

11. Streszczenie rozprawy w języku angielskim

Summary

Carbon footprint of major field crops and possibilities for its reduction: a case study of selected farms in Poland

Keywords: greenhouse gas emissions, carbon footprint, technical efficiency, DEA, greenhouse gas reduction

The aim of the presented doctoral dissertation was to assess the carbon footprint of field crops and evaluate the possibilities of its reduction.

In achieving the research objective, the carbon footprint of cultivating seven crops with the largest sowing areas in Poland was estimated. Data for the analyses were collected through surveys from several dozen to several hundred fields (depending on the crop) during the 2015/2016 or 2016/2017 seasons. The analyses included greenhouse gas emissions from both the production of applied inputs and direct emissions on the farm (mainly nitrous oxide emissions from the soil). The opportunities for reducing the carbon footprint in cultivation were examined using DEA (Data Envelopment Analysis) models, indicating differences in the level of inputs and outputs (also greenhouse gas emissions) between efficient and inefficient farms.

It was shown that greenhouse gas emissions per hectare ranged from 1,9 tCO₂e ha⁻¹ to 4,3 tCO₂e ha⁻¹, depending on the crop and the intensity of its cultivation.

The carbon footprint per kilogram of yield was estimated to range from 0.06 kgCO₂e kg⁻¹ (in the cultivation of sugar beet) to 1.57 kgCO₂e kg⁻¹ (in the cultivation of winter rapeseed); for basic cereals, it averaged 0.54 kgCO₂e ha⁻¹.

It was found that inefficient farms (in terms of DEA models) use from a few to several dozen percent more inputs (production means) while achieving lower yields and emitting more greenhouse gases. The research results indicate the possibility of reducing the carbon footprint of the cultivation of the studied crops by 10.5 to 32.0% (in relation to the yield mass). The impact of weather and structural factors on the efficiency of crop cultivation was also confirmed.

The obtained results allowed for confirming the research hypothesis that it is possible to reduce the carbon footprint of plant production by improving the input use efficiency.

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