Regional height-diameter model for Taurus cedar using nonlinear mixed-effects approach

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Abstract: Lebanon cedar (*Cedrus libani* A. Rich.) is significant from historical, cultural, aesthetic, scientific, and economic perspectives. It is presently found primarily in the Taurus Mountains of Turkey. Presently, Lebanon cedar forests cover an area of about 463521 ha with a current standing volume of approximately 27.4 million m^3. Because of its valuable wood properties, it is the most important conifer species from an economic point of view for the forest products industry in Turkey. Furthermore Lebanon cedar forests play a key role in providing important benefits and environmental services such as protection of soil and water resources and conservation of biological diversity in the Taurus Mountains. In this context, knowing the state and limitations of growth and yield of Lebanon cedar forests in the Taurus Mountains is necessary for improving future management and planning strategies of timber resources. However, information regarding growth and yield is currently lacking in Turkey. The relationship between diameter at breast height and tree height is an important in growth and yield models, carbon budget, stand description, damage appraisals, and timber volume models. In this study, a diameter-height model for natural Taurus cedar stands was developed in Western Mediterranean Region of Turkey. For this aim, data were collected in 88 sample plot and about 50% of plots were randomly selected for model development and the reminder (50%) used for model validation. The diameter-height model was based on an allometric model, which was linearized to include both fixed- and random-effects parameters using mixed effects modeling technique. Based on goodness-of-fit criteria, the model including random-effects in all parameters was the best. In this study, different calibration alternatives were tested and an example of model calibration is provided. Accordinlgy results of model calibration based on independent data, the use of three trees for a particular species from a plot to calibrate the model will likely provide a reasonable compromise between predictive ability and field sampling times. The results of this study support previous findings indicating that If calibrated at the stand level, three trees could be used.
Keywords: Height-diameter, Taurus cedar, Mixed-effects, Calibration