

## DAFTAR PUSTAKA

- Amateis, R. L., & Burkhart, H. E. (2012). *Thinning: A review*. Southern Forest Science Conference.
- Ameray, A., Bergeron, Y., Valeria, O., Montoro Girona, M., & Cavard, X. (2021). Forest Carbon Management: a Review of Silvicultural Practices and Management Strategies Across Boreal, Temperate and Tropical Forests. In *Current Forestry Reports* (Vol. 7, Issue 4, pp. 245–266). Springer Science and Business Media Deutschland GmbH. <https://doi.org/10.1007/s40725-021-00151-w>
- Ampoorter, E., Vanhellemont, M., & Verheyen, K. (2010). The effect of thinning on the carbon stock in live trees and its allocation in a 100-year-old oak forest. *Forest Ecology and Management*, 260(10), 1735-1741.
- Assmann, E. (1970). *The Principles of Forest Yield Study: Fundamentals of Productivity Science*. Pergamon Press.
- Balittan. 2006. Sifat Fisik Tanah dan Metode Analisisnya. Balai Besar Penelitian dan Pengembangan Sumberdaya Lahan Pertanian. Departemen Pertanian, Bogor.
- Balesdent, J., C. Chenu, and M. Balabane. 2000. Relationship of soil organic matter dynamics to physical protection and tillage. *Soil Till. Res.* 53:215-230.
- Bianchi, S., Huuskonen, S., Hynynen, J., & Niemistö, P. (2024). Comparing wood production and carbon sequestration after extreme thinnings in boreal Scots pine stands. *Forest Ecology and Management*, 553. <https://doi.org/10.1016/j.foreco.2023.121641>
- Brady, N. C., & Weil, R. R. (2008). *The Nature and Properties of Soils* (14th ed.). Pearson Prentice Hall. (Buku teks standar ilmu tanah yang banyak membahas BOT dan fraksinasinya).
- Bravo-Oviedo, A., Ruano, C., & Díaz-Pinés, E. (2015). Thinning effects on tree growth, stand productivity, and carbon stocks of European temperate forests. *Forest Ecology and Management*, 358, 268-278.
- Brown S, Gillespie AJR & Lugo AE. 1984. Biomass estimation methods for tropical forests with applications to forest inventory data. *For. Sci.* 35(4): 881-902.
- Budiadi, Widiyatno, & Ishii, H. (2017). Response of a Clonal Teak Plantation to Thinning and Pruning in Java, Indonesia. In *Journal of Tropical Forest Science* (Vol. 29, Issue 1).
- CABI. (2019). *Tectona grandis*. Dalam: *Invasive Species Compendium*. Wallingford, UK: CAB International. [www.cabi.org/isc](http://www.cabi.org/isc).
- Cambardella, C. A., & Elliott, E. T. (1992). Particulate soil organic matter changes across a grassland cultivation sequence. *Soil Science Society of America Journal*, 56(3), 775-783. (Salah satu studi klasik yang mempopulerkan metode fraksinasi densitas).
- Castro Filho, C., Lourenço, A, Guimaraes, ~ M. de F., Fonseca, I.C.B., 2002. Aggregate stability under different soil management systems in a red latosol in the state of parana, brazil - sciencedirect. *Soil Tillage Res.* 65, 45–51.
- Cates, A.M., Braus, M.J., Whitman, T.L., Jackson, R.D., 2019. Separate drivers for microbial carbon mineralization and physical protection of carbon. *Soil Biol. Biochem.* 133, 72–82.
- Chen, S., Zhang, Y., Lin, Q., & Wang, R. (2015). Changes in SOC fractions under different land uses. *Geoderma*, 246–247, 24–31.



