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Risk of phosphorus loss in surface runoff from agricultural land in the Baltic Commune of Puck

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Background. Risk assessment of Phosphorus (P) losses in surface runoff from agricultural land is the basic measure that should be used as a part of actions taken to counteract the water eutrophication in watercourses and water reservoirs. To assess this risk, a new method has been recently developed based on the determination of degree of P saturation (DPS) which depends on P content in soil determined with the use of distilled water (water-soluble P – WSP).

Methods. Based on DPS method, the risk of P losses in surface runoff from agricultural land in Puck Commune (Baltic Sea Coast) was assessed and a critical analysis of assessment results was carried out. The research was conducted on mineral and organic soils from 50 and 11 separate agricultural plots with a total area of 133.82 and 37.23 ha, respectively. In collected soil samples, P content was determined using distilled water (all soil samples), Egner-Riehm method (mineral soils) and extract of 0.5 mol HCl • dm^{-3} (organic soils). The results of determinations P content in water extract from soils were converted to DPS values, which were classified by appropriate limit intervals.

Results & Discussion. It was found that on 96.7% of tested agricultural parcels (96% plots with mineral soils and 100% plots with organic soils) there was a potentially high risk of P losses from soil by surface runoff. At the same time, it was ascertained that in soils from 62% of agricultural plots, there was a large deficiency of plant available P. Due to the above, as well as due to the lack of connection with other factors affecting the P losses in surface runoff such as type of crop and area inclination, it was considered that the assessment based on the DPS index may be unreliable.

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Abstract

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type of crop and area inclination, it was considered that the assessment based on the DPS index may be unreliable.

Introduction

The Baltic Sea is a basin affected by strong eutrophication which results in many adverse changes in the marine flora and fauna and in turn leads to large social and economic losses. One of the main reasons for eutrophication of the Baltic Sea waters is the excessive inflow of phosphorus (P) to it through rivers. The inflow from the entire Baltic basin is at 29.3 tons per year, of which 35.7% comes from dispersed sources, mainly from agriculture (*HELCOM, 2018*). 12.7 tons of P are brought from Poland to the Baltic Sea by river waters (*HELCOM, 2018*), including 21 or 33% from the agricultural sector depending on the method of assessment (*National..., 2016*). In order to counteract the eutrophication of the Baltic Sea, various initiatives and actions have been taken for many years, both at the regional and national level, aimed at limiting the supply of the mentioned component to the waters of the Baltic Sea. In this respect, particularly important arrangements have been recently made at the Conference of Ministers for the Environment of the HELCOM countries held on 3rd October 2013 in Copenhagen. There were specified, among others, expected degrees of reduction of total P loads discharged by the HELCOM Member States to the Baltic Sea. According to them, Poland should reduce the P inflow to the Baltic Sea by 51%, respectively, compared to the reference period 1997-2003

(*National..., 2016*). Poland approved this level of reduction as a rough indication, stating that it will adopt a final position after conducting relevant analyses. Regardless of their result, Polish agriculture is expected to face a major challenge to significantly reduce its pressure on the Baltic Sea in terms of P. There is a need to seek and implement effective solutions to reduce P loss from agricultural sources to waters considering the above as well economic reasons and prevention from eutrophication of inland surface waters (according to polish monitoring data, in 2012-2015 eutrophication parameters were exceeded in 42% for sites located on flowing waters (rivers) and 66% for stands on stagnant waters (lakes/water reservoirs) (*National..., 2016*)). Undoubtedly, the list of measures should include tools and procedures for controlling agricultural land soils in case of P loss in surface runoff. Thanks to the results of such a control it is possible to manage agricultural land so as to minimize the threat posed by the component in question. In this context, it should be stated that the problem of diagnosing threats to rivers and reservoirs by P loss from agricultural soils is by no means new and has been of interest to many researchers for years. This problem is most commonly considered in terms of interactions between the content of plant available P in soil (determined by various methods, for example Mehlich 3, Olsen, Egner-Riehm), and P saturation in runoff water. Using this approach, it was proved that as P content in soil increases, its amount increases along with surface runoff (*Torbert et al., 2002; Sharpley & Kleinman, 2003; Pietrzak et al., 2017*), yet the system of cultivation of plants and the type of soil have an impact, too (*Gaj, 2008 after: Sharpley et al., 1981*). It should be emphasized that the existing P agrochemical tests are not equally useful for testing all soil types – which is a factor limiting their use.

