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MANAGEMENT OF LAND RESOURCES AND SUSTAINABLE DEVELOPMENT OF RURAL AREAS

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GOSPODAROWANIE ZASOBAMI ZIEMI A ROZWÓJ ZRÓWNOWAŻONY OBSZARÓW WIEJSKICH

STRESZCZENIE: Celem opracowania jest przedstawienie zmian gospodarowania zasobami ziemi jako naturalnego czynnika środowiska i produkcji rolniczej w kontekście rozwoju zrównoważonego obszarów wiejskich. Nie można traktować ziemi jako zasobu w pełni odnawialnego, gdyż niewłaściwe jej użytkowanie może doprowadzić do utraty jej właściwości i zagrożeń dla przyszłych pokoleń, co jest sprzeczne z paradygmatem rozwoju zrównoważonego. Analizą objęto zmiany zachodzące na terenie Polski oraz województwa dolnośląskiego z podziałem na regiony funkcjonalne. W Polsce i województwie zmniejsza się powierzchnia ziemi wykorzystywana na cele rolnicze oraz ulega zmianie struktura jej użytkowania. Zbyt duży ubytek gruntów przeznaczanych na cele rolnicze może doprowadzić do obniżenia produkcji zabezpieczającej potrzeby życiowe populacji ludzkiej, dlatego gospodarowanie ziemią musi opierać się na jej ochronie i maksymalnym wykorzystaniu.

SŁOWA KLUCZOWE: obszar wiejski, zasoby naturalne, ziemia, zrównoważony rozwój

Introduction

Due to the human activity, the natural environment surrounding us undergoes constant degradation. Consumption of renewable and non-renewable resources increases. In the face of such phenomena, it is necessary to search for solutions which would deter such degradation. Limiting the use of non-renewable resources results in the search for renewable raw materials.

The most important resources and values of nature include:

- the space of inanimate nature – minerals, soil, water, air,
- resources of living nature – animals, plants,
- other components of the biosphere such as landform, landscape, climate, flows of energy and in particular solar energy¹.

Kotarbiński after Łojewski² most accurately explains how actions should be implemented in terms of space and matter. Thus, every fragment in space should be used so that there is enough space left for everything and the managed area could serve many purposes at once. As to matter, no more resources should be used than it is necessary to manufacture products nor is it allowed to waste any kinds of refuse. All activities must be limited to savings and thriftiness. Therefore, it is necessary to apply such scientific and technical solutions which consist in the optimal use of resources as the basis for development, in accordance with the concept of sustainable development.

Among renewable resources focus is put on renewable resources which are exhaustible such as; soil, agriculture, animal population or forest biomass. While using such renewable resources it is necessary to manage them so as to obtain maximum benefit from their exploitation without compromising the ability of their natural renewal³. Only such utilization of them ensures the possibility to develop rural areas, in compliance with the paradigm of sustainable development.

According to Buks⁴ agricultural production is based on natural resources and therefore environmental changes have an impact on it. Agricultural producers are forced to adapt their business solutions to the changing environment and management in accordance with sustainable development. The production volume should be maintained simultaneously with its positive impact on the environment. The production function of agriculture cannot be

¹ S. Łojewski, *Environmental economics*, Bydgoszcz 1998, p. 39–41.

² S. Łojewski, *Economics of resources and the environment*, Bydgoszcz 2007, p. 54–63.

³ J.S. Zegar, *Basic issues of sustainable development*, Bielsko-Biala 2007, p. 229.

⁴ J. Buks, *Land factor as an element of sustainability*, "Scientific Annals SERIES" 2012 vol. XI, issue 1, 2012, p. 82.

realized without protection of the environment⁵. Breaking this rule may result in lower production and inhibition of economic development in rural areas and the entire state. Therefore, it is necessary to manage both environmental and land resources so as not to violate the ecological balance nor reduce their contribution to creation of social welfare. Thus, economic exploitation of natural resources is associated not only with their exploitation but also with their security⁶.

The aim of this paper is to present changes in land resources management as a natural factor of the environment and agricultural production in the context of sustainable development of rural areas.

The importance of land resources management

Land is a basic resource of the environment and a factor of agricultural production. In the context of the concepts of sustainable development the significance of land is even much wider. Apart from its production function, land has many other functions, as it creates landscape and has recreational, sports, tourist as well as environmental values. As a factor of production, land is characterized by immovability, irreproducibility and indestructibility⁷. Immovability of land is associated with its fixed location as the use of it may occur under conditions created by nature. Irreproducibility of land results from the limited area of it – its supply is limited and not subject to reproduction. However, land is stable and indestructible in relation to durable goods and the natural environment.

