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Protection of soil in Poland within implementation of rural development programs (PROW)

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Abstract: The article provides an analysis of the effectiveness of rural development programs implementation in 2004–2006 and 2007–2013, especially agri-environmental measures in terms of their impact on soil fertility indicators and changing their rational use in agriculture. The changes in the structure of agricultural land for the 2004–2013, changes in acreage of main crops and their productivity during this period, the main trends in the using of mineral and organic fertilizers, the comparing of indexes of organic matter, macronutrients, acidity soil in 10 years were analysed. Proved that despite the presence of negative terms of soil protection trends in agriculture, such as reducing the use of organic fertilizers, reducing the acreage for grazing, growing number of applied pesticides and other significant deterioration in the quality of arable soil, some positive trends such as reducing soil loss from erosion were observed.

Keywords: soil protection, rational land use, soil quality, degradation, PROW implementation.

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1. Introduction. Formulation of the problem

It is well known that agricultural activity affects the environment and often leads to irreversible qualitative changes in natural resources, including soil, which is the most important mean of production, since the type of cultivated crops, quantity and quality of the crop depends on it. The formation of market relations in agriculture of Poland, which has began in 1989, resulted in leaving the practice of crop rotation and a sharp decline in the diversity of cultivated crop species. However, after joining the European Union Polish agriculture had to adapt to its rules, that is why the last 10 years it has dynamically changed, especially in agriculture.

For the 2004-2013 biennium., i.e. the period of the implantation of two rural development programs (PROW) agri-environmental surcharges accounted for more than 5.6 billion zł, including within PROW 2004-2006 – 2,6 billion zł, and PROW 2007-2013 (as of 01.31.2013) – more than 3.03 billion zł, an average of 2.4 thousand. zł per hectare. As part of the agri-environmental measures programs (agri-environmental surcharges) it was issued 409.5 thousand decisions on funding totaling more than 4.7 billion zł. During the continued acceptance of calls within PROW 2004-2006 it was issued another 262 thousand decisions for a total of over 2.6 billion zł. The total quota for decisions on the appointment of agri-environmental payments within PROW 2004-2006 and PROW 2007-2013 amounted to 7.4 billion zł`. Polish experience in implementation of PROW, including their agroecological programs, the achievement of agri-environmental objectives, changes in agriculture and the use of soil resources is very interesting and important as a global goal of these measures – to achieve a balance between economic efficiency and the laws of nature.

2. Analysis of recent research and publications

Since 2004 agriculture and rural areas of Poland are covered by the rules of the Common Agricultural Policy (CAP). The instrument of implementing EU policy in the field of rural development in Poland is the Rural Development Programme – a document which defines the objectives, priorities and principles for implementation of activities related to the socio-economic development of these areas.

As Ukraine is moving purposefully to the Europe area and is in reforming, including agriculture, experience of the European Union and Poland directly as "the closest European neighbour" is very important and interesting for local scientists. This applies to both general studies in the field of agriculture, such as on the formation of the CAP [27] or the actual experience of Poland [29] and on narrower topics related to the assessment of implementation of agri-environmental measures in the framework of rural development [28]. The protection of soil in terms of the basic principles of sustainable use of agricultural land, the similarities and differences laws of Poland and Ukraine were investigated by K. Havronsky, R. Kuryltsiv, J. Hernik [4], A. Kucher, I. Kazakova [30]. The continuation of this work should be research related to effective implementation of PROW, including its agri-environmental programs and specific activities in the field of soil protection.

3. Problem statement

The main purpose of the article is to study the characteristics of the use and protection of soils in Poland influenced by the implementation of rural development programs.

The basis of the study was the reports of the Central Statistical Office of Poland for the 2004-2014, documents of the Agency of Modernization and Restructuring Agriculture, reports of the Ministry of Agriculture and Rural Development for the study period, Institute of Soil Science and Plant Cultivation in Pulawy.

4. Presenting main material

During the implementation of rural development programs 2004-2006 and 2007-2013 and the beginning of the implementation of program 2014-2020 it is possible to estimate the first effects results of implemented measures in qualitative changes in the agriculture of the country.

The average quality of the soil in Poland is relatively low. According to research, more than 40% of Polish soils are characterized by low quality and agricultural suitability [10, 23]. There are good soils and very good (classes I-III), representing 28.6% of the total arable land, soil of medium quality (classes IV-IVa) – 39.1%, and poor and very poor (classes V and VI) – 32,3%. Under permanent pastures there are occupied 15% of good soil and about 42% – by medium and poor [9]. About 80% of agricultural land in varying degrees are acidified (very acid – 29%, acid – 28%, slightly acid – 24%) [10]. Threats soil such as erosion, loss of organic matter, loss of biodiversity, soil acidification, etc., are the result of agricultural and non-agricultural activities. That is why the protection of soil from erosion is relevant and important.