Another applied approach to assessing P loss from agricultural soils via rainwater and the risk of surface waters eutrophication is based on the determination of the degree of P saturation (DPS) (*Alleoni et al., 2014*). The DPS in its classical formula is expressed in percentage relation of the P content in the soil extract to the P sorption capacity of soil, wherein various approaches are used for determination of the components in this formula (*Nair et al., 2004; Casson et al., 2006*). The procedure for determining the DPS index according to this formula is unique for different types of soil, which can create specific methodological problems and limit the possibilities of its wider use (*Sapek, 2007*). Pöthig et al. (2010) have recently developed a different method for determining this index according to which the only factor from which the DPS parameter depends is the P content in soil determined with the use of distilled water – WSP (water-soluble P). This method is simpler and can be used to assess the risk of P loss from all soils, regardless of their type and use – that is why it is often described as ‘universal’. In the MONERIS model (Modelling Nutrient Emissions into River Systems), developed for quantifying the amount of nutrient emissions from point and diffuse sources in river catchments (*Venohr et al., 2001 after: Behrendt et al., 2000*), it is particularly used to determine P saturation in surface runoff.

The aim of this work is to test the usefulness of the Pöthig et al. method (*2010*) to assess the risk of P loss in surface runoff from agricultural soils in the conditions of the Puck Commune. It was assumed that this aim would be achieved by determining and analysing indicators characterizing these soils, such as: P saturation determined by the tested method, content of plant available P determined by the Egner-Riehm method (for mineral soils), content of P soluble in 0.5 mol HCl · dm^{-3} (for organic soils), as well as data concerning their composition and use.

Material & Methods

The research was conducted in the Puck Commune. It is located in Poland, in the north-eastern region of the Pomeranian Voivodeship, on the western shore of the Puck Bay, which is part of the Baltic Sea. This commune is agricultural by nature. The land use structure is dominated by agricultural land (57.3% of the total area of the commune), the vast majority of which is characterized by high yield potential. The area of the commune is largely undulating, with land falls up to approx. 9% (5.14°). Such landform features increase the danger of P loss in surface runoff.

The research was conducted in 61 agricultural plots from 22 farms taking part in the project „Modelling of the impact of the agricultural holdings and land use structure on the quality of inland and coastal waters of Baltic Sea set up on the examples of the Municipality of Puck region – Integrated info-prediction Web Service WaterPUCK" (*Dzierzbicka-Głowacka et al., 2019*) (this project was established, among others, to determine the impact of farms located in the Puck Commune on the pollution of surface and ground waters and ultimately the Baltic Sea, with biogenic compounds).

In the spring of 2018, soil samples from the above mentioned agricultural plots were taken for chemical analysis based on the guidelines included in the PN-R-04031: 1997 standard to determine the percentage of floating particles (i.e. the fraction content <0.02 mm), the organic matter content in the layer of 0-5 cm, pH in the layer 0-30 cm, the content of plant available P in layers 0-5 and 0-30 cm, the content of WSP in the layer of 0-5 cm. In this regard:

- fraction content below 0.02 mm was determined by the sedimentation (pipette) method according to PN-EN ISO 17892-4: 2016 standard;
- organic matter content was determined as a loss on ignition at 550°C by the weight method according to PN-EN 12879: 2004 standard;
- pH measurement of soil was conducted in 1N suspension of KCl by potentiometric method according to PN-ISO 10390: 1997 standard;
- the content of available P forms in mineral soils was determined by the Egner-Riehm method, with the use of calcium lactate solution (pH ~ 3.55) according to PN-R-04023: 1996 standard, in organic soils the content of available P was determined in the extract of 0.5 mol $HCl \cdot dm^{-3}$ according to PN-R-04024: 1997 standard; the content of WSP was determined by the method of Inductively Coupled Plasma Optical Emission Spectroscopy ICP-OES after stages involving drying soil samples in the air and sieving them (through the sieve <2 mm),

preparing a suspension in the ratio: 1 g of soil in 50 ml of distilled water, agitation for 2 hours, filtration through a 0.45 μm filter.

