Cattle grazing under *Pinus caribaea*
1. Evaluation of farm historical data on stand age and animal stocking rate

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**Abstract.** An analysis is made of the animal stocking rate used in commercial *Pinus caribaea* plantations 2.5–8.5 yr old. Pines were planted at 2.5 × 2.5 m and programmed for clear-cut harvest at 10 yr rotations (pulpwood). Cattle grazing was introduced to reduce weeding costs.

Stocking rate in 1983–1985 was 0.67 AU/ha/yr (AU = animal units 350 kg live weight). A quadratic model calculated using 1984 data (\( S = 0.0108 + 0.385A - 0.0418A^2 \)) describes the relationship between animal stocking rate (\( S \)) and stand age (\( A \leq 9.5 \) in yr). The model predicts a maximum of 0.89 AU/ha/yr at plantation age 4.5 yr. Grazing started at plantation ages \( \geq 2.5 \) yr; no plantations older than 9.5 yr are grazed.

**Introduction**

Cattle grazing under forestry plantations is a well documented production alternative in temperate and subtropical areas [Adams 1975; Beveridge et al. 1973; Grelen 1953; Halls 1953, 1984; Tustin et al. 1979]. Extant information has proven the biological feasibility and economic attractiveness of this integrated form of land use [Borough 1979; Gregor 1973; Lewis et al. 1983; Pearson & Whitaker 1973]. In the tropics, little information is available [Bell 1981; Gregor 1973].

Several studies have documented the importance of the animal component (trampling, bark stripping, direct browsing or soil compaction) in technology design [Barr 1973; Clary et al. 1975; Schneider et al. 1978]. Equally important is the understanding of the changes in the productivity and botanical composition of the herbaceous understory as the stand develops. This paper documents historical data on the animal stocking rate managed under even-aged stands of *Pinus caribaea* in a private farm in Costa Rica.
Site description

The environmental setting

The study farm (Finca Buenavista, Celulosa de Turrialba) is located at 9°54'N and 83°37'W at elevations between 600–1050 m. Annual precipitation is 3240 mm (12 yr of data, 1978–1989, measured at the study site) with average monthly rainfall always above 100 mm. Some years, however, rainfall may fall below 100 mm in February, March or April. No temperature records are available.

Soil samples taken in 1985 (16 composite samples at 0–20 and 20–40 cm depths) indicate a clay fraction >40%, an organic matter content of 4.58%, pH (H₂O) 5.6, and cation exchange capacity of 35 meq/100 g of soil. Effective cation exchange capacity was 9.63 meq/100 g, with an extractable acidity of 0.38. These soils are characterized by a very low phosphorus content (2.7 ppm).

Forest stands

The farm is 668 ha in size with 611 ha devoted to forestry plantations, 41 ha under protective natural forests, and 16 ha planted to coffee and pejivaye palm (Bactris gasipaes). Forest operations started in 1976 using Pinus caribaea for pulpwood production. Starting in 1981 Gmelina arborea (common name melina) was planted as a substitute for pine because of a faster and more homogeneous growth, and lower resin content for pulping operation. At present no new areas are planted to pine and the objective is to replace it with melina. As of 1986, 536 ha were planted to pines and 93 ha to melina.

Pine seeds were brought from both Poptum, Guatemala (390 ha) and Santa Rosa de Culmi, Honduras (146 ha), and planted at 2.5 × 2.5 m spacing (1600 trees/ha). No provisions were made for thinnings or tree prunings. Clearcut harvest was programmed at 10 yr rotations. Stand growth and tree form are very irregular; site heterogeneity and poor genetic material are mentioned as causes.

Pine stands of unequal areas were established in different years. For instance, 19 ha were planted in 1976, 296 ha in 1977, 176 ha in 1978, 23 ha in 1979, and 22 ha in 1981. Stands of the same age were planted as spatially separated units of unequal areas. For instance, eight stands with areas between 24–56 ha were planted in 1977 (to account for the total 296 ha planted that year). Large stands were subdivided into paddocks (5–26 ha) for pasture management. Depending on stand size a maximum of six paddocks per stand were demarcated.