In 2004-2006 on the implementation of PROW it was appointed national funds and EU funds in excess of 3.5 billion euros. The total program consisted of so-called measures or actions which include: support low commercial farms, support for farming in mountain areas and in less-favoured areas, supporting organic farms

and improving animal welfare, afforestation of agricultural land, the adaptation of farms to EU standards etc. Action Package "Ground and water protection" is directly related to solving problems of soil and it is part of the measures to support agri-farms and improve animal welfare, which was destined to 218.90 million euros (6% of the funding PROW budget)

In PROW 2007-2013 agri-environmental programs became a major focus of environmental activities, they allocated more than 13% of the funds and the use of designated funds in 2012 reached almost 60% [16]. The area covered by PROW financial support 2007-2013 is 3,310.7 thousand ha of arable land, while agri-environmental programs cover 2,789.6 thousand ha (some packages may be combined in one area). Under package "Ground and water protection" was paid about 1084.0 thousand zł. Area of support issued by a decision on granting agri-environmental payments amounted to 841, 5 thousand ha, or about 84% of the target for 62.4 thousand farms. [19]

It should be noted that the issues of soil protection are provided in other activities. For example, in early retirement it is provided for distribution of agricultural land for non-agricultural purposes, if the land cannot be used for agricultural activities in an economically acceptable level; within the measures to support for farming in mountain areas and in less-favoured areas it is provided financial support for farms located in areas where agricultural production is complicated by natural conditions, including where there is a danger of water erosion.

General support by PROW 2004-2006 in the country amounted to 1.2% of GDP (average for 2004-2006). Given that it was addressed to a relatively small part of the population in the country (farmers-beneficiaries), the support can be considered significant. As a result PROW implementation contributed to economic growth (1.4%), increase income of the rural population (3.5%) and increase rural employment (0.8%), without causing inflationary pressure (-0.5%) [13]. The projected impact of PROW 2007-2013 in 2015 included the increase of GDP by 0.41%, increasing rural employment by 0.36% in 2015 [15]. So PROW overall impact on the Polish economy was positive.

4.1. Changes in land use in Poland

One of the indicators of the soil use is the structure of land use. According to Table 1, the changes were slow in Poland, there were more visible changes in the structure of crops, which is adapted to the demand for agricultural products.

Table 1. Dynamics and structure of land use in Poland in 2004-2014, thousand ha

Year	Total area	Agricultural lands	Including					Forests and forest soils	Soils under bodies of water
			arable soils	orchards	meadows	pastures	soils under constructions, ponds, ravines		
2004	31269	19148	14074	297	2353	1695	527	9338	636
2006	31298	19099	14059	290	2343	1694	722	9389	636
Dynamics of changes 2004=100	100,1	99,7	99,9	97,8	99,6	99,9	136,9	100,5	100,0
2007	31268	19069	14037	294	2333	1670	736	9401	636
2013	31268	18770	13851	287	2274	1616	742	9634	647
Dynamics of changes 2007=100	100	98	99	98	97	97	101	102	102
2014	31268	18717	13818	385	2260	1613	740	9658	649
Dynamics of changes 2004=100	100,0	97,7	98,2	130,0	96,1	95,2	140,3	103,4	102,0

Source: own calculations based on data from the Central Bureau of Statistics (GUS).

Over the country change of agricultural land in the first period (2004-2006 years) did not exceed 0.5% for each area of use and averaged 0.3%. In the second period farmland area was decreased by 2%. In general, for two periods the farmland area was decreased slightly (more than 2%) and major changes related to the area under orchards (up 30%) and lands under constructions, ponds, ditches (up 40%).

Analysing the impact of PROW implementation on land use, it should be noted that a number of measures of program ("Extensive meadows and pastures" and "Afforestation of agricultural land") was aimed to preserve or develop perennial plants, and it reduces the intensity of land use. In addition, area of agricultural land in ecological farms, with a view to protecting executable functions in the landscape, exposed by favourable changes, largely to changes in land use affect decreasing area allocated land in different regions. Financing PROW to

support activities related to the best way to use the land ("Sustainable agriculture", "Extensive meadows and pastures" and "Afforestation of agricultural land"), shows a differentiation of costs by region, the largest share of PROW expenditure on these measures (more than 12%) is in the province Podkarpatske (distribution of ecological agriculture is predominant) and Zachodniopomorskie (afforestation of agricultural land is predominant). The largest share of the area, which is appointed by support to improve land use is observed in the western and northern part of the country (1.88-2.77%). But compared to the area of agricultural land in the country and various provinces their share is insignificant. Useful changes in land use occur due to the greening measures in agriculture, it promotes integrity of the landscape, reducing nutrient pollution and supporting biodiversity.

The share of area, that is used in ecological farming system compared with an area of farmland is a little one and shows regional differences in the range of 0.14 to 4.53%. Total area where there have been positive changes in land use (in the result of PROW), 6% of the total agricultural land in the country [13]. That is on the territory covered by the program, changes in land use, firstly, are positive, and secondly, there are faster than the average in the country.

Investigations in Lower Silesia [22] indicate a significant impact of revenue streams from non-agricultural activities on the level derived from the cultivation lands. An important factor is the size of farms and the quality of soil – agricultural lands of low suitability, highly acidic, located in small farms are derived more. These factors more than 80% cases explain the spatial variability of the phenomenon of abandoned land. It is confirmed by the thesis that the withdrawal of land from cultivation meets the same factors responsible for the poor economic performance, especially farms with a small area. This is evidenced by the fact that after the introduction of direct subsidies and other support tools that are used from 2004, the area of derived lands is decreased significantly [13]. Motivation factor for the recovery of agricultural production in large part of lands previously derived from circulation was increasing profitability associated with various forms of payments, rather than individual instruments. The national average reduction of area of degraded soils in 2003-2006 was 58% compared to 2003.