- Cliff, J.B., Caspar, D.A., Dettmer, P.J., Myrold, D.D., 2002. Exploration of inorganic C and N assimilation by soil microbes with time-of-flight secondary ion mass spectrometry. *Appl. Environ. Microbiol.* 68 (8), 4067–4073.
- Conway, C. E., Morris, S. J., & Powers, J. S. (2020). Thinning effects on forest carbon: A meta-analysis across North American forests. *Forest Ecology and Management*, 461, 117951.
- Del Río, M., Bravo-Oviedo, A., Ruiz-Peinado, R., et al. (2017). Carbon sequestration in mixed-species stands across Europe. *Forest Ecology and Management*, 403, 137–150.
- Eliasson, L., & Wästerlund, I. (2007). Effects of mechanized harvesting on soil compaction and root damage in northern Sweden. *Forest Ecology and Management*, 241(1-3), 258-266
- Eriksson, E., Gillespie, A. R., Gustavsson, L., Langvall, O., Olsson, M., Sathre, R., & Stendahl, J. (2007). *Integrated carbon analysis of forest management practices and wood substitution*. Canadian Journal of Forest Research, 37(3), 671–681.
- Eriksson, E., 2006. Thinning operations and their impact on biomass production in stands of Norway spruce and Scots pine. *Biomass Bioenergy* 30 (10), 848–854. <https://doi.org/10.1016/j.biombioe.2006.04.001>.
- Forestry Commission. (2019). *Thinning practice: a silvicultural guide*. Forestry Commission Practice Guide. Retrieved from.
- Franzluebbers, A.J., Haney, R.L., Honeycutt, C.W., Schomberg, H.H., & Hons, F.M. (1999). Flush of carbon dioxide following rewetting of dried soil relates to active organic pools. *Soil Science Society of America Journal*, 63, 1387–1392.
- Geng, Y., Yao, F., Wu, H., & Peng, C. (2021). Effects of thinning on forest carbon stocks and dynamics: A global meta-analysis. *Forest Ecology and Management*, 494, 119341.
- Gerrand, A. M., Neilsen, W. A., & Medhurst, J. L. (1997). *Thinning and pruning eucalypt plantations in Tasmania*. Tasforests, 9, 15–34.
- Gijsman, A.J. 1996. Soil aggregate stability and soil organic matter fraction under agropastoral systems established in native savanna. *Aus. J. Soil Res.* 34: 891-907.
- Gong, C., Tan, Q., Liu, G., Xu, M., 2021. Forest thinning increases soil carbon stoks in China. *Forest Ecology and Management* 482
- Hardjana, A. K. (2010). Potensi Biomassa dan Karbon pada Hutan Tanaman Acacia mangium di HTI PT. Surya Hutani Jaya, Kalimantan Timur. *Jurnal Penelitian Sosial Dan Ekonomi Kehutanan*, 7(4), 237–249.
- Han, S., Thelin, J., Kellogg, L. D., & Lyons, D. (2019). Long-term soil recovery after compaction by forest harvesting. *Journal of Soil and Water Conservation*, 74(3), 297-307.
- Han, Y., Han, J., Shi, Z., Yan, X., & Gao, Y. (2019). Effects of different thinning intensities on soil physical and chemical properties and microbial communities in a *Pinus tabulaeformis* forest. *Forest Ecology and Management*, 451, 117540.
- Hayaporn, P., Saraya, J., & Srikham, C. (2021). Biomass and carbon stock of teak (*Tectona grandis* L.f.) plantations in Thailand. *Journal of Agricultural Science and Technology A*, 11(1), 1-10.
- Jansen, M., Vanhellemont, M., De Neve, S., De Schrijver, A., & Verheyen, K. (2022). Long-term effects of thinning on growth and productivity in mixed broadleaved forests. *Forest Ecology and Management*, 506, 119934.
- Jastrow, J.D., Amonette, J.E., & Bailey, V.L. (2007). Mechanisms controlling soil carbon turnover and their potential application for enhancing carbon sequestration. *Climatic Change*, 80, 5–23.
- Jia, X., Shao, M. A., & Wei, X. (2020). *Effects of thinning on soil microbial biomass and activity*. *Applied Soil Ecology*, 150, 103477.



