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Sustainable Wood Harvesting from Juniperus procera Trees Managed under a Participatory Forest Management Scheme in Ethiopia

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Abstract : Sustainable forest management planning requires up-to-date information on the structure, standing volume, biomass, and growth rate of trees from a given forest. This kind of information is lacking in many forests in Ethiopia. The objective of this study was to quantify the population structure, diameter growth rate, and standing volume of wood from Juniperus procera trees in the Chilimo forest. A total of 163 sample plots were set up in the forest to collect the relevant vegetation data. Growth ring measurements were conducted on stem disc samples collected from 12 J. procera trees. Diameter and height measurements were recorded from a total of 1399 individual trees with dbh ≥ 2 cm. The growth rate, maximum current and mean annual increments, minimum logging diameter, and cutting cycle were estimated, and alternative cutting cycles were established. Using these data, the harvestable volume of wood was projected by alternating four minimum logging diameters and five cutting cycles following the stand table projection method. The results show that J. procera trees have an average density of 183 stems ha^{-1}, a total basal area of 12.1 m^2 ha^{-1}, and a standing volume of 98.9 m^3 ha^{-1}. The mean annual diameter growth ranges between 0.50 and 0.65 cm $year^{-1}$ with an overall mean of 0.59 cm $year^{-1}$. The population of J. procera tree followed a reverse J-shape diameter distribution pattern. The maximum current annual increment in volume (CAI) occurred at around 49 years when trees reached 30 cm in diameter. Trees showed the maximum mean annual increment in volume (MAI) around 91 years, with a diameter size of 50 cm. The simulation analysis revealed that 40 cm MLD and a 15-year cutting cycle are the best minimum logging diameter and cutting cycle. This combination showed the largest harvestable volume of wood potential, volume increments, and a 35% recovery of the initially harvested volume. It is concluded that the forest is well stocked and has a large amount of harvestable volume of wood from J. procera trees. This will enable the country to partly meet the national wood demand through domestic wood production. The use of the current population structure and diameter growth data from tree ring analysis enables the exact prediction of the harvestable volume of wood. The developed model supplied an idea about the productivity of the J. procera tree population and enables policymakers to develop specific management criteria for wood harvesting.

Keywords : logging, growth model, cutting cycle, minimum logging diameter
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