According to conducted research [18, 22, 26] implementation of agri-environmental measures in the farms occurs mainly through financial reasons (74%) and only 12% are guided by the need and desire to protect the environment.

In 2007-2012 it was a tendency to increasing the land area that is covered by agri-environment payments. Since the beginning of the implementation of PROW 2007-2013 the declared area increased from 1123.7 thousand ha in 2007 to 2282.9 thousand ha in 2012 (more than 103%), which is more than 13% of agricultural land. The greatest interest among the owners of farms in Poland had the package "Sustainable Agriculture", the area of support to which in 2011 amounted to over 771 thousand ha. Not much smaller area was covered by benefits in terms of "Ground and water protection" – 700 thousand ha. The area, which was designed to support measures under the package "Ecological agriculture" was more than 568 thousand ha [16].

It is important that the implementation of agri-environmental measures, especially in relation to the package "Ground and water protection" would increase the proportion of land covered with vegetation in autumn and winter. The proportion of "green fields" in the reporting period was outside the area covered by agri-environment programs, compared to the total area of agricultural land – 65.8%, as compared with arable land – 58.6%. In the areas covered by agri-environment programs, the proportion of "green fields" made up 76.6% of the total area of agricultural land and 73.4% of arable soils. In connection with this part of the area covered by vegetation in the autumn and winter, in the areas of implementation of agri-environment programs was higher by 10.8% in relation to agricultural land and 14.8% – in relation to arable soils [14]. These data show that the implementation of the program helps to maintain and improve the use of lands in Poland.

4.2. Changes of sown area and yield of major crops

The gradual decline of agricultural land in Poland is a phenomenon that coincides with the global trends. This is connected primarily with the buildings, development of infrastructure accompanying housing estates as well as the gradual industrialization of the country. The land, withdrawn from farming, not only is transferred to the construction of settlements and industrial enterprises, but also stands in reforestation.

The total area of crops is an indicator of the production capacity of agriculture, which, in turn, determines the degree of satisfaction of people's needs in food. With the decrease in the total area of arable land, significant changes in the total sown area are not expected, but market conditions may change the amount of sown area under certain crops [25]. In addition, the projected climate changes, increased variability of weather conditions necessitate production of new crops and/or increasing the area of individual crops that are growing now [8]. There were favourable conditions for growing corn, sorghum, sunflower, grape, worse – for potatoes and spring grain. The opinions of experts on the matter are ambiguous, but violations of the ratio between the areas of cultivation of different cultures are certainly a serious problem, especially in the long run [9].

Species composition of grains is determined by climatic and soil conditions. In the structure of grain crops over the period certain differences are noticeable (Fig. 1).

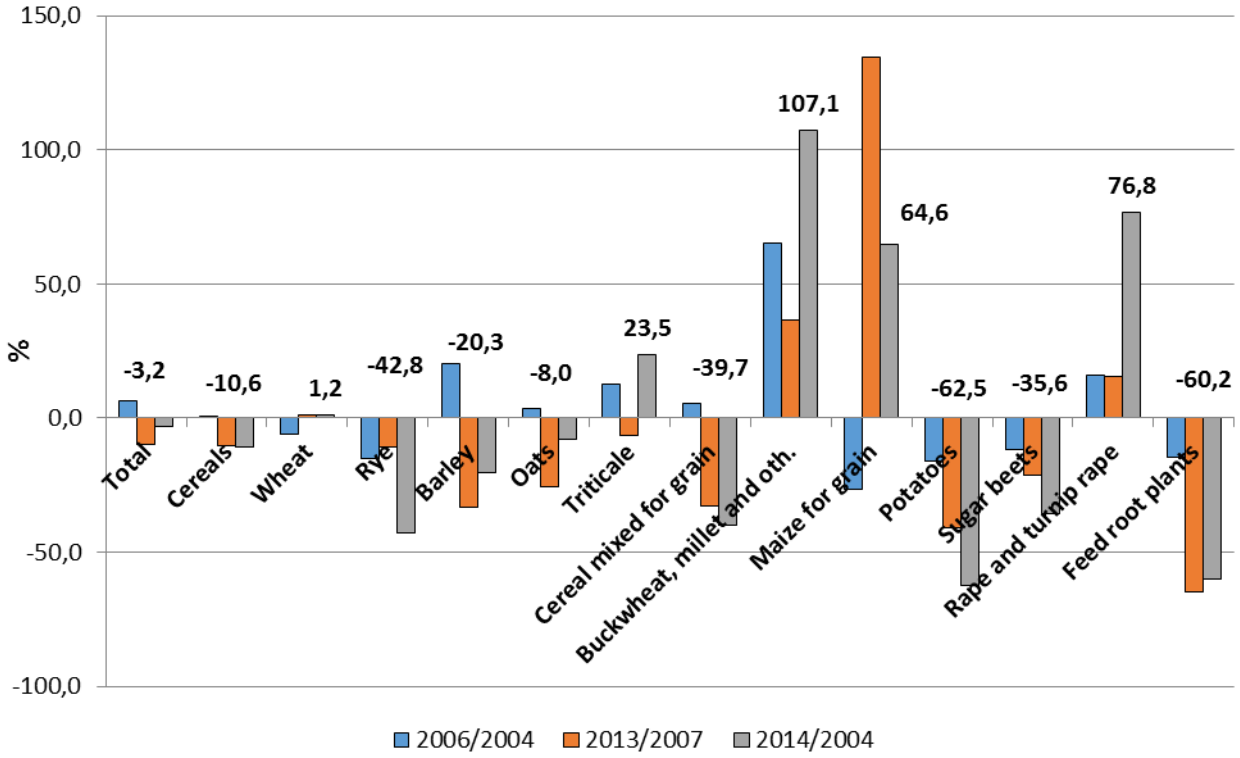

Figure 1. Dynamics of sown area of basic crops in Poland in 2004-2014, %
Source: Own calculations based on data from the Central Statistical Office (GUS).