The rapid development of civilization, which is the hallmark of modern times, leads to degradation of the natural environment as well as land. The change occurs not only in the area used for agriculture, but also in the composition and properties of soil. Degradation of land results not only from the human activity, but also from the impact of natural factors. Threats to soils (erosion, loss of organic matter; adverse changes in biodiversity, acidification of soils, etc.) result from agricultural and non-agricultural activities as well as from the loss of land used for production purposes. In this situation, action is needed to ensure the proper use and protection of land.

Protection of soils against erosion can be achieved by means of anti-erosion drainage treatments (terracing of slopes; strengthening ravines, rivers,

⁵ J.S. Zegar, *The concept of research on socially sustainable agriculture* (10), Final Report, Synthesis and recommendations, Warsaw 2009, p. 175.

⁶ H. Adamska, *Sustainable development of rural areas on the example of Lower Silesia*, Wrocław 2015, p. 111.

⁷ A. Woś, F. Tomczak, *Agricultural Economics. Outline of Theory*, Warsaw 1983, p. 84.

streams and landslides; keeping road routes along small declines in terrain) as well as by agricultural treatments (no-till crops or crops with minimum tillage; stoppage of animal grazing; transformation of arable land into permanent grassland; maintaining landcover, including permanent meadow, forest and woodland cover; the use of strip fields, buffer zones; improving crop rotation; the use of deep-rooting plants, various types of set-aside; avoiding the use of heavy equipment and farm machinery, etc.). Soil protection against chemical degradation can be realized by means of the rational use of pesticides, mineral and natural fertilizers as well as sewage sludge, liming of soil, the use of natural fertilizers on a larger scale, the use of biological and mechanical plant protection products⁸.

In the face of emerging phenomena, the assumption that land is indestructible must be regarded as erroneous. Land is destructible and must be protected.

The importance of land was recognized by the UN and the year 2015 was declared the International Year of Soils. Such a move was to draw public attention to the quality of land and its impact on economy and the environment on a global scale.

Sustainable management of land resources is difficult but indispensable due to rapidly growing needs for food for the increasing population⁹. Land turns out to be a resource of varying values depending on its location and people's inclination to pay for their non-food needs¹⁰. Therefore, it is necessary to take special care of land and its rational use. Misuse of land and its area is hazardous both for agricultural and non-agricultural activities. Increasing soil degradation processes may ultimately lead to a complete loss of the function which they perform: functions of habitat, production and retention. Krasowicz¹¹ believes that the changes related to land use result from economic development, therefore it is necessary to change the patterns of production and consumption. Such an approach should be regarded as appropriate, but how to persuade the society to change consumption patterns in order to protect land resources for future generations in accordance with the concept of sustainable development.

Systematic decrease in the area of agricultural land in Poland is a permanent phenomenon, and it coincides with global trends. It is primarily associ-

⁸ A. Muzalewski et al., *Implementation of transversal objectives – the environment, climate change mitigation, adaptation to climate change – within the framework of investment activities of the Rural Development Programme 2014–2020*, Warsaw 2014, p. 70.

⁹ A. Czudec, *Economic conditions of the development of multifunctional agriculture*, "Scientific Papers, Monographs and Studies" 2009 no. 6, p. 10–13.

¹⁰ S. Kozłowski, *The future of sustainability*, Lublin 2005, p. 95.

¹¹ S. Krasowicz, *Premises of rational use of soil in Poland*, "Scientific Papers SERIES" 2012 vol. XIV, no. 5, p. 113.

ated with development of housing, infrastructure accompanying housing estates, as well as progressive industrialization of the state. Land excluded from agriculture is allocated not only for construction of housing estates and industry but also for afforestation. The total area of crops is an indicator of the production capacity of agriculture, which in turn determines the degree of satisfaction of the population's food needs. With a decrease in the total area of agricultural land, significant changes in the total area under cultivation cannot be expected. As a result of varying market conditions there may occur changes in the structure of different crops¹².

