**Effect of stand density and site conditions on growth and productivity of oak in Poland**

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**Summary**

Forest growth and site productivity are critical to forest management. This information allows forest managers to predict stand growth rates and monitor the response of stands to environmental changes, which are key to making effective forest management decisions. In forestry practice, forest growth and site productivity are often determined using models that allow tree and stand growth to be simulated for different climate change scenarios or management strategies, enabling stakeholders to assess the long-term effects of environmental factors on the stand. The aim of this study was to develop models to describe the relationship of volume increment of oak stands and site productivity for oak as a function of stand characteristics and environmental factors. In order to ensure full representation of site factors across Poland, the study used data from the National Forest Inventory in Poland collected in 2005-2019. The effect of stand characteristics and site variables on site productivity and volume increment of oak stands was analysed using generalised additive models (GAM). Modelling results showed that site productivity for oak, as measured by the site index, was strongly dependent on environmental variables, stand age and density. Site productivity for oak was also affected by climatic factors, soil type, geology and height above sea level. In turn, volume increment of oak in Poland was significantly determined by stand characteristics such as basal area, age, top height and relative stand density index. The study also showed the effect of temperature, precipitation, slope and soil subtype on volume increment. In more homogeneous areas, such as natural forest regions, volume increment was mainly determined by stand characteristics and to a lesser extent by site factors such as slope and climate. The study provided information that can help inform management decisions for oak stands. This knowledge can also be used to optimise the potential for timber production, while increasing the forest's capacity to sequester carbon, thereby contributing to climate change mitigation.

Keywords: Site productivity, site index, forest growth, volume increment, GAM.