobra and Kołbaskowo are the areas used for housing within the Szczecin agglomeration, which confirms the significant conversion of grasslands into built-up land.

In the case of the Kołobrzeg County, the investment process (housing, infrastructure, business) occurs mainly within the Kołobrzeg urban municipality (Gorzalczyńska-Koczkodaj and Szaja, 2013). However, the investment pressure related to development for tourist purposes and servicing the accommodation base is also subject to the coastal area within the county.

Across the country, there is a successive loss of permanent grasslands in favour of urbanised areas, with these changes in the region showing significant dynamics (Castanho, Gómez and Kurowska-Pysz, 2019). The vital role of permanent grasslands in



**Fig. 8.** Percentage of grassy areas in the West Pomeranian Voivodeship in 2021; source: own elaboration based on the BDOT grassland database (GUGiK, no date; Mapa glebowo-rolnicza w skali 1:5000; 1970)



**Fig. 9.** Main trends in grassland changes by county in 1970–2021; source: own elaboration based on the BDOT grassland database (GUGiK, no date; Mapa glebowo-rolnicza w skali 1:5000; 1970)

the agricultural landscape and in protecting the natural environment is indisputable, and grasslands are becoming increasingly important in protecting valuable habitats (Weber, 2007; Jastrzębska and Kostrzewska, 2016; Burczyk *et al.*, 2018). There are noticeable positive effects of conservation measures concerning grasslands within the framework of systemic support of the agricultural sector within the framework of subsidies (Burczyk *et al.*, 2018), which results in the maintenance of a significant share of TUZ in the total area of agricultural land declared for support.

## CONCLUSIONS

The research confirmed the hypothesis, which assumed a decrease in the share of PG (−0.9%) in the West Pomeranian Voivodeship in the analysed period and additionally showed a decrease in the overall share of agricultural land (−1.4%) in less than 20 years. The differentiation of the share of PG in the analysed area depending on the location was confirmed, the largest share of meadows is in the northern part of the voivodeship (22.2–36.0%) compared to the southern part (10.9–15.4%). This is due to extensive wetlands and a significant share of organic and mucky soils predisposed for grassland in the northern part of the analysed area. This diversity was also the reason for the greater preservation of meadows in the northern part of the voivodeship. The research showed that the main direction of change in grassland area is arable land and forest, and it is determined by soil quality, where PG on good soils are converted into arable land, and on poor soils into forests or spontaneously wooded through abandonment.

The obtained results may indicate similar directions of changes and dynamics in other lowland regions of Central and Eastern Europe countries that have recently joined the EU structures and in which significant changes are related to the common agricultural policy and the development of investments based on European funds.

## FUNDING

The publication is financed by the Ministry of Science and Higher Education under agreement No. DKN/SP/546699/2022.

## REFERENCES

- ARiMR (no date) *Powierzchnie upraw w gminach (Dane w hektarach z wniosków o przyznanie płatności bezpośrednich)* [Cultivated areas in municipalities (Data in hectares from applications for direct payments)]. Agencja Restrukturyzacji i Modernizacji Rolnictwa. Available at: <https://rejestrupraw.arimr.gov.pl/> (Accessed: December 07, 2022).
- Bański, J. (2003) “Współczesne i przyszłe zmiany w strukturze przestrzennej obszarów wiejskich – wybrane zagadnienia [Contemporary and future changes in the spatial structure of rural areas – selected issues],” *Studia Obszarów Wiejskich. Współczesne Przeobrażenia i Przyszłość Polskiej Wsi*, 4, pp. 11–25.
- Bański, J. (2017) “Zmiany własnościowe użytków rolnych w wybranych krajach Europy Środkowej [Ownership changes of agricultural land in selected countries of Central Europe],” *Wies i Rolnictwo*, 1(174), pp. 7–22. Available at: <https://doi.org/10.53098/wir012017/01>.
- Bartoszewski, Z. *et al.* (1965) *Instrukcja w sprawie wykonywania map glebowo-rolniczych w skali 1:5 000 i 1:25 000 oraz map glebowo-przyrodniczych w skali: 1:25 000* [Instruction regarding the preparation of soil-agricultural maps on a scale of 1:5,000 and 1:25,000 and soil-nature maps on a scale of 1:25,000], 1. Warszawa: Ministerstwo Rolnictwa, Instytut Uprawy Nawożenia i Gleboznawstwa.
- Bołtryk, P. (2020) “Conversion of agricultural land into non-agricultural land in Poland,” *Ekonomia i Środowisko*, 72(1), pp. 40–57. Available at: <https://doi.org/10.34659/2020/1/3>.