The results of analysis of soil samples were ordered and evaluated according to the principles and criteria presented below.

1. Based on the organic matter content, the soils were divided into mineral and organic. With the content of more than 10% (threshold value between mineral and organic soils) organic soil was classified as organic (on the basis of: *Szymanowski, 1995; PN-R-04024: 1997*).

2. According to the accepted standards, the assessment of soil acidification was conducted, defining their reaction classes: very acidic, acidic, slightly acidic, neutral and alkaline under conditions where their measured pH was in the following ranges: ≤4.5; (4.5-5.5>; (5.5-6.5>; (6.5-7.2> and >7.2.

3. An assessment of P content in soil was conducted with respect to threshold values given in the following standards: PN-PN-R-04023 and PN-R-04024: 1997, for the following abundance classes: very low, low, medium, high and very high – Table 1. The basis for the assessment was the percentage share of the soil samples tested in individual reaction and abundance classes.

4. Based on the results of the P content determination in soil using water extract, DPS indices were calculated using the equation (*Pöthig et al., 2010*):

$$DPS(\%) = \{1/[1 + (1.25 \cdot WSP^{-0.75})]\} \cdot 100$$

where: WSP – is the content of water soluble P, mg $P \cdot kg^{-1}$ of soil.

On the basis of the determined P saturation indices, the risk of P loss by surface runoff was assessed using the limit intervals specified by Pöthig et al. (*2010*) – Fig. 1. It was assumed that if the DPS value exceeds 80%, there is a high risk of P loss from the soil by surface runoff, DPS values lower than 70% were considered as safe, and values between 70 and 80% as tolerable. The results of laboratory tests were also developed statistically determining the basic parameters of descriptive statistics and correlations between the analysed soil indices. The statistics of the results were prepared with the use of the Statistica 6.

Irrespectively of the research and assessments discussed above, indoor work was conducted aimed at determining the area and type of development of agricultural plots selected for research, recognizing the categories, types and soils subtypes occurring on them as well as inclination of slopes in the research area. In these works the following were used: the results of own terrain observations, a 1:25 000 soil-agricultural map of the Puck Commune in a vector format developed by IUNG-PIB Puławy and maps of selected agricultural plots acquired with the use of Google Earth Pro.

Results & Discussion

The research covered soils taken from 61 separate agricultural plots with a total area of 171.05 ha. 50 plots with a total area of 133.82 ha were agricultural lands (AL) made from mineral-derived soils (with an organic matter content of 2.53-7.01%), and 11 plots with a total area of

37.23 ha were AL made from organic soils (characterized by organic matter content at the level of 25.60- 68.17%). Given the genetic criteria, the following types and subtypes of soils occurred in the research area in the given proportions (constituting the share in the area):

- brown soils – 61.9%,
- brown soils, lessive soils, podzolic soils and rusty soils made from gravel and sands – 10.2%,
- lessive soils – 3.7%,
- black soils – 2.4%,
- peat and muck-peat soils – 21.8%.

Among mineral soils, in terms of the agronomic category, medium soils dominated, covering 49.7% of their area, followed by light and very light soils, whose share in the mineral soil area was respectively 39.1 and 11.2%. On most plots with mineral soils, grains were grown, while most of the plots with organic soils were covered with permanent grassland. The area of these plots was largely undulating – Fig. 2, with landfalls of up to approx. 9% (5.14°). Such landform features increased the danger of P loss in surface runoff.

The analysed soils in the 0-30 cm layer – which is treated as a diagnostic layer in the analysis of agrochemical properties of soils for the needs of fertilizer consultancy, were characterized by a pH within 4.2-7.2 (average 5.4). In 62.3% of plots, these soils were characterized by a very acidic and acidic reaction, in 31.1% of plots slightly acidic, and in 6.6% neutral, whereby the share of mineral and organic soils in individual reaction classes varied – Fig. 3.

