

Streszczenie rozprawy doktorskiej w języku angielskim

Summary

Multi-criteria assessment of the effectiveness of agricultural practices in maize production under current and projected climatic conditions

Słowa kluczowe: MCDM, sustainability, LCA, agricultural practices, maize, climate change

The aim of this thesis is to apply multi-criteria evaluation to assess the effectiveness of agricultural practices in the face of economic, environmental, social and climate challenges, using the example of maize cultivation in Poland.

To achieve the research objective, the effectiveness of tillage systems, fertilisation practices, variety selection, sowing date adjustments and irrigation as examples of agricultural practices in maize cultivation were evaluated in the context of achieving sustainability and adapting to climate change. The research material consisted of the results of four field experiments carried out at the Agricultural Experimental Stations of IUNG-PIB and EURO-CORDEX climate scenarios for two Representative Concentrations Pathways: RCP4.5 and RCP8.5.

The analysis showed that the introduction of new cultivation techniques can reduce production costs, but the final economic assessment depends on the level of yield achieved. Improvements in environmental performance, in terms of reducing the environmental impact of the selected practices, can be achieved by reducing tillage intensity and reducing fertiliser levels. In the case of tillage, high environmental indicators did not outweigh the overall assessment, and according to the adopted indicators and their weights, the conventional system was ranked highest in the sustainability assessment ranking. Sensitivity analysis for different cases of main criteria weights and different production scenarios demonstrated that in the scenario where environmental criteria had the highest priority, and in the low-yield scenario, no-tillage received the highest rating, followed by reduced tillage with very similar ratings for all three tillage techniques analysed. However, in the case of reducing the maize fertilizer dose to 80 kg N ha⁻¹, high environmental and economic indicators determined the highest position in the sustainability ranking. The practice of deep fertilization ranked higher in the sustainability ranking than surface fertilization only if it resulted in increased yield levels compared to surface fertilization.

Under projected future climate conditions, heat resources are expected to increase, but rainfall deficits during the growing season are also expected to increase. It has been shown that beneficial changes can be optimally managed through the cultivation of varieties with higher thermal requirements, while adverse changes can be mitigated through the practice of irrigation and adjusting sowing date according to thermal conditions.

The results obtained confirmed the research hypothesis that appropriate agricultural practices can achieve the environmental, economic, and social objectives of agriculture and enable sustainable maize production. Furthermore, the spatial variability of soil and climatic conditions for maize cultivation determines the agricultural practices beneficial for maize cultivation in Poland under current and projected climatic conditions, especially in the face of an increasing threat of water deficiency.

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