Place of Intensive Forestry in Ecosystem Management

David R. Bower

SUMMARY. As population increases, the needs for products from the forest increase, along with the needs for recreation, wildlife, and esthetics. Although some of these products can also be produced by substitutes, such as plastic, steel, or aluminum, forest products have the desirable property of coming from a renewable resource, that is economically produced, and has positive environmental aspects. While use of forests for products does not preclude their use for recreation, and other nonproduct values, setting aside large tracts solely for recreation obviously can constrain total forest product yields. It is proposed that emphasis should be placed on intensive plantation management, or production forests, to significantly improve product flows to meet people's needs, while freeing other areas for alternative uses. Examples are given to show how genetically improved stock, seedling culture, site preparation, management of competing grass and hardwoods, fertilization, and thinning, can be used to increase product yields from intensively managed forests. The proposed forest management practices are also conducive to good wild life production, recreation, soil stability, and water quality. *[Article copies available for a fee from The Haworth Document Delivery Service: 1-800-342-9678. E-mail address: getinfo@haworthpressinc.com < Website: http://www.haworthpressinc.com>]*

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COMMODITY-PRODUCTION FORESTRY

Staebler (1993) suggested that focusing on "commodity-production forestry" as a dominant use would allow foresters to grow timber crops "in such quantities that the pressures to produce wood in forests set aside for other dominant, uses would be greatly reduced." Sedjo and Botkin (1997) suggested that if planted forests could produce 10 m^3/ hectare annually, that only 0.15 billion hectares of plantation, or roughly 4% of the global forest, would be required to produce the world's industrial wood production of 1.5 billion cubic meters. Drawing on a large experimental data base for planted loblolly pine (***Pinus taeda*** L.), in the Southern U.S., this report shows that medium site intensively managed plantations should produce up to 9.5 m^3/hectare/year.

INTENSIVE PLANTATION MANAGEMENT

Site Quality and Early Treatments-Site quality varies widely across the Southern U.S., dependent on soils and climate. Published yield tables show volume productivity increasing directly with site quality or site index. Financial incentives for intensive management typically increase with increased site quality. Early growth rate and even long-term site quality can be enhanced by contour ripping (producing improved planting spots for seedlings in rocky soils), bedding on wetter sites, grass control (reduced competition for seedling) and fertilization in beds. Seedling quality can also enhance seedling survival and early growth.

Plantation Spacing and Thinning Level-Bower and Baldwin (1992) reported on a 38-year old loblolly plantation in Southwest, Louisiana, USA, grown at a wide range of initial planting spacings (1.8 x 1.8 m^2 to 3.7 x 3.7 m^2) and subsequently thinned (age 18, 23, 28, 32, 38) to a wide range of residual basal area (BA) levels (13.8 m^2/ha to 27.6 m^2/ha). Narrow spacing provided more total yield thru age 38 on the thinned plots but less total yield on non-thinned plots (Table 1). As expected, tree diameter is enhanced by wider initial spacings and heavier thinnings on this 19.5 m (age 25) site index land.

Another example of tradeoffs in tree diameter vs. volume per hectare by residual thinning level is provided by the Red Cut Thinning Study in Southwest Arkansas, USA, Figures 1 and 2, (Bower 1995).

TABLE 1. Final Diameter at Breast Height (DBH), Largest 125 Trees/ha, and Total Yield, Age 38, by initial Spacing and Residual BA, for the Loblolly Pine Plantation at Merryville, Louisiana, USA

Residual BA Level	DBH and Total Yield[1] by Residual BA and Initial Spacing					
	DBH (9 cm). - Top 125 T/ha			Total Yield (m^3/ha)		
(m^2/ha)	1.8 340 X 1.8	2.7 37.0 x 2.7	3.7 39.2 x 3.7	1.8 350 x 1.8	2.7 330 x 2.7	3.7 272 x 3.7
13.8						
18.4	31.5	34.3	37.2	353	305	309
23.0	31.9	34.6	38.1	395	364	362
27.6	32.6	34.6	- - -	421	402	---
Controls	30.0	34.1	35.7	267	326	331

[1]Yield of all thinnings plus final standing volume.