In the range of the optimum pH value – which can be assumed at 5.6 to 7.0 for mineral soils (for the majority of cultivated species of plants in Poland) (*Kocoń, 2014*) and at 4.5 to 5.5 for organic soils (*Moraczewski, 1996*; *Barszczewski et al., 201;*), there were soils covering 34.4% of plots, including 30% plots with mineral soils and 54.5% plots with organic soils.

The available P content in the discussed layer of analysed soils reached values from 3.6 to 66.5 mg $P_{ER} \cdot kg^{-1}$ (average 33.3 mg $P_{ER} \cdot kg^{-1}$) in case of mineral soils and from 171.0 to 707.0 mg $P_{HCl} \cdot kg^{-1}$ (average 340.6 $P_{HCl} \cdot kg^{-1}$) in case of organic soils. P content in these in relation to 62.3% of plots was „very low" and „low", compared to 3.8% „medium" – Fig. 4. In 4.9% of all plots, soil fertility in P was „high" and „very high". In comparison with mineral soils, the share of organic soils was much smaller in the abundance classes „very low" and „low", and much higher in the classes „medium" and „very high".

In the soil layer of 0-5 cm – treated as a standard in environmental research on establishing relationships between the quantitative state of P in soil and surface runoff (*Sharpley et al., 1985; Schindler, German & Gelderman, 2002; Hansen et al., 2012*), P content ranged from 3.6 to 68.8 mg $P_{HCl} \cdot kg^{-1}$ (average 35.4 mg $P_{ER} \cdot kg^{-1}$) in mineral soils and from 136.0 to 526.0 mg $P_{HCl} \cdot kg^{-1}$ (average 284.6 $P_{HCl} \cdot kg^{-1}$) in organic soils. In this layer of mineral soils, the P content was on average 6.5% higher than in the 0-30 layer. In organic soils, the P content in the shallower of the analysed seams was 16.6% lower than in the deeper ones. In turn, the content of WSP at the level of 0-5 cm of the tested mineral and organic soils determined in water extract was in the range of 2.2-58.5 mg P_{H2O} P · kg^{-1} (average 24.6 P_{H2O} P · kg^{-1}) and 13.7-79.5 mg P_{H2O} P · kg^{-1} (average 40.3 P_{H2O} P · kg^{-1}), respectively. At this level of mineral soils there was on average 39.0% less P than in organic soils. Calculated on the basis of WSP in the analysed soils, their DPS was 59.1-94.4% (average 87.8%) for mineral soils and 85.1-95.5% (average 91.4%) for organic soils. For soils from 59 plots, including 48 with mineral soils and 11 organic soils, the DPS values were set at 80% and higher – Table 2. There was a high risk of P loss from these soils to water following the approach to determining this risk suggested by Pöthig et al. (*2010*).

There were numerous interactions between the analysed soil indices. First of all, they occurred between indices describing mineral soils. In this case, each parameter analysed was correlated with all others (according to the peer-to-peer mechanism) – Table 3. These were positive and mostly strong or very strong dependencies.

There was a relatively low correlation between the pH value of the soil and its P content determined by the Egner-Riehm method both in the layer up to 5 and 30 cm. However, this correlation indicates that by reducing the acidity of soils plant available P would increase. It is worth emphasizing that the pH of soil is one of the factors that have the greatest direct impact on the P availability. In acid soils, a large part of this component is immobilized by Manganese

(Mn), Iron (Fe) or Aluminium (Al) compounds. The use of liming on such soils increases the amount of plant available P.

The P content was most strongly correlated with 0-5 and 0-30 cm soil profiles, which indicates that it was quite homogeneously accumulated in the topsoil. Hence, the data regarding P state may prove equally useful to quantify P loss in surface runoff from agricultural land at each of mentioned levels.