Materials and methods of research

The carried out study had a theoretical and empirical character. The empirical study included secondary materials. The CSO statistical data as well as elaborations of the Wrocław Marshal's Office of 1999–2015 were made use of. The study included the area of Poland and Lower Silesia divided into five functional regions of rural areas. The functional regions vary in respect of their development goals: I – region of intensive agriculture with a dominant agricultural sector, II – agro-recreational region based on tourism and recreation development, III – industrial, recreational and tourist region covering mostly foothill and mountainous area, IV – agro-industrial region influenced by copper industry and V – agro-industrial and recreational region influenced by its three economic functions: industry, agriculture and tourism.

The following research questions were stated:

- How have area structure and agricultural land use changed?
- How can agricultural production influence the quality of soils?

The assumption of land use structure has been purposeful as it shows the natural load of land. The quantity of applied mineral and organic fertilizers improves soil fertility, and therefore is associated with the issues of rational use, protection and restoration of soil fertility.

The method of descriptive and comparative analysis was applied. Based on the collected materials, the direction and dynamics of changes in the use of land resources were indicated.

¹² E. Wasilewska, *Changes in the crop structure in Poland in 1996–2007*, "Scientific Papers of University of Life Sciences – Economics and Organization of Food Economy" 2008 no. 71, p. 123–135.

Changes in the structure of land use

One of the indicators influencing the sustainable soil use are changes in the structure of land use. Improper use of land inhibits sustainable development of the entire state, including rural areas. Considering the period of 1999–2015, the area of land used for agriculture decreased, as less land was allocated for agricultural purposes. That occurred both in the state and Lower Silesia Province and in its respective sub-regions (15%). In 2015 compared to 1999, the dynamics of changes in the area of agricultural land amounted respectively to 78.9% and 78.0% (i.e. approx. 22%), (table 1) both in the state and the province. Agricultural land comprised: arable land, perennial crops and permanent grassland. In the structure of the use of arable land there also occurred a similar rate of changes as in the case of agricultural land. The loss of arable land was higher in the state and it amounted to 77 (23%), whereas in the province 85 (15%). The highest dynamics of changes took place in the area of permanent grassland including meadows and pastures. In 2015 compared to 1999 the area of permanent grassland in Poland dropped to 941.2 thousand ha (dynamics of changes 76.7%). In Lower Silesia the area of permanent agricultural land decreased by more than half, from 278.8 thous. ha (1999) to 128.5 thous. ha (2015), (table 1). Among others, two factors had an impact on the structure of agricultural land. One of them was increasing allocation of farmland for investment purposes. The other was related to economic conditions of agricultural production, in favor of crop production, which led to reduction of the area of permanent grassland.

A growing trend was observed in the area of forest land. In the state, the area of forest land increased from 8970.2 thous. ha (1999) to 9420.0 thous. ha (2015), i.e. by 5% (dynamics of changes was 105), while in Lower Silesia from 572.9 (1999) to 609.4 thousand ha (2015), i.e. by 6.4% (dynamics of changes 106.4), (table 1). The increase in forest area resulted from the state policy adopted by the Council of Ministers in 1995, "The National Afforestation Programme", the aim of which was to achieve 30% of the forest area in the state. Similar patterns related to the management of land took place in the functional regions of Lower Silesia. In the period 1999–2014 agricultural land disappeared in its respective functional regions. The biggest loss of agricultural land took place in region V, where the dynamics of changes was 95.5%. Except for region I, arable land diminished in all the regions. In region I there was an increase in arable land from 385.4 (1999) to 392.4 thous. ha (2014), i.e. by 1.8% (dynamics of changes 101.8). In respective regions there occurred a large loss of land allocated for perennial crops – orchards. The largest loss was observed in region V (dynamics of changes 68.5%), and the smallest in region III (dynamics of changes 92).

Table 1. Land use in Poland and Lower Silesia [thous. ha]