- Burczyk, P. *et al.* (2018) "Rola trwałych użytków zielonych w zapewnieniu stanu równowagi ekologicznej środowiska przyrodniczego [The role of grasslands in providing ecological sustainability of the natural environment]," *Woda-Środowisko-Obszary Wiejskie*, 18(3), pp. 21–37.
- Castanho, R.A., Gómez, J.M.N. and Kurowska-Pysz, J. (2019) "Assessing land use changes in Polish territories: patterns, directions and socioeconomic impacts on territorial management," *Sustainability*, 11(5), 1354. Available at: <https://doi.org/10.3390/su11051354>.
- Eurostat (no date) *Eurostat: Statistics Explained*. Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Main\\_Page](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Main_Page) (Accessed: December 14, 2022).
- IUSS Working Group WRB (2015) *World reference base for soil resources 2014, update 2015 International soil classification system for naming soils and creating legends for soil maps, World Soil Resources Reports*. 106. Rome: FAO.
- Gabryszyk, M., Barszczewski, J. and Wróbel, B. (2021) "Characteristics of grasslands and their use in Poland," *Journal of Water and Land Development*, (51), pp. 243–249. Available at: <https://doi.org/10.24425/jwld.2021.139035>.
- Głębocki, B. and Kacprzak, E. (2020) "Użytki rolne w strukturze użytkowania ziemi w Polsce w XXI wieku [Agricultural land in the land use structure in Poland in the 21st Century]," *Studia Obszarów Wiejskich*, 57, pp. 51–66. Available at: <https://doi.org/10.7163/SOW.57.3>.
- GUGiK (no date) *Geoportal infrastruktury informacji przestrzennej: geoportal.gov.pl [Geoportal of spatial information infrastructure: geoportal.gov.pl]*. Główny Urząd Geodezji i Kartografii. Available at: <https://geoportal.gov.pl/> (Accessed: November 17, 2022).
- GUS (no date) *GUS – Bank danych lokalnych [GUS – Local data bank]*. Główny Urząd Statystyczny. Available at: <https://bdl.stat.gov.pl/bdl/start> (Accessed: September 23, 2022).
- GUS (1990) *Mały rocznik statystyczny 1990 [Small statistical yearbook 1990]*. Warszawa: Główny Urząd Statystyczny.
- Goźdździńska-Koczkodaj, M. and Szaja, M. (2013) "Finansowanie prorozwojowych inwestycji samorządowych na przykładzie gmin nadmorskich województwa zachodniopomorskiego [Financing pro-development local government investments on the example of seaside gminas of the West Pomeranian Voivodship]," *Annales Universitatis Mariae Curie-Skłodowska, Sectio H – Oeconomia*, 47(3), pp. 197–208.
- Harasim, A. (2015) "Użytkowanie powierzchni ziemi w Polsce w aspekcie stabilności ekologicznej [Land use in Poland in terms of ecological stability]," *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu*, 17(1), pp. 66–71.
- Jadczyzyn, J. and Smreczak, B. (2017) "Mapa glebowo-rolnicza w skali 1:25 000 i jej wykorzystanie na potrzeby współczesnego rolnictwa [Soil and agricultural map in the scale of 1:25 000 and its use for the needs of modern agriculture]," *Studia i Raporty IUNG–PIB*, 51(5), pp. 9–27.
- Jastrzębska, M. and Kostrzevska, M.K. (2016) "Evaluation of the land use structure in the Warmian-Masurian Voivodeship (Poland) based on various classification methods – changes in 2002–2012," *Polish Journal of Natural Sciences*, 31(3), pp. 309–330.
- Kabała, C. *et al.* (2019) "Polish Soil Classification, 6th edition – principles, classification scheme and correlations," *Soil Science Annual*, 70(2), pp. 71–97. Available at: <https://doi.org/10.2478/ssa-2019-0009>.