There were fairly strong correlations between WSP and P content determined by the Egner-Riehm method. Similarly strong relationships were found between WSP and P content in Brazilian and German soils defined by Mehlich-1 and CAL (calcium-acetate-lactate) methods based on the P-extraction by a mixture of calcium lactate and calcium acetate (*Fischer 2018*). In case of such correlations, it is possible to convert the results obtained with one method to another with great accuracy. As DPS is a function of P_{H2O}_w1 (R=1), then in a view of a relatively strong relationship between P_{H2O}_w1 and P_{ER}_w2 and P_{ER}_w1, the latter two indices also remained in a strong relationship with DPS.

While all the analysed indices in mineral soils were correlated, in case of organic soils only P_{HCl}_w1 and P_{HCl}_w2 were statistically correlated, with the moderate degree of this correlation – Table 4, ignoring the natural relationship between DPS and P_{H2O}_w1 (DPS is a function of P_{H2O}_w1).

The correlation between the P contents in soil profiles 0-5 and 0-30 cm of organic soils is less stronger than in mineral soils which may result from the fact that they were not usually mixed when used (mainly for grasslands) and therefore did not favour homogenisation of their top layer composition – including P content. The lack of correlation between P_{H2O}_w1, P_{HCl}_w2 and P_{HCl}_w1 indicates that P transfers from soil to water and 0.5 mol HCl extracts in a different way and in disproportionate amounts due to their different extraction possibilities (HCl solution is an aggressive extractant, water – not).

In the light of presented research results and analyses as well as the purpose of the work, it should be stated that the risk of P loss to waters based on the DPS is arguable. As established, the share of agricultural plots with soils at high risk of P loss by surface runoff (DPS ≥ 80) was 96.7%, with 96% plots with mineral soils and 100% plots with organic soils. The obtained results indicate that, in environmental terms, soils practically in the whole analysed area of agricultural lands were overly supplied with P, and suggest that measures need to be taken in this area to prevent its outflow to waters, e.g. by decreasing phosphate fertilizers application. However, the results of agronomic tests revealed that in order to obtain satisfactory crops, the P content in assessed soils should be significantly increased rather than decreased (therefore, in terms of soil P management various or even contradictory conclusions emerge from environmental and agronomic assessments). They were indeed largely characterized by very low or low level of P – in case of plots with mineral soils, 72% of them were affected by this problem. It should be emphasized that in case of serious P deficiencies in soil (as identified in the research area), relatively small amounts of this component are found in surface runoff (*Pietrzak et al., 2017*), which, given the episodic character of the formation of runoffs, indicates that the risk of surface water quality under these conditions should not be overestimated.

With regard to the above, it is worth adding that from an agronomic point of view the vast majority of analysed soils requires not only increased application of phosphate fertilization, but also liming in order to optimize their pH. This treatment would increase the resources of plant available P and would be productively justified, yet it could be considered unnecessary in terms of DPS-based analyses.

Doubts over the adequacy of determining the risk of P loss from soils to waters by means of DPS threshold values are increased by the results of the assessment conducted with respect to all analysed organic soils, which were mainly under grasslands. DPS for these soils exceeded 80% each time so the risk of P loss to waters was high. However, it is difficult to take it as a deciding conclusion as grassland is a biological filter that protects against the release of pollutants into waters. The fact that this approach overlooks the aspect of landform features contributes to the uncertainty as to the risk of P loss in surface runoff from agricultural land soils to waters determined by DPS index. In these assessments, the inclination factor should be taken into account as it contributes to the risk of surface runoff –Table 5. In the research area there were sometimes significant landfalls which undoubtedly affected the dynamics of P outflow to waters.

In addition, it should be considered that the outflow was shaped by a number of other factors, such as: physical and chemical soil properties (including pH and organic matter content), soil and plants cultivation, atmospheric conditions (*Ulen, 2013; Sapek, 2014)*.

As indicated above, the problem of determining the risk of P loss in surface runoff from agricultural soils to waters is complex. The assessment of such a risk should by no means depend solely on the value of DPS index.