Overall, in the country with the decrease of farmland area sown area of cereals were decreased slightly: in 2004 grains were grown on an area of 8.4 million hectares, in 2014 – only 7.5 million hectares. The national production of grain wheat predominates (31.2% in 2014). However, a high proportion of grain crops in the structure (75.7% in 2014) also has negative consequences, because crops have a negative impact on soil (through repeated sowing crops in one place there is a decrease in organic matter, soil structure deterioration, strengthening diseases and weeds, etc.) [5].

However, in the 2004-2014 plantings of corn for grain were increased (on 266.2 hectares). Area of buckwheat, millet and other cereals in 2004 amounted to 52 thousand ha or 0.5% of the total sown area, and in 2014 – 107.7 thousand ha, or 1%, it also shows its growth.

The area under potatoes was decreased (in the first period – 16%, in the second – more than 40%), it had negative consequences as meant limiting the possibility of growing other crops after good predecessor.

Also there is a need to note a gradual increase in the share structure of the crop of so-called industrial crops. Thus, the sown area of rape was increased by 16%, during 2004-2006 beet area – decreased by 12%. In the second period (2006-2013) area under beet declined another 21.5%, while under rapeseed increased by 15.6%. Overall a decade the rape sown area was increased by more than 75%.

The proportion of forage crops in the total sown area was 0.4% in 2004, in 2014 it was decreased to 0.2%. These negative processes, including change in the proportion of forage plants area are associated with a gradual decrease in number of animals in the country; all this is not conducive to the rational use of land, on the contrary, can lead to deterioration.

In general during the 2004-2014 yield of crops was characterized by significant fluctuations due to weather variability, but mostly tended to increase (Fig. 2).

Due to adverse weather conditions crop yields in 2006 were decreased by approximately 25-50% compared to the 2004. Second period (2007-2013) was characterized by a significant increase in productivity (by 5-20% in 2013 compared to 2007). 2014 can be considered as the most favourable, since then wheat yield was 51.5 c/ha, barley – 46.2, potatoes – 278 beet – 603 c/ha.

It should be noted that Polish soils have with high production potential. This is evidenced by the fact that on very good arable land (24%) it may be received grain harvest to 6.08 t/ha, on the good lands (24.8%) – 5.16 t/ha on soils of medium quality (15.9%) – 4.57 t/ha [10].

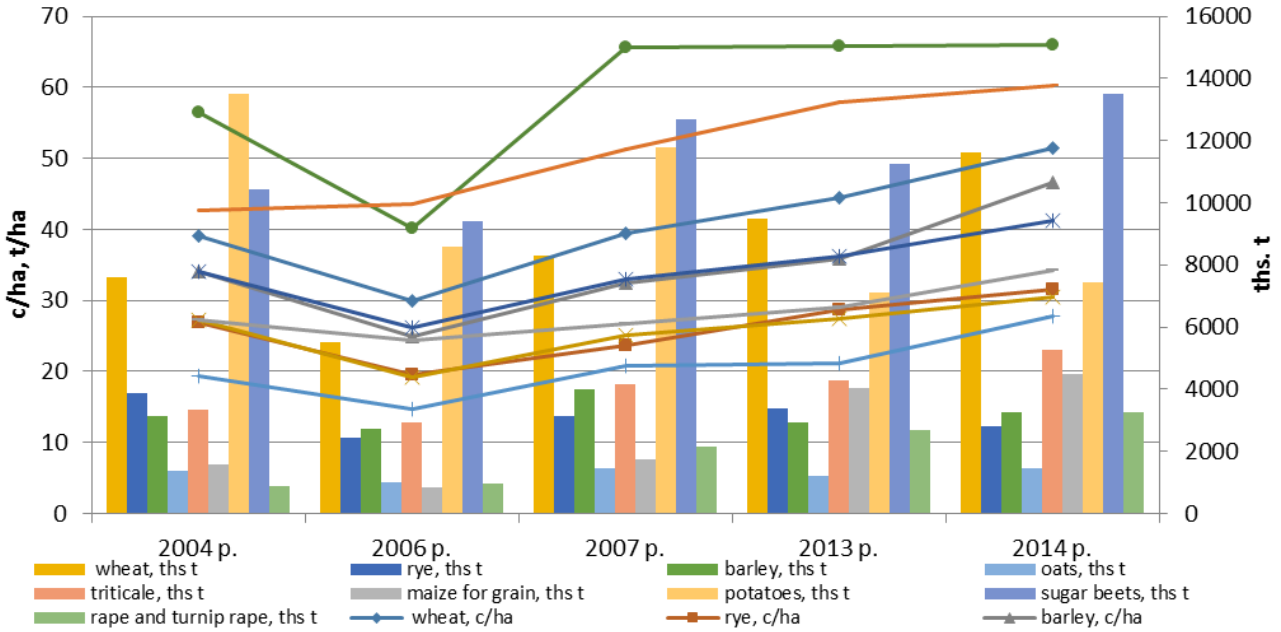

Figure 2. Changes in crop yields in Poland

Source: Own calculations based on data from the Central Statistical Office (GUS).