- Jourgholami, M., Faankar, P., Kuchayari, S., & Pechio, R. (2020). Long-term impacts of different thinning intensities and logging techniques on soil disturbance in a mixed beech (*Fagus orientalis*) forest. *European Journal of Forest Research*, 139(2), 241-255.
- Jurgensen, M.F., Tarpey, R., Pickens, J., & Palik, B. (2012). *Long-term effect of silvicultural thinnings on soil carbon and nitrogen pools. Soil Science Society of America Journal*, 76(3), 1419–1430.
- Kaosa-ard, A. (1981). *Teak: Its natural distribution and related factors*. Teaknet Bulletin.
- Kaosa-ard, A. (1986). *Teak (Tectona grandis Linn.f.) its natural distribution and related factors*. University of Queensland.
- Kaosa-ard, A. (2000). *Teak in Asia*. FORTROP International Workshop.
- Kemper, W. D. and R. C. Rosenau. 1986. Aggregate stability and size distribution. pp. 425-442. *In: American Society of Agronomy-Soil Science Society of America (eds.). Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods- Agronomy Monograph no. 9. Madison, WI, USA.*
- Kim, C., Lim, H., Lee, D., & Lee, W. (2016). The effect of thinning intensity on growth and productivity of *Larix kaempferi* plantations. *Journal of Forest Research*, 21, 219–227.
- Krisnawati, H., Imanuddin, R., Adinugroho, W. C., & Hutabarat, S. (2015). Standard methods for estimating greenhouse gas emissions from forests and peatlands in Indonesia: Version 2. Ministry of Environment and Forestry, Research, Development, and Innovation Agency.
- Lin, J. C., Chiu, C. M., Lin, Y. J., & Liu, W. Y. (2018). Thinning Effects on Biomass and Carbon Stok for Young Taiwania Plantations. *Scientific Reports*, 8(1). <https://doi.org/10.1038/s41598-018-21510-x>
- Lagomarsino, A., Mazza, G., Agnelli, A.E., Lorenzetti, R., Bartoli, C., Viti, C., Colombo, C., Pastorelli, R., 2020. Litter fractions and dynamics in a degraded pine forest after thinning treatments. *Eur. J. Forest Res.* 139, 295–310.
- Li, B., & Olmstead, R. (2017). Two new subfamilies in Lamiaceae. *Phytotaxa*. 313 (2): 222-226. <https://doi.org/10.11646/phytotaxa.313.2.9>.
- Lal, R. (2004). Soil carbon sequestration impacts on global climate change and food security. *Science*, 304(5677), 1623-1627.
- Lal, R. (2019).** *Soil quality and carbon sequestration*. In: Principles of soil conservation and management (pp. 57-79). Springer, Cham. (Membahas peran FOR/FOB dalam kualitas tanah dan sekuestrasi karbon).
- Li, Y., Wen, H., & Olmstead, R. (2016). Phylogeny and biogeography of *Tectona* inferred from molecular data. *Molecular Phylogenetics and Evolution*, 94, 44–53.
- Li, Y., & Olmstead, R. (2017). Evolution of tropical timber tree genus *Tectona* (Lamiaceae): insights from plastid and nuclear DNA sequences. *Systematic Botany*, 42(2), 293–301.
- Li, P., & Olmstead, M. A. (2017). Genetic diversity and population structure of teak (*Tectona grandis* L. f.) revealed by microsatellite markers. *Tree Genetics & Genomes*, 13(2), 1-11.
- Liang, J., Buongiorno, J., Monserud, R. A., Kruger, E. L., & Zhou, M. (2016). *Effects of thinning on carbon stocks and timber production: A modeling approach*. *Forest Ecology and Management*, 364, 160–173.
- Lin, L., Wang, H., Wang, J., et al. (2018). Effects of thinning on carbon storage. *Forest Ecology and Management*, 429, 351–357.
- Liu, X., Zhao, Y., & Liu, S. (2021). Effects of forest management practices on soil aggregate stability and organic carbon in temperate forests: A meta-analysis. *Forest Ecology and Management*, 498, 119565.