Conclusion

The research was conducted on a typical undulating area of agricultural land in the Puck Commune, 78.2% of which consisted of arable land and 21.8% of grassland. In terms of mechanical composition, agricultural land soils were predominantly medium and light, whereas alluvial soils were entirely of organic origin. Most of them were characterized by high acidity (on more than 62% of agricultural plots the soils had a very acidic and acid reaction) and deficiency of plant available P. In the latter case, over 62% of the analysed soils – including 72% of mineral soils and over 18% of organic soils – were characterized by very low and low content of the mentioned component. The DPS (determined on the basis of P content extracted in the water extract) in almost all of the assessed soils exceeded 80%. Hence, taking into account the existing criterion of DPS index assessment, there was a high risk of P loss in surface runoff to water. It seems, however, that this assessment should be approached cautiously as it does not correspond to the results of the agronomic assessment of the P content in soil (conducted in terms of requirements for application of phosphate fertilization). It also disregards other factors affecting P loss in runoff, such as the type of crop or area inclination.

In the light of the above, it can be concluded that the problem of determining the risk of P loss in surface runoff from agricultural land to water is still open. There is a need for further work on its solution.

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Figure 1(on next page)

Correlation between DPS and WSP of soils; own elaboration (based on: Pöthig et al., 2010)

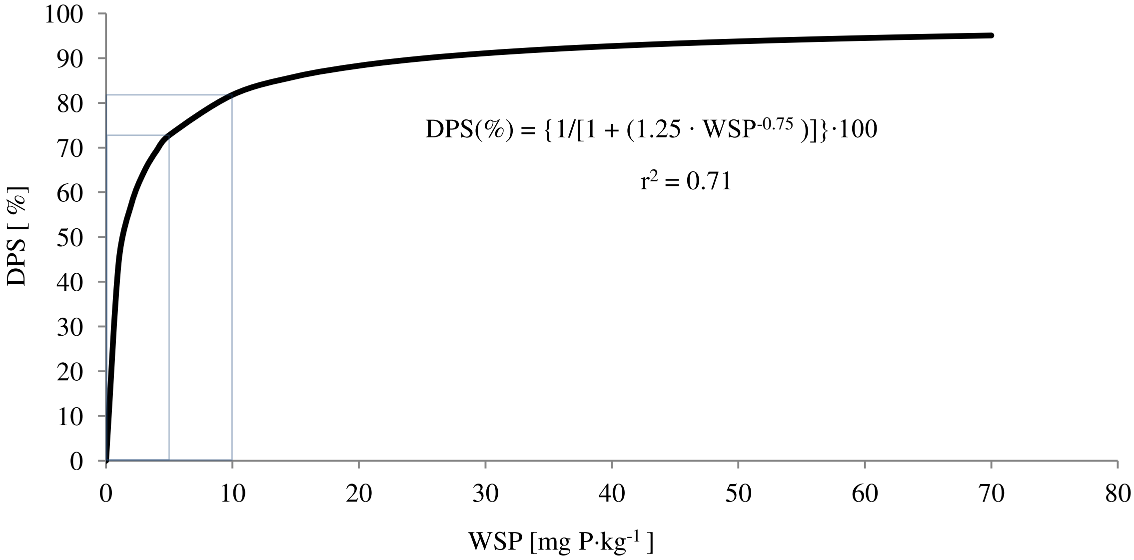

Figure 1: Correlation between DPS and WSP of soils; own elaboration (based on: *Pöthig et al., 2010*).

Figure 2(on next page)

View of an exemplary agricultural plot from the research area and the shape of its longitudinal profile; Map data © 2019 Google Earth Pro

Figure 2: View of an exemplary agricultural plot from the research area and the shape of its longitudinal profile; Map data © 2019 Google Earth Pro.