4.3. Changes in fertilization of crops

To obtain high yields of crops it is necessary a large amount of nutrients. In particular, for the production of 1 unit of cereals (1 = 100 kg of grain or 50 kg of rape, 400 kg of sugar beet roots or tubers, 600-900 kg of feeds) plants consume in average 6.4-6.8 kg of NPK [6].

Intensification of agriculture on the one hand, has always been associated with an increase in the use of mineral fertilizers and increasing water pollution of their components. Data of scientists on the level of use of mineral fertilizers in Poland differ. Thus, according to research by F. Chizchik [1], the consumption of fertilizer (especially nitrogen) in farms with intensive crop production is too high and exceeds the recommended value for sustainable agriculture. Polish investigators A.M. Fotyma and others [3] argue that because of the relatively low level of productivity and agrochemical indices of soil fertilization moderate increase in Poland is necessary. For an increase of grain yield per unit, soil should be added at least 2 kg/ha of nitrogen and 0.8 kg/ha of phosphorus and 0.6 k /ha of potassium. Given that the average grain yield in Poland is 3.9-4.0 t/ha, the level of consumed fertilizers should be increased to 150-160 kg NPK/ha, that is 30-40% higher compared to the doses are used the national average today. Research of Institute of Soil Science and Plant Cultivation in Pulawy, conducted in the control farms showed that this level of productivity and volume of applied fertilizer doses improved soil fertility [the same].

The negative impact of agriculture on soil quality is often the result of improper use of fertilizers, pesticides and low culture of agriculture. Poland is a country with an average level use of fertilizers and plant protection products. In the 1998-2003 fertilizer consumption was at around 93 kg/ha. In 2003-2004 there was an increase in the amount of fertilizers to 99 kg/ha, and in 2005-2006 – almost 123 kg/ha. Most likely, these changes are the result of Poland's accession to the European Union and associated subsidies for agriculture [21].

Table 2 shows that after 2006 in Poland there was a positive trend in the consumption of fertilizers. Thus, in the first period (2004-2006) the use of phosphates and potash fertilizers increased by 40.6 and 33.5% respectively, the second period (2007-2013) was characterized by a rapid change in the consumption of nitrogen fertilizers – from 65.3 to 80.7 kg/ha.

It should be noted that during 2004-2006 in farms covered by agri-environment programs (afforestation and farms with poor conditions of agricultural activity) fertilizers were decreased: reducing the amount of fertilizers was noted by 50% of respondents, or 291 respondents, 28% of respondents reported on no changes and only 22% reported increasing in mineral fertilization [13].

Important to remember that information on the number of applied fertilizers Polish researchers consider in terms of the threat to groundwater contamination and water quality.

Question of crop fertilizing should be considered not only from the standpoint of their productivity growth, but from a position of support fertility and soil structure, including those physical parameters that allow saving water and help conserve biological activity. The combination of these factors and the availability of soil

nutrients, at least on average, determine its fertility. These parameters can be maintained and improved if it is a care of the balance of organic matter in soil, the optimal reaction of soil solution, balanced mineral fertilizer [6].

Table 2. Consumption of fertilizers and lime in Poland in 2004-2014

Indicator	2004	2006	Dynamics of changes 2004= 100	2007	2013	Dynamics of changes2007= 100	2014	Dynamics of changes 2004= 100
Total NPK, kg/ha of a.m.	99,3	123,3	124,2	121,8	133,0	109,2	132,9	133,8
Including nitrogen	54,8	62,5	114,1	65,3	80,7	123,6	75,5	137,8
phosphorous	19,7	27,7	140,6	25,5	25,6	100,4	23,4	118,8
potassium	24,8	33,1	133,5	31,1	26,7	85,9	34,2	137,9
Lime fertilizers	93,5	54,8	58,6	37,4	43,4	116,0	47,9	51,2
Organicfertilizers	46,3	46,6	100,6	43,8	39,0	89,0	36,3	78,4
Total NPK, ths. tons ai	1711,2	1966,2	114,9	1970,7	1943,4	98,6	1935,3	113,1
Including nitrogen	985,0	996,5	101,2	1056,2	1179,1	111,6	1098,4	111,5
phosphorous	321,0	441,9	137,7	411,9	374,1	90,8	341,1	106,3
potassium	405,2	527,8	130,3	502,6	390,2	77,6	495,8	122,4
Lime fertilizers	1525,9	873,7	57,3	604,9	634,7	104,9	697,2	45,7

Source: Own calculations based on data from the Central Statistical Office (GUS).

Rational use of fertilizers always improves crop yield and its stability, improves soil fertility and does not cause negative effects on the environment. However, effective use of fertilizers by plants is possible only with proper pH level and soil organic matter (humus) in the soil.

The determining factors in the process of acidification are: calcium leaching, acid rains, nitrogen fertilizer use, especially with sulfur, removal of calcium with harvest. In 2002-2011 lime fertilizer use in Poland was declined annually by about 8.43 kg/ha. Restrictions in liming soil began in the country in 2005-2006, now it deepened and preserved until now [7].