- Ullrich, P. L., & Bhattarai, S. (2003). Biomass and net primary productivity of Bhabar Shisham forests in central Himalaya, India. *For. Ecol. Manage.* 176: 217-235
- López, F., García, M., & Martín, J.A. (2003). Effects of thinning on growth and carbon sequestration in pine plantations. *Forest Systems*, 12, 101–108.
- Lull, C., Bautista, I., Martínez, J., & del Campo, A. (2020). *Effects of thinning on soil carbon*. *Forests*, 11(7), 761.
- Mäkinen, H., Mielikäinen, K., & Nöjd, P. (2021). Response of tree growth and wood density to thinning in Scots pine stands in Finland. *Forest Ecology and Management*, 487, 118999.
- Medhurst, J. L., Pinkard, E. A., & Beadle, C. L. (2006). *Photosynthetic responses to pruning in Acacia melanoxylon*. *Tree Physiology*, 26(12), 1423–1431.
- Mosca, G., Tagliavini, M., & Scandellari, F. (2007). Soil biological and biochemical responses to thinning in deciduous forests. *Biology and Fertility of Soils*, 43, 497–502.
- Nunery, J. S., & Keeton, W. S. (2010). *Forest carbon storage in the northeastern United States: Net effects of harvesting frequency, post-harvest retention, and wood products*. *Forest Ecology and Management*, 259(8), 1363–1375.
- Nyland, R. D. (2002). *Silviculture: Concepts and applications* (2nd ed.). Waveland Press.
- Nyland, R.D., Kenefic, L.S., Bohn, K.K., & Stout, S.L. (2016). *Silviculture: concepts and applications*. Edisi ketiga. United State of America: Waveland Press, Inc. ISBN 978-1-4786-2714-2
- Okalebo, J.R., K.W. Gathua, and P.L. Woomer. 1993. *Laboratory Methods of Soil and Plant Analysis. A Working Manual*. UNESCO
- Olesinski, J., Smal, H., & Ligeza, S. (2012). Influence of thinning on soil properties in pine stands on sandy soils. *Forest Research Papers*, 73(2), 101–108.
- Oliver, C. D., & Larson, B. C. (1996). *Forest Stand Dynamics*. John Wiley & Sons. (Buku klasik dalam silvikultur yang menjelaskan prinsip-prinsip kompetisi dan pertumbuhan tegakan, yang sangat relevan dengan dampak penjarangan).
- Pachas, A., Montes, D., & Ruiz, M. A. (2019). Economic valuation of teak (*Tectona grandis* L.f.) plantations in the Peruvian Amazon. *Forestry Systems*, 28(1).
- Pan, Y., Birdsey, R. A., Fang, J., et al. (2011). A large and persistent carbon sink in the world's forests. *Science*, 333(6045), 988–993.
- Pandey, D., & Brown, S. (2000). *Forest resources assessment 2000: Global forest products outlook study--forest plantations*. FAO.
- Pretzsch, H., Grote, R., Reineking, B., Rötzer, T., & Seifert, S. (2014). Concepts and strategies of forest growth modelling. In *Forest dynamics, growth and yield: from measurement to process-based models* (pp. 3-45). Springer. (Membahas model pertumbuhan hutan dan bagaimana praktik pengelolaan seperti penjarangan memengaruhi pertumbuhan dan produktivitas).
- Pretzsch, H., Klesse, S., & Grote, R. (2020). Thinning effects on tree growth and forest carbon sequestration: A global meta-analysis. *Forest Ecology and Management*, 462, 117904.
- Pukkala, T. (2016). *Optimizing thinning regimes for carbon and timber in structurally variable forests in Finland*. *Forestry*, 89(2), 221–234.
- Puget, P., Chenu, C., & Balesdent, J. (2010). Dynamics of soil organic matter associated with particle-size fractions of water-stable aggregates. *European Journal of Soil Science*, 51, 595–605
- Rahmawati, R. B., Widiyatno, Hardiwinoto, S., Budiadi, Nugroho, W. D., Wibowo, A., & Rodiana, D. (2022). Effect of spacing on growth, carbon sequestration, and wood quality of 8-year-old clonal teak plantation for sustainable forest teak management in Java Monsoon Forest, Indonesia. *Biodiversitas*, 23(8), 4180–4188.