- Kuemmerle, T. *et al.* (2016) "Hotspots of land use change in Europe," *Environmental Research Letters*, 11(6), 064020. Available at: <https://doi.org/10.1088/1748-9326/11/6/064020>.
- Mapa glebowo-rolnicza w skali 1:5000 [Soil-agricultural map on scale 1:5000]* (1970) [digital version]. Szczecin: Urząd Marszałkowski Województwa Zachodniopomorskiego.
- Mról, M. (2020) "Kategoryzacja uwarunkowań procesu suburbanizacji w świetle literatury zagranicznej i krajowej [Categorization of the conditions of the suburbanisation process in the light of foreign and domestic literature]," *Urban Development Issues*, 66, pp. 7–14. Available at: <https://doi.org/10.2478/udi-2020-0006>.
- Roszkowska-Mądra, B. (2020) "Analiza zmian użytkowania gruntów rolnych w Polsce po 1990 roku [Analysis of changes in agricultural land use in Poland after 1990]," in R. Przygodzka and E. Gruszewska (eds.) *Instytucjonalne i strukturalne aspekty rozwoju rolnictwa i obszarów wiejskich. Księga poświęcona pamięci dr hab. Adama Sadowskiego Profesora Uniwersytetu w Białymstoku [Institutional and structural aspects of agriculture and rural development. Book dedicated to the memory of dr hab. Adam Sadowski Professor at the University of Białystok]*. Białystok: Wydawnictwo Uniwersytetu w Białymstoku, pp. 183–199.
- Roszkowska-Mądra, B., Przygodzka, R. and Sadowski, A. (2017) "A range and reasons of farmland withdrawal from agricultural use in Poland," *EU Agrarian Law*, 6(1), pp. 37–42. Available at: <https://doi.org/10.1515/eual-2017-0005>.
- Stacherzak, A., Hájek, L. and Heldak, M. (2019) "Changes in the use of agricultural land in Poland and Czech Republic," *Journal of Ecological Engineering*, 20(7), pp. 211–221. Available at: <https://doi.org/10.12911/22998993/109869>.
- Schils, R.L.M. *et al.* (2022) "Permanent grasslands in Europe: Land use change and intensification decrease their multifunctionality," *Agriculture, Ecosystems & Environment*, 330, 107891. Available at: <https://doi.org/10.1016/j.agee.2022.107891>.
- Ustawa (2003) "Ustawa z dnia 14 lutego 2003 r. o zmianie ustawy o przeznaczeniu gruntów rolnych do zalesienia oraz ustawy - Prawo ochrony środowiska [Act of 14 February 2003 amending the Act on the allocation of agricultural land for afforestation and the Act - Environmental Protection Law]," *Dziennik Ustaw*, 46, poz. 392.
- Vertès F. *et al.* (2007) "Short-term and cumulative effects of grassland cultivation on nitrogen and carbon cycling in ley-arable rotations" in A. De Vlieghe and L. Carlier (eds.) *Permanent and temporary grassland: Plant, Environment and Economy, Proceedings of the 14th symposium of the European Grassland Federation, Grassland Science in Europe*, 12, pp. 227–246. Ghent, Belgium, 3-5 Sep 2007. Ghent: European Grassland Federation, Instituut voor Landbouw-, Visserij- en Voedingsonderzoek.
- Wasilewska, A. (2007) "Zmiany zasobu użytków rolnych w Polsce [Changes in farmland resources in Poland]," *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu*, 9(1), pp. 508–512.
- Weber, J.-L. (2007) "Implementation of land and ecosystem accounts at the European Environment Agency," *Ecological Economics*, 61(4), pp. 695–707. Available at: <https://doi.org/10.1016/j.ecolecon.2006.05.023>.
- Witek, T. (1981) *Waloryzacja rolniczej przestrzeni produkcyjnej Polski według gmin [Valorisation of Poland's agricultural production space by gminas]*. Puławy: Dział Wydawnictwa i Małej Poligrafii, IUNG.