Year	Total area	Agricul- tural land	Including			Forest area	The remaining area
			Arable land	Perennial crops	Meadows & pastures pastures		
Poland							
1999	31267.9	18434.6	14134.2	266.4	4034.0	8970.2	3863.1
2004	31267.9	16327.4	12684.6	282.4	3365.1	9126.7	5813.8
2007	31267.9	16177.1	11748.0	375.0	3271.2	9229.3	5861.5
2010	31267.9	14859.7	10797.5	389.7	3229.5	9328.9	7079.3
2013	31267.9	14609.2	10759.5	412.2	3206.4	9382.9	7275.8
2014	31267.9	14558.4	10895.1	376.0	3119.8	9403.1	7306.4
2015	31267.9	14545.2	10887.0	390.9	3092.8	9420.0	7302.7
Dynamics of changes – 1999=100							
2004	100	88.6	89.7	106.0	83.4	101.7	150.5
2007	100	87.8	83.1	140.8	81.1	102.9	151.7
2010	100	80.6	76.4	146.3	80.1	104.0	183.3
2013	100	79.2	76.1	154.7	79.5	104.6	188.3
2014	100	79.0	77.1	141.1	77.3	104.8	189.1
2015	100	78.9	77.0	146.7	76.7	105.0	189.0
Lower Silesia Province							
1999	1994.7	1165.3	901.2	8.7	272.8	572.9	256.5
2004	1994.7	1053.5	869.4	7.4	175.7	585.9	355.3
2007	1994.7	971.3	759.0	8.1	148.1	600.3	423.1
2010	1994.7	967.5	749.7	10.7	142.7	605.1	422.1
2013	1994.7	922.9	756.2	8.4	143.2	608.0	463.8
2014	1994.7	934.9	766.4	7.7	151.1	608.8	451.0
2015	1994.7	909.5	766.8	7.0	128.5	609.4	475.8
Dynamics of changes – 1999=100							
2004	100	90.4	96.5	85.1	64.4	102.3	138.5
2007	100	83.4	84.2	93.1	54.3	104.8	165.0
2010	100	83.0	83.2	123.0	52.3	105.6	164.6
2013	100	79.2	83.9	96.6	52.5	106.1	180.8
2014	100	80.2	85.0	88.5	55.4	106.3	175.8
2015	100	78.0	85.1	80.5	47.1	106.4	185.5

Source: own calculations based on the Central Statistical Office (CSO) data.

A large loss of the area of meadows and pastures took place in region I (dynamics of changes 80.7%), and the smallest in region V. In all the regions the share of forest area increased. The biggest changes in the forest area occurred in region V, from 146.9 to 163 thous. ha (dynamics of changes 111), (figure 1).

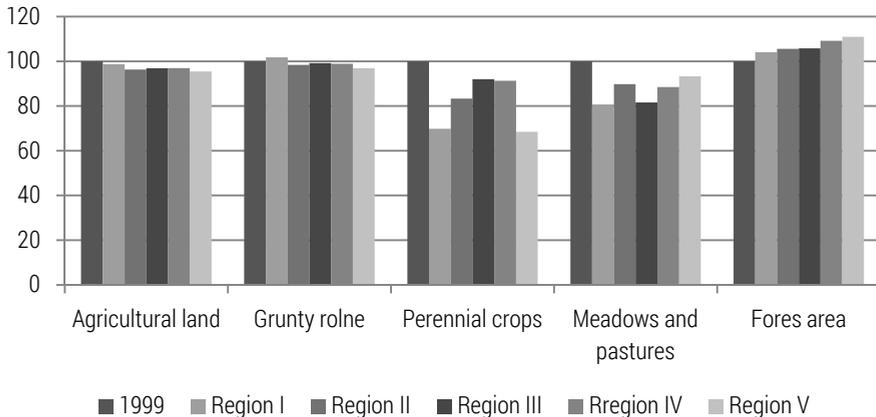


Figure 1. Dynamics of changes in land use in the functional regions of Lower Silesia

Source: own study based on: Z. Surdyk, I. Warchił, *Analysis of changes in the agrarian structure and the monitoring of changes in land use in the rural areas of Lower Silesia in the years 1999–2007, 2013*, Wrocław 2015, p. 9.

Changes in the structure of land use might result from allocation of land for implementation of investment objectives, in particular for the purpose of development industry. The area of forest land increased as a significant area of agricultural land was allocated for this purpose. Such a course of changes resulted from RDP of 2007–2013 which was ensured subsidies for farmers who allocated so called marginal land for afforestation.

Production factors affecting the quality of land

There are a number of production factors affecting the quality of land. Among others, the main factors include: fertilization, the use of plant protection products, crop structure, cultivation technologies.

The use of mineral and organic fertilizers increases the yield of plants, however it contributes to environmental pollution. Therefore, the use of very high doses of fertilizers may cause deterioration of soil quality.

Despite the increasing use of mineral fertilizers, Poland is a state with its average use. In the years 2004–2014, there was an increase in the use of mineral fertilizers from 99.3 kg NPK / ha to 132.9 kg NPK / ha (figure 2). That increase might have resulted from the accession of Poland to the European Union and introduction of the system of subsidies for agricultural production.

