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Ecological and social sustainability of agricultural production in the Roztocze Region

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Abstract

The level of sustainability of agricultural production in the surveyed holdings was assessed both in ecological and in social terms. The balance of reproduction and degradation of organic matter was prepared using the calculation method, with coefficients provided by the Institute of Soil Science and Plant Cultivation (IUNG). The level of sustainability of organic matter in the soil was the most favourable in holdings that were the biggest territorially and economically and with the highest amount of subsidy and business income. They also had the greatest net commodity production. This group of holdings (area of 70 ha UAA) showed the highest level of decomposition of organic matter in crop production, but the overall balance was positive due to large-scale animal production. In contrast, small farms with lower production do not produce a sufficient mass of organic matter. Environmental sustainability was found in holdings using more than 30 ha of arable land that received subsidies in the amount over 100 thousand Polish zlotys and showed a balance of organic matter above 0.26 tons per hectare of arable land. Social sustainability was shown in households using more than 30 ha of arable land, where the level of mechanization reduced the workload (less than 2,000 working hours per employee per year and less than 100 man-hours per ha UAA).

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1. Introduction

Agri-environmental undertakings are a priority of the Common Agricultural Policy system and are implemented by all EU member states (Program... 2014). Instruments that can help farmers to achieve sustainable farming are agri-environmental-climatic measures including, among others, the package "Sustainable Agriculture". The aim of the package is to promote the introduction of crop rotation and balancing the use of fertilisers, which helps to reduce the pollution of soil and water with compounds from agricultural sources. Rational crop rotation reduces the growth of fungal diseases of cereals and weeds, maintains an adequate organic matter content in the soil. If a high proportion of cereal crops is a long-term phenomenon, it leads to the so-called soil fatigue, manifested by a decrease in harvest. In this case, more funds are spent on crop protection and fertilizers. Measuring dosages and limiting yield-increasing measures on farmland makes it possible to minimize the loss of nutrients and to reduce pollutants from agricultural land. Another activity is "Organic Farming" consisting of several packages that are included in the Rural Development Programme (Program... 2014). It represents a specific area of agricultural production, performed without the use of fertilizers or pesticides that may adversely affect the environment or result in the presence of residues in agricultural products. By means of appropriately selected crop rotation and rational choice of livestock, holdings can balance the global level of organic matter on their farmland (Golka and Wojcicki, 2006, Wojcicki, 2009). It is particularly very difficult to determine the effects of environmental sustainability (Wibberley, 1995, Morris and Winter, 1999, Leiva and Morris, 2001). Obtaining reliable information in this field requires years of research, since both degradation and renewal of organic matter in soil takes 5-30 years (Stelow, 2003). The negative balance of organic matter, persisting for several or dozens of years, can lead to soil degradation and loss of soil fertility and productivity. Decomposition of organic matter is usually associated with the release of large amounts of minerals, especially nitrogen, which can lead to the contamination of groundwater and surface water.

2. Materials and methods

The level of sustainability of agricultural production in the surveyed households was assessed in ecological and social terms (Kaufmann and Cleveland, 1995, Czyż, 2000, Niewęglowska, 2005, Pawlak, 2005, Sawa et al., 2006, Van Passel et al., 2007). The following metrics were used as the basis for the evaluation: direct surplus value ($\text{PLN} \cdot \text{PFE}^{-1}$; $\text{PLN} \cdot \text{ha}^{-1} \text{UAA}$), operating costs ($\text{PLN} \cdot \text{ha}^{-1} \text{UAA}$; $\text{PLN} \cdot \text{mh}^{-1}$; $\text{PLN} \cdot \text{PFE}^{-1}$), commodity production in cereal units ($\text{CU} \cdot \text{ha}^{-1} \text{UAA}$), gross value added ($\text{PLN} \cdot \text{ha}^{-1} \text{UAA}$; $\text{PLN} \cdot \text{PFE}^{-1}$), the cost of labour (man-hours $\text{ha}^{-1} \text{UAA}$), workload ($\text{mh} \cdot \text{PFE}^{-1}$), and the balance of organic matter renewability ($\text{t} \cdot \text{ha}^{-1} \text{UAA}$). Reproduction of organic matter takes place in perennial field crops (legumes and their mixtures with grasses), as well as permanent grassland (Code... 2002).

In 2004-2009, 70 farms were studied in the Roztocze region, benefiting from EU subsidies for technical modernization. To determine the ecological and social sustainability of agricultural production, all the holdings under evaluation were divided according to the criterion of the aid, surface of UAA, economic size (ESU) and income of the business. Maintenance costs of means of mechanisation include the purchase of fuel and lubricants, electricity charges, purchases of spare parts, materials for repairs, charges for repair services etc. The presented group of costs enables the assessment of the current engagement of technology in agricultural production processes. The operating costs of technical measures were calculated using a method developed by IBMER in Warsaw (Goć et al., 1994, Muzalewski, 2009):

$$K_e = K_u + K_{uz} \quad (1)$$

where:

K_e - operating costs of technical measures $\text{PLN} \cdot \text{year}^{-1}$,

K_u - fixed cost (depreciation and amortization, storage, insurance, taxes).

K_{uz} - running costs (repair, use of energy, fuels and lubricants, auxiliary materials).

The balance of reproduction and degradation of organic matter was prepared using the calculation method, using coefficients provided by the Institute of Soil Science and Plant Cultivation (IUNG). On this basis, it was estimated how much organic matter accumulated or decomposed in the soil on the area of 1 ha under cultivation of

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