- Rohoskova, M. and M. Vahid, 2004. Comparison of two methods for aggregate stability measurement – a review. *Plant Soil Environ.*, 50: 379–382.
- Ruiz-Benito, P., Madrigal-González, J., & Zavala, M. A. (2014). Forest management strategies in response to climate change: A review. *Forest Ecology and Management*, 329, 1-14.
- Rolando, J.L., Dubeux, J.C.B., de Souza. T.C. 2020. Organic carbon is mostly stored in deep soil and only affected by land use in its superficial layers: A case study. *Agrosystems, Geosciences & Environment*. Vol (4).
- Ruiz-Benito, P., Gomez-Aparicio, L., Paquette, A., Messier, C., Kattge, J., Zavala, M.A., 2014. Diversity increases carbon storage and tree productivity in Spanish forests: Diversity effects on forest carbon storage and productivity. *Glob. Ecol. Biogeogr.* 23 (3), 311–322. <https://doi.org/10.1111/geb.12126>.
- Ryan, M. G., Harmon, M. E., Birdsey, R. A., Giardina, W. K., Heath, L. S., Houghton, R. A., ... & Waring, R. H. (2006). A synthesis of the carbon cycle in forests of the United States. *Forest Ecology and Management*, 259(11), 1957-1972.
- Saarinen, N., Kankare, V., Yrttimaa, T., Viljanen, N., Honkavaara, E., Holopainen, M., Hyypä, J., Huuskonen, S., Hynynen, J., Vastaranta, M., 2020. Assessing the effects of thinning on stem growth allocation of individual Scots pine trees. *For. Ecol. Manage.* 474, 118344. <https://doi.org/10.1016/j.foreco.2020.118344>.
- Saarinen, N., Mäkinen, H., & Valkonen, S. (2020). Effects of thinning on the structure and development of Scots pine stands in Finland. *Forest Ecology and Management*, 459, 117814
- Schaedel, M., Schiedt, M., & Meiwes, K. J. (2017). Carbon sequestration in managed forests of southwestern Germany: The role of thinning and fertilization. *Forest Ecology and Management*, 391, 312-322.
- Schilling, G., Hagemann, N., & Schulz, R. (1999). Carbon sequestration in forest ecosystems on former agricultural land: A case study from Germany. *Forest Ecology and Management*, 123(1-3), 23-34.
- Schimel, J. P., et al. (2022). Mechanisms of organic carbon movement in Vertisol profiles and implications for carbon stock measurements. *Soil Biology and Biochemistry*, 168, 108604.
- Seta, G. W. (2024). *Strategi Peningkatan Produktivitas dan Kualitas Kayu pada Perhutani jati Klon* (Disertasi tidak diterbitkan). Universitas Gadjah Mada.
- Schilling, E.B., Locke, M.A., & Zablutowicz, R.M. (1999). Thinning affects carbon and nutrient cycling in managed forests. *Soil Science Society of America Journal*, 63, 224–231.
- Schroeder, P. (1991). The effect of thinning on carbon sequestration in Douglas-fir stands. *Forest Science*, 37(6), 1584-1596
- Schroeder P. 1992. Carbon storage potential of short rotation tropical tree plantations. *For. Ecol. Manage.* 50: 31-41
- Schaedel, M.S., Smithwick, E.A.H., & Eissenstat, D.M. (2017). Carbon storage in root systems of temperate forests. *Ecology*, 98(2), 329–339.
- Six, J., Bossuyt, H., Degryze, S., & Denef, K. (2004). A history of research on the link between (macro) aggregates, soil biota, and soil organic matter dynamics. *Soil and Tillage Research*, 79(1), 7-31. (Tinjauan mendalam tentang hubungan antara agregat dan dinamika bahan organik, termasuk fraksi).
- Smith, D. M., Larson, B. C., Kelty, M. J., & Ashton, P. M. S. (2007). *The Practice of Silviculture: Applied Forest Ecology*. John Wiley & Sons.