Figure 3(on next page)

Distribution of soil pH in tested agricultural plots, in the 30 cm layer

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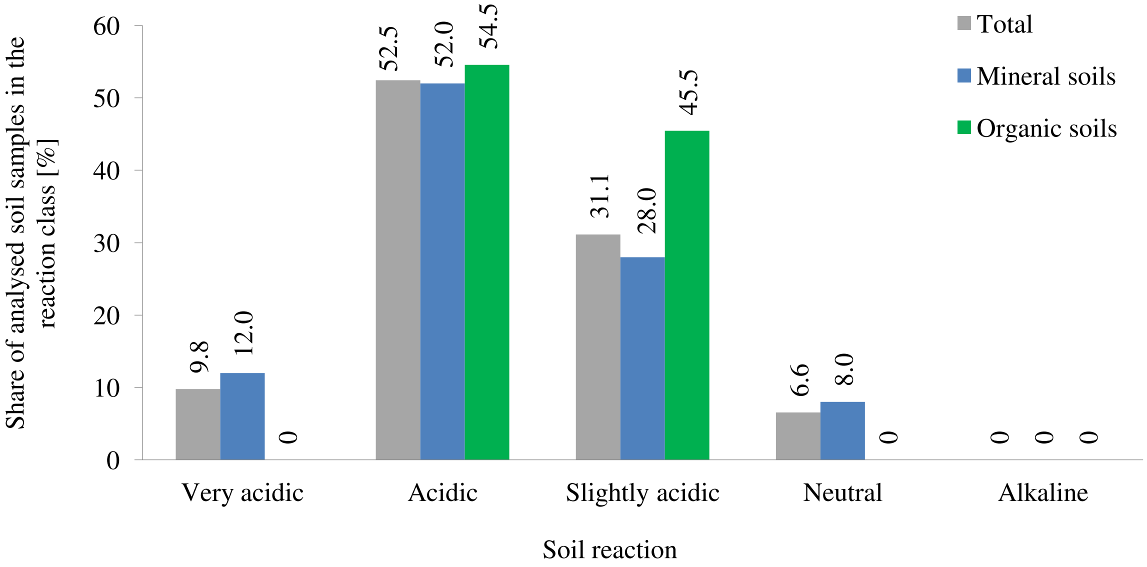

Figure 3: Distribution of soil pH in tested agricultural plots, in the 30 cm layer.

Figure 4(on next page)

Distribution coming from the tested agricultural parcels, in the layer of 30 cm

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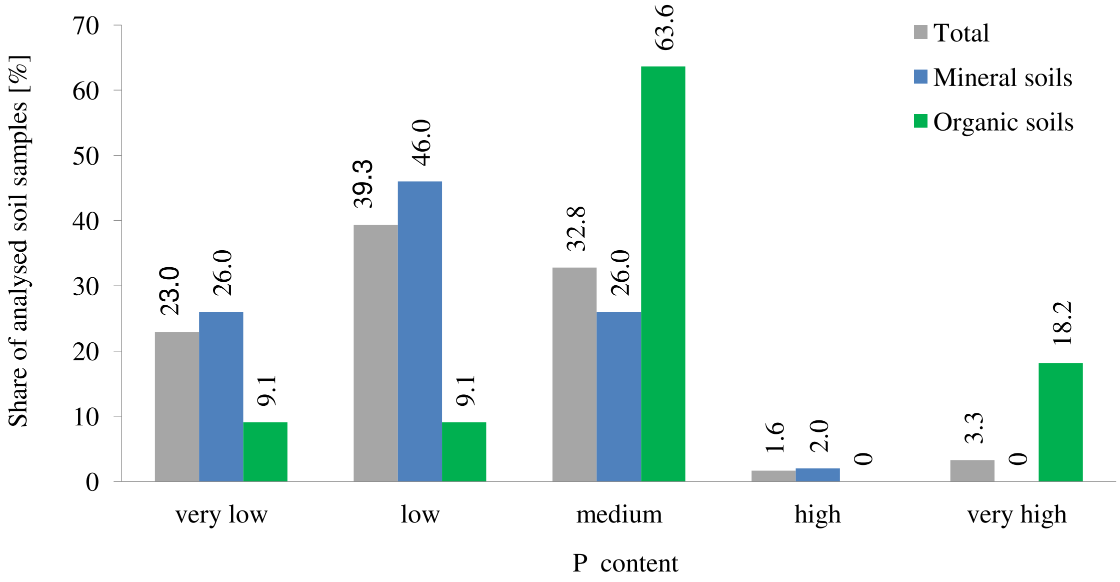

Figure 4: Distribution coming from the tested agricultural parcels, in the layer of 30 cm.