According to the results of other studies [6], natural processes and those related to human activities lead to annual losses of calcium in the soil at least 140 kg/ha CaO under heavy cultivation and intensive fertilization with nitrogen, and in contaminated areas – 250 kg/ha CaO. According to data of the Institute of Soil Science and Plant Cultivation in Pulawy, more than 4 million hectares of arable land require urgent liming. [10] In terms of sustainable growth in the use of nitrogen fertilizers reduce in liming is dangerous because acidification of soils reduces their productivity and contributes to land degradation.

By the evaluation of the fertilizer use we must pay attention to organic fertilizer, which is a valuable source of essential nutrients for plants. The importance of organic fertilizer (manure etc.) is widely known. They have a diverse effect on all the properties of soils. Organic fertilizer improves the efficiency of mineral, increases the capacity of moisture in the soil and thus ensures stable yields under adverse weather conditions, and in case of agronomic errors. In addition, the lighter the soil, more necessary the organic fertilizer is [6]. The annual dose of manure in terms of the active substance shall not exceed 170 kg/ha, which is 35 t/ha of manure per year [15].

The use of organic fertilizers during the period tends to decrease. For 2013-2014 in agriculture of Poland there were used 38.8 million tons of manure enriching farmland for more than 36.3 kg a.m. of NPK [20].

The difference in the nitrogen gross balance in farms covered by environmental programs is less than 2% for farms implementing appropriate agri-environmental measures (57.4 and 58.5 kg/ha respectively). [14] Based on these data it can be argued that the implementation of environmental programs allowed only maintaining soil quality in terms of nitrogen balance, with no tangible effect toward improvement.

4.4. Changing soil quality

Among the works of scientists to change the soil quality in Poland the research of Institute of Soil Science and Plant Cultivation in Pulawy (IUNG) "Arable soil chemistry monitoring" are interesting, they are parts of the state environmental monitoring. Monitoring of arable soil covers a network with 216 points of measurement and control located on agricultural land throughout the country [11].

According to IUNG research, we can identify the following trends:

1. Soil organic matter is a key indicator of soil quality and is crucial for determining the physical and chemical properties. In the group of analyzed profiles soil with average humus content (1-2%) dominate. They

are more than 60% of all profiles. Profiles with high humus content (> 3.5%) at all control points in each round of testing are less than 10% [the same].

Results of the research by S. Krasovich et al. [10] show that in the last 20 years, the balance of soil organic matter is adversely affected by reducing the share of perennial forage crops in seeded area, reducing the number of livestock farms and changing specialization caused by economic factors. Thus, farms of crop specialization are characterized by a negative balance of soil organic matter. In these farms the main source of soil organic matter is straw, 50-70% of which are plowed. In livestock farms, with a high density of livestock (more than 2.5 h/ha), we can observe excessively high positive balance of soil organic matter, which in turn can lead to large losses of nitrogen from soil.

2. Total phosphorus and potassium are natural components of soil and present in it in a large amount (often more than 1%). Therefore we do not expect significant changes in their content. Their presence in the soil is not considered in terms of pollution (excess), while they significantly affect soil properties and processes of transformation of contaminants (Fig. 3).

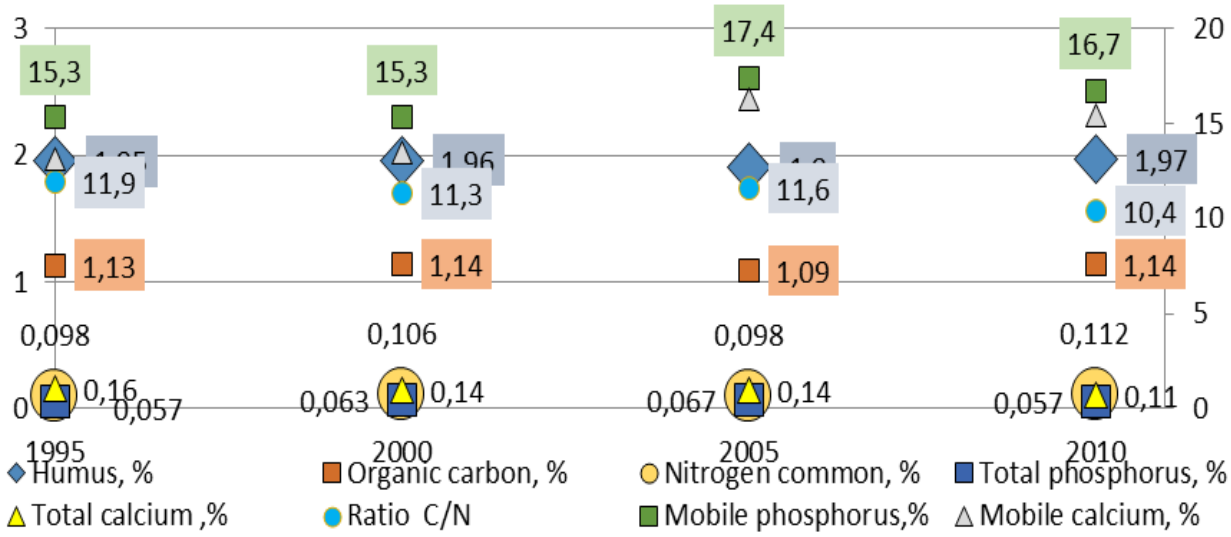

Figure 3. Average values of basic chemical indicators of soil quality in Poland in 1995-2010

Note: organic carbon and humus are determined using a modified method by Turin, available phosphorus and potassium with the Egner-Raim method, the total nitrogen content – by the Kjeldahl method.
Source: elaborated based on IUNG data.