- Shuyong, L., Shengcong, L., Mei, H., 2017. Effects of Thinning Intensity on Carbon Stoks and Changes in Larch Forests in China Northeast Forest Region. *J. Resour. Ecol.* 8 (5), 538–544. <https://doi.org/10.5814/j.issn.1674-764x.2017.05.011>
- Silva, M. R., Pereira, M. G., & Beutler, S. I. (2014). Soil aggregation in different tillage systems and cover crops. *Soil and Tillage Research*, 136, 15-22.
- Simatupang, M.H. (2001). Jati: Riwayat Budidaya dan Penyebarannya. *Buletin Penelitian Hasil Hutan*, 19(1), 1–10.
- Six, J., Conant, R.T., Paul, E.A., & Paustian, K. (2004). Stabilization mechanisms of soil organic matter: implications for C-saturation of soils. *Plant and Soil*, 241, 155–176.
- Smith, J. A., et al. (2023). Long-term effects of thinning on tree growth, nutrient uptake, and biodiversity in temperate forest ecosystems. *Forest Ecology and Management*, 540, 111162.
- Suwardji, & Elberach, H. (1998). *Dasar-dasar Ilmu Tanah*. Fakultas Pertanian Universitas Mataram
- Tisdall, J. M., & Oades, J. M. (1982). Organic matter and water-stable aggregates in soils. *Journal of Soil Science*, 33(2), 141-163.
- Tolonay, D., Güner, Ş.T., & Aydın Çömez, D. (2019). *Litterfall and the effects of thinning and seed cutting on carbon input into the soil in Scots pine stands in Turkey*. *European Journal of Forest Research*, 138(1), 1–14.
- Vallet, P., & Perrot, T. (2011). Thinning effects on carbon sequestration of temperate forests: A review. *Annals of Forest Science*, 68(5), 785-794.
- Vesterdal, L., Dalsgaard, M., Felby, C., Raulund-Rasmussen, K. & Jorgensen, B. B. Effects of thinning and soil properties on accumulation of carbon, nitrogen and phosphorus in the forest floor of Norway spruce stands. *For. Ecol. Mgmt.* 77, 1–10 (1995).
- Wang, Y., Shao, Y., & Li, X. (2005). Carbon sequestration in Chinese forests and its implications for climate change mitigation. *Climatic Change*, 72(1-2), 1-13.
- Wanneng, R., Kaosa-ard, A., & Siril, S. (2014). Teak (*Tectona grandis* Linn.f.) wood quality evaluation for pulp and paper production. *Journal of Tropical Forest Science*, 26(1), 1-8.
- Whittaker, R.H., Likens, G.E., & Bormann, F.H. (1975). *Net production of forest ecosystems*. Ecological Studies, Springer.
- Verhaegen, D., Fof ana, I.J., Logossa, Z.A., & Of ori, D. (2010). What is the genetic origin of teak (*Tectona grandis* L.) introduced in Africa and in Indonesia?. *Tree Genetics & Genome*. 6: 717-733. DOI: 10.1007/s11295 -010-0286-x.
- Wu, J., Brookes, P. C., & Jenkinson, D. S. (2019). *Microbial biomass and SOC under thinning*. *Soil Biology and Biochemistry*.
- Yadav, V. S., Yadav, S. S., Gupta, S. R., Meena, R. S., Lal, R., Sheoran, N. S., & Jhariya, M. K. (2022). Carbon sequestration potential and CO<sub>2</sub> fluxes in a tropical forest ecosystem. *Ecological Engineering*, 176, 106541. <https://doi.org/10.1016/j.ecoleng.2022.106541>
- Zhao, D., Zhang, Y., & Zhu, S. (2019). Thinning effects on forest biomass and soil carbon in temperate plantations: A meta-analysis. *Forest Ecology and Management*, 442, 164-173.
- Zheng, H., Ouyang, Z., Xu, W., Wang, X., & Miao, H. (2019). Effects of forest thinning on carbon storage and emissions. *Ecological Indicators*, 103, 565–573.
- Zhou, T., Wang, C., Zhou, Z., 2020. Impacts of forest thinning on soil microbial community structure and extracellular enzyme activities: A global meta-analysis. *Soil Biol. Biochem.* 14.



**DAMPAK TEKNIK PENJARANGAN DAN PEMANGKASAN CABANG TERHADAP AGREGASI TANAH,  
FRAKSI BAHAN ORGANIK  
TANAH, PRODUKTIFITAS DAN STOK KARBON PADA TEGAKAN JATI KLON DI KHDTK WANAGAMA**

1

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Zhou, Z., Li, G., & Luo, Y. (2021).

Effects of thinning on stand growth and carbon sequestration in Chinese fir plantations. *Forest Ecology and Management*, 484, 118836.