While assessing the level of soil fertilization it is necessary to take into account natural fertilization which, in addition to mineral fertilization, is a valuable source of essential plant nutrients. The importance of natural fertilizers (natural manure, liquid manure, slurry) is commonly known. They have a significant effect on all the properties of soils. The lighter the soil, the greater is the importance of organic fertilization. It affects a better efficiency of mineral fertilization, it increases water capacity of soils and therefore provides protection – it secures stable yields under adverse weather conditions, and most importantly it provides protection in case of committing agro-technical errors¹³. The conducted analyses indicated a decrease in the use of organic and calcium fertilizers – whereas acidification of soils and shortage of humus are very important for the quality of soil. Therefore, it is necessary to undertake actions aiming at introduction of the systems of production and agricultural technology conducive to accumulation of organic matter in the soil.

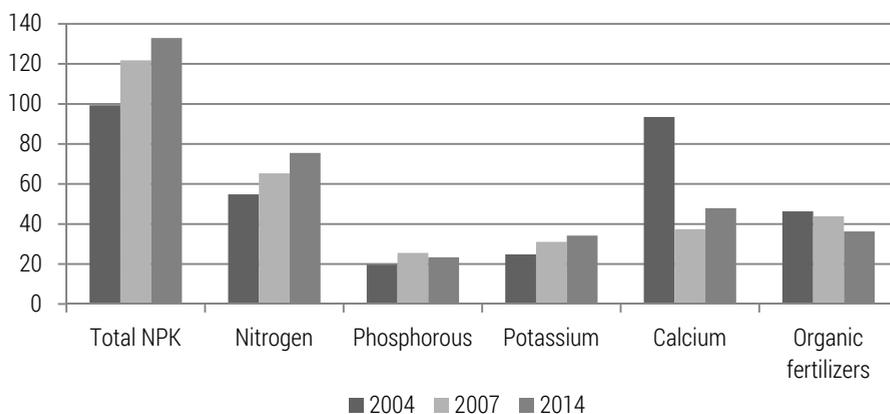


Figure 2. The use of mineral, organic and calcium fertilizers in Poland in terms of pure NPK ingredient [kg/ha]

Source: own study based on Central Statistical Office (CSO) data.

¹³ A. Grześkowiak, *Vademecum of fertilization – a set of basic, Practical information about fertilization*, the Azoty Group Tarnow, Tarnow 2013, p. 122.

It is important to remember that plant selection and cultivation technology influence the quality of soil. The crop structure was dominated by cereals which had a detrimental impact on soil. A big share of cereals decreased the amount of organic matter as well as humus and resulted in deterioration of the soil structure. In addition, most of cereal crops did not tolerate each other. Consequently, there occurred problems with crop rotation, diseases as well as strong weed infestation of fields¹⁴. Cultivation of potatoes – which normally leave good grounds for cultivation of other plants¹⁵ – was reduced. All these trends were not conducive to rational land use, but led to deterioration of its condition.

Conclusions

Land is one of the basic natural resources of the environment. The conducted study has revealed that land should not be treated as a fully renewable resource because its improper use may lead to the loss of its properties and risks for future generations, which is not in accordance with the concept of sustainable development.

Over the past several years in the state and Lower Silesia Province as well as its regions, there have occurred changes in the structure of land use. The area of agricultural land has not only diminished, but changes in their internal structure have also been observed.

The quality of soil resources is extremely important. In rural areas, it is mainly shaped by agricultural production: fertilizers, plant protection, technology of cultivation, plant succession. Improper trends in fertilization and crop structure lead to the deterioration of soil quality.

Excessive loss of land and its inadequate protection may result in reduction of the production essential to safeguard vital needs of the future human population, which does not comply with the concept of sustainable development. Therefore, it is necessary to base land management on its protection and maximum utilization.

The contribution of the authors in the article:

Hanna Adamska, Ph.D, MSc., Eng. – 50%

Irina Kazakowa, Ph.D, MSc. – 50%

¹⁴ D. Gołaszewska, *Crop structure then and now*, "The Mazowieckie County" 2003 no. 1.

¹⁵ E. Wasilewska, *Changes in crop structure in Poland in 1996–2007*, "Scientific Papers of Warsaw University of Life Sciences – Economics and Organization of Food Management" 2008 no. 71, p.123–135.

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