Estimating the Time Consumption and Productivity of Round Wood Skidding in Group Shelterwood Cuttings – A Case Study in a Mixed Stand Located in Reduced Accessibility Conditions

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In Romanian forestry, skidders represent the most used equipments for wood extraction while the group shelterwood system is one of the most used silvicultural forest management strategies. Production rates are important indicators when trying to assess the efficiency of a process, since they can be used in different practical applications, starting with operational planning and ending with energetic analyses or LCA studies. The reduced accessibility of forest stands is one of the main problems of Romanian forestry, fact which leads frequently to increased amounts of time and energy expenditures in harvesting operations, while knowing the effects of these operational conditions has became very important in the present days.

Our study aimed to emphasize and quantify how and to what extent, the reduced accessibility conditions (in terms of extraction distance) may affect the time consumption and operational productivity in skidding operations. In order to evaluate the effects of very long skidding distances on the time inputs and productivity we conducted a time study for a Romanian skidder which operated in a mixed hardwoods stand located in Central Romania, where group shelterwood cuttings were applied. A team consisting of 4 field researchers conducted a detailed time study for a number of 285 winched logs, grouped within 44 winching and skidding work cycles. During the study, a volume of 215 m^3 was skidded representing about 36% of the timber volume proposed for extraction. For this purpose we used two different approaches when collecting field data. In case of winching operations we used a video camera for data collecting and we extracted the elemental time categories at the office by replaying the media files. In case of on-road skidding we used a proffesional

stopwatch in order to collect time data. Winching distance was measured using a tape, while the skidding distance was deduced using GIS software at the office, based on GPS recordings made in the field for each turn. Following office data processing, we used STATISITCA 8.0 software package in order to develop time prediction models for the main group of operations. We found out that the time input of a winching work cycle was most affected by winching distance and number of logs. Since we collected only the skidding distance as a process variable, we developed time consumption equations for empty and loaded travels as a function of distance. Within the delays category, which accounted for 29.3% of the total time, operational delays (OD) were responsible for a share of 57.36%, personal delays for a share of 37.02% while mechanical delays accounted for a share of 5.62%. We found out that for the mean study conditions (winching distance of 8.7 m, mean skidding distance of 1706.3 m, a load volume of 4.89 m^3 and 6.48 logs per turn) the net and gross production rates were of 4.41 $m^3 \times h^{-1}$ and 3.12 $m^3 \times h^{-1}$ respectively. Also, we found significant differences between the empty and loaded travel speeds, hence, between the time consumptions. While the empty travel was performed, in average, on longer distances, the mean time consumption for this phase was in fact less than that required by the loaded travel.

If compared with other results reported by studies done for the same type of equipment, the net and gross production rates were low indicating the key role which an adequate transportation infrastructure can play in the overall harvesting operations economy. Since the results reported until now which dealt with skidding operations considered, in general, much smaller extraction distances, the results of this study may be helpful in operational costing or harvesting planning when similar reduced accessibility conditions are in question.

Keywords: skidding, efficiency, group shelterwood system, time prediction, production rates

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