3. The content of available phosphorus in 2010 ranged over a wide range – from1,8 to 155 mg P_2O_5 per 100 g^{-1}). Average phosphorus content does not exceed 17 mg P_2O_5 per 100 g^{-1}. These figures hardly changed since 1995 – the share of soils with very low and low content (less than 10 mg P_2O_5 per 100 g^{-1}) in four rounds of testing was 38-42% of all accounts. The soils are very rich in available phosphorus (> 20 mg P_2O_5 per 100 g^{-1}) are just over 20% of all profiles.

4. Diversity of available potassium forms in soil at all stages of the selection is characterized by fluctuations between 2.3 and 66.8 mg K_2O $100g^{-1}$. Average potassium content slightly increased during 2005-2010 compared to the initial level in the studied profiles.

5. The average pH level in 2010 amounted to 5.48 (median – 5.38). The optimal range of pH for the implementation of biological processes related to the metabolism of most species of plants and soil microorganisms is from 5.5 to 7.2. The average level of acidity of soils in Poland increased slightly compared to the first round of research – namely, from 5.31 in 1995 to 5.48 in 2010 (Fig. 4). However, comparing the average level of acidity for years, according to Polish researchers, does not confirm the trend towards increasing the acidity of the soil.

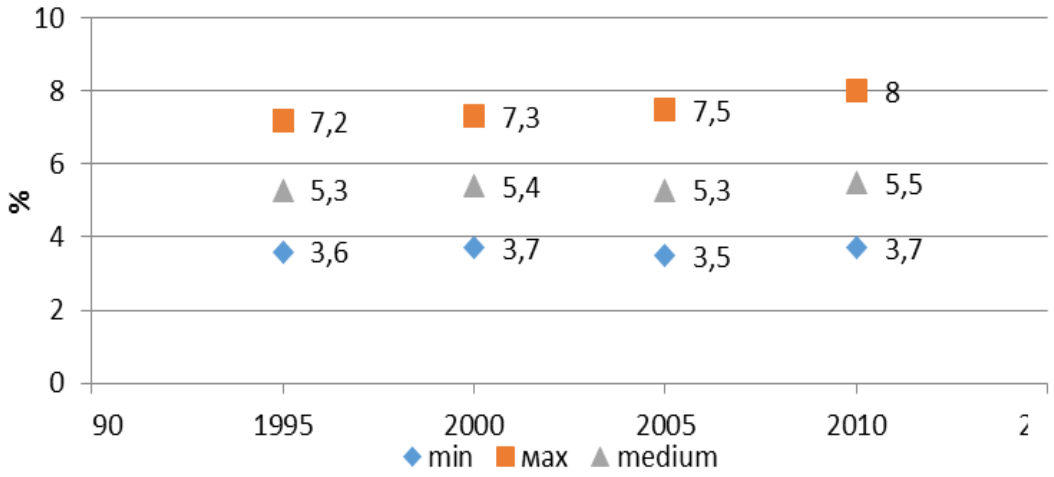

Figure 4. Changing the pH level in the soil for 1995-2010.

Note: hydrolytic acidity is determined using the Kappen method
Source: elaborated based on IUNG data.

Share of profiles of very acidic and acid soils in the research group is over 50%. This is due to natural causes and restraint in liming soils.

4.5. Other results of the PROW

In general, low culture of agriculture leads to erosion, chemical pollution, biological degradation, compaction, acidification, salinization, waterlogging etc. Agriculture influences the development of these negative effects through: destruction of vegetation (grass or forest), wrong tillage, the wrong choice of crops and selection in their rotation, poor grazing, improper land improvement measures. Chemical contamination of soil creates an imbalance in the biological soil environment. Agricultural contamination can occur due to improper use of mineral and organic fertilizers, sewage or sewage sludge and plant protection or plant growth regulators [12].

Although Poland is located in the temperate zone, which does not create a strong threat to the erosion, however, for 1/3 areas there is a threat of water and wind erosion, and on 1/5 surface spring erosion can be observed [2]. Thus, the impact of programs on the rate and spread of erosion is equally important. As a result of erosion in areas that are not covered by the PROW implementation, soil loss in 2006 amounted to 1.82 t/ha compared to 1.56 t/ha in 2009. In contrast, in areas that are covered by the PROW support, losses of soil in 2006 were 1.31 t/ha and 1.18 t/ha in 2009. The results show that erosion in average through the country reduced in areas covered by the program and beyond their borders. But soil losses in areas without agri-environmental measures were higher by 40% in 2006 and 32% in 2009 [14]. This indicates that the implementation of programs on balanced development reduces soil losses caused by water erosion. It should be noted that most influence here had changes in the structure of sowing crops and increasing vegetation in winter (package "Protection of soils and waters").