Table 1(on next page)

Assessment of P content; own elaboration (based on: *PN-PN-R-04023; PN-R-04024:1997*)

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Table 1: Assessment of P content; own elaboration (based on: *PN-PN-R-04023; PN-R-04024:1997*).

Abundance class	**Abundance assessment**	**Ingredient content, mg P·kg^{-1} of soil dry matter**	
		mineral soils	**organic soils**
V	very low	≤ 22	≤ 174
IV	low	(22-44>	(174-262>
III	medium	(44-65>	(262-349>
II	high	(65-87>	(349-523>
I	very high	> 87	> 523

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Table 2(on next page)

Share of agricultural plots with soils in various DPS thresholds

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Table 2: Share of agricultural plots with soils in various DPS thresholds.

DPS thresholds, %	**Risk of phosphorus loss from soil:**	**Type of soil**		
		mineral	**organic**	**total**
		Number of plots (share, %)		
70 <	lack	1 (2.0)	0 (0.0)	1 (1.6)
<70-80)	acceptable	1 (2.0)	0 (0.0)	1 (1.6)
≥ 80	big	48 (96.0)	11 (100.0)	59 (96.7)

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Table 3(on next page)

Correlations between analysed indices of mineral soils

Explanation: pH_{KCl} – soil acidity measured in a suspension of KCl solution; P_{ER} – P content in soil determined by the Egner-Riehm method; P_{H2O} – water soluble P (WSP) content; DPS – degree of P saturation; w1 – layer 0-5 cm; w2 – layer 0-30cm; * – correlation significant at $\alpha = 0.05$; ** – correlation significant at $\alpha = 0.01$

Table 3: Correlations between analysed indices of mineral soils.

Explanation: pH_{KCl} – soil acidity measured in a suspension of KCl solution; P_{ER} – P content in soil determined by the Egner-Riehm method; P_{H2O} – water soluble P (WSP) content; DPS – degree of P saturation; w1 – layer 0-5 cm; w2 – layer 0-30cm; * – correlation significant at α = 0.05; ** – correlation significant at α = 0.01.

Index	**pH_{KCl}**	**P_{ER}_w2**	**P_{ER}_w1**	**P_{H2O}_w1**	**DPS**
	Spearman rank correlation coefficient (R)				
pH_{KCl}		0.3655**	0.3244*	0.4017**	0.4017**
P_{ER}_w2			0.9552**	0.8474**	0.7474**
P_{ER}_w1				0.8176**	0.8176**
P_{H2O}_w1					1**
DPS					

Table 4(on next page)

Correlations between analysed indices of organic soils

Explanation: P_{HCl} – P content in soil determined in the extract of 0.5 mol HCl dm^{-3}; other explanations as in Table 3

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Table 4: Correlations between analysed indices of organic soils.

Explanation: P_{HCl} – P content in soil determined in the extract of 0.5 mol HCl dm^{-3}; other explanations as in Table 3.

Index	**pH_{KCl}**	**P_{HCl}_w2**	**P_{HCl}_w1**	**P_{H2O}_w1**	**DPS**
	Spearman rank correlation coefficient (R)				
pH_{KCl}		0.4828	0.4771	0.4863	0.4863
P_{HCl}_w2			0.6196*	0.0866	0.0866
P_{HCl}_w1				0.3091	0.3091
P_{H2O}_w1					1**
DPS					

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Table 5(on next page)

Assessment of runoff risk for all soil types; own elaboration (based on: *DEFRA 2005*)

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Table 5: Assessment of runoff risk for all soil types; own elaboration (based on: *DEFRA 2005*)

Specification	**Inclination:**			
	>7° (12.3%)	**3-7° (5.2-12.3%)**	**2-3° (3.5-5.2%)**	**<2° (3.5%)**
runoff risk	high	moderate	low	low

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