Note that from 214 beneficiaries covered by the questionnaire survey on the impact of implementation of PROW 13% indicated that the implementation of programs helps protect the soil insufficiently, 35% noted the impact as satisfactory and 34% of respondents highlighted the significant impact of agri-environmental programs in this area [the same].

An important feature of the program is its multifunctional nature, based on the fact that a single event can be directed both at production and development, and environmental protection – economic and environmental functions of these measures often are not mutually exclusive, but rather reinforce each other. Examples are programs for reforestation, ecological farms and sustainable agriculture, their tools focused on production and economic development, but by changing the system, its extensification that contributes to the environmental (main) purpose and functions of the local landscape formation [17]. Farm owners, who ignore intensive production, receive compensation in the form of subsidies to those areas where the health program is implemented, so it does not reduce the economic efficiency of the farm.

In addition to positive trends in Polish agriculture, by V. Yaretsky opinion [7] we should pay attention to the acceleration of adverse changes in agriculture. To them can be included, in particular, reducing consumption

of certified seeds of major crops and seed potato, pesticide use, reducing the usage of lime fertilizers. All this is a threat to the quality of soil, water and air, which are the main means of production in agriculture.

In addition, analysis of the balance of organic matter in the areas covered by the implementation of PROW shows that implementing the measures do not improve balance compared to other areas. According to the obtained results, the balance of organic matter in the areas of implementation of agri-environment measures amounted to 0.564 tdw / ha per year, while others – 0.625 tdw/ha per year. On the lower balance of organic matter can affect lower density of livestock in areas where the program is implemented, so it helps avoid other environmental threats. Also a big impact on the balance of organic matter may have a smaller proportion of pastures and meadows, in the areas of implementation of individual packages. In addition, the estimated increase in organic matter in the country through the implementation package "Protection of soil and water" for PROW 2004-2006 amounted to 587 ths. t. for other packages of agroecological program – only 261 tonnes [14].

5. Conclusions and recommendations for further research in this area

So far, there are many problems related to the conservation and protection of the environment and use of its resources for agricultural production, including soil. The assessment showed that without the implementation of the measures provided for in PROW 2004-2006 and 2007-2013 and dispersing funds many of these problems could not be solved in a proper level. In addition, the environment would deteriorated, and the task of environmental protection would be implemented to a lesser degree and with limited effectiveness.

Overall, within the CAP Polish agriculture should receive more than 32 billion euros over the next seven years. In the next period (2014-2020) are planned also a number of activities that facilitate in particular the following objectives: improving water management, including fertilizer and pesticide use; preventing soil erosion and improving soil management; reduce greenhouse gases and ammonia in agriculture etc.

So main results of implementation of agri-environmental programs are soil quality support at an appropriate level, countering the deterioration of basic quality indicators, promoting better use of agricultural land and increased environmental awareness of farmers who joined the proposed measures and must follow good agricultural practices because it is based on minimizing the risk of environmental degradation in the process of agricultural production and should lead to favourable qualitative changes in the environment, including soil environment.

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Охорона ґрунтів у Польщі в межах реалізації програм розвитку сільських територій (PROW)
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Анотація. Метою статті є аналіз ефективності реалізації Програм розвитку сільських територій у 2004–2006 рр. та 2007–2013 рр., особливо агроекологічних заходів з погляду їхнього впливу на зміну показників родючості ґрунтів та їх раціональне використання в сільському господарстві. Було проаналізовано зміни в структурі використання сільськогосподарських угідь за 2004–2013 рр., зміни посівних площ основних культур та їхню урожайність за цей період, визначено основні тенденції в застосуванні мінеральних та органічних добрив, порівняно показники вмісту органічної речовини, макроелементів, кислотність ґрунтів за 10 років. Доведено, що, незважаючи на наявність негативних з погляду охорони ґрунтів тенденцій у сільському господарстві, таких як зниження застосування органічних добрив, зменшення посівних площ під пасовищами, зростання кількості застосовуваних пестицидів тощо, значного погіршення якості орних ґрунтів не спостерігалось, навіть навпаки, відзначено окремі позитивні тенденції, наприклад, зниження втрат ґрунтів від ерозії.

Ключові слова: охорона ґрунтів, раціональне використання, якість ґрунтів, деградація, реалізація PROW.

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Охрана почв в Польше в рамках реализации программ развития сельских территорий (PROW)
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Аннотация. Целью статьи является анализ эффективности реализации программ развития сельских территорий в 2004–2006 гг. и 2007–2013 гг., особенно агроэкологических мероприятий, с точки зрения их влияния на изменение показателей плодородия почв и их рациональное использование в сельском хозяйстве. Проанализировано изменения в структуре использования сельскохозяйственных угодий за 2004–2013 гг., изменения посевных площадей основных культур и их урожайность за этот период, определены основные тенденции в применении минеральных и органических удобрений, сравнены показатели содержания органического вещества, макроэлементов, кислотность почв за 10 лет. Доказано, что, несмотря на наличие негативных с точки зрения охраны почв тенденций в сельском хозяйстве, таких как снижение применения органических удобрений, уменьшение посевных площадей под пастбищами, рост количества применяемых пестицидов и прочее, значительного ухудшения качества пахотных земель не наблюдалось, более того, отмечены отдельные положительные тенденции, например, снижение потерь почв от эрозии.

Ключевые слова: охрана почв, рациональное использование, качество почв, деградация, реализация PROW.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.14254/2223-3822.2016.14-1.14

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