FIGURE 1

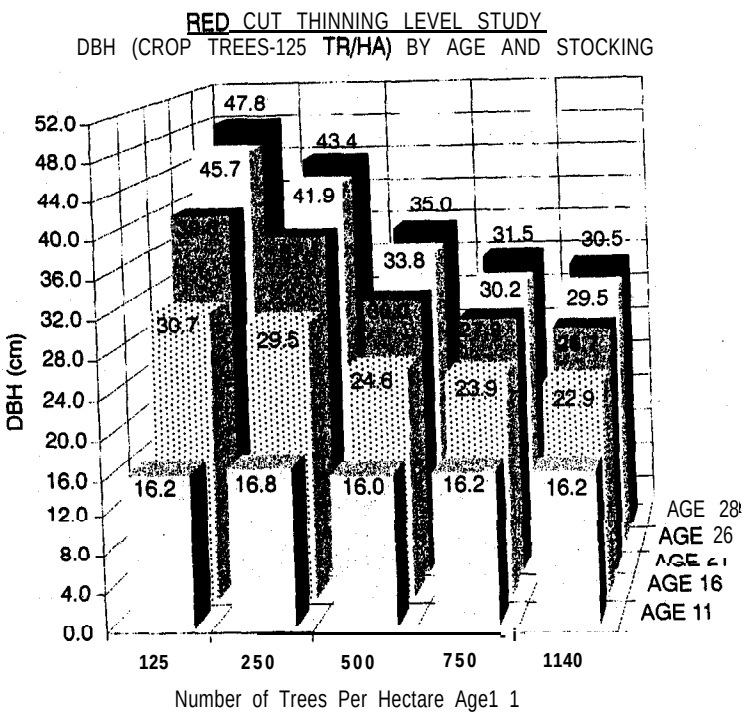
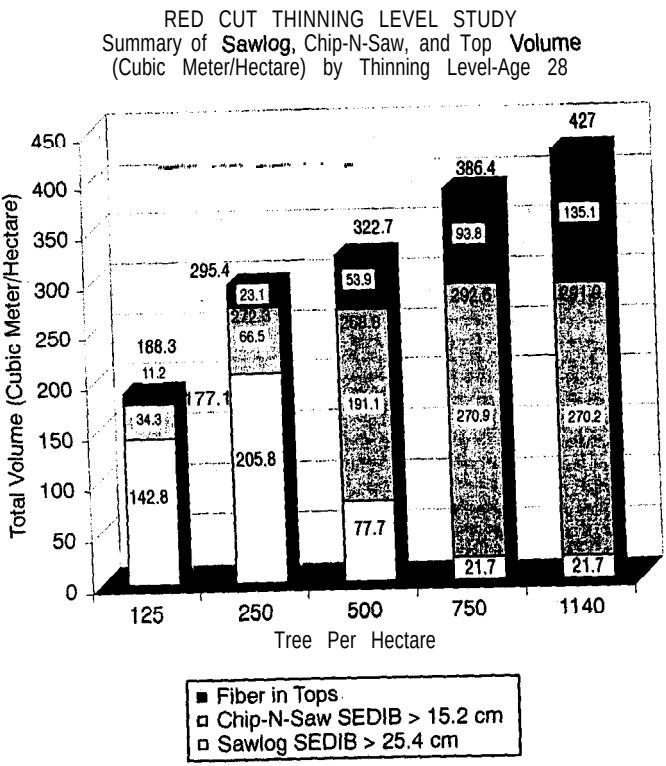


FIGURE 2



At age 11, when Red Cut was thinned, the residual diameter, of 125 crop trees per hectare averaged ≈ 16.2 cm for all thinning levels. Figure 1 shows the responsiveness of loblolly pine to stocking level, such that by age 28, tree diameter ranged from 47.8 cm for 125 trees per hectare to 30.5 cm for 1140 trees per hectare. Figure 2 shows that the higher residual stocking levels provided much higher standing volume at age 28, ranging from 427 m^3/hectare at 1140 trees/hectare to 188 m^3/hectare at 125 trees/hectare. Potential solidwood product volume (5.0 meter logs with small end diameter > 15.2 cm) varied much less from the 250 tree/hectare treatment to the 1140 tree/hectare treatment on this 20.7 meter site index land. The highest residual stocking level at Red Cut provided 15.8 m^3/hectare per year annual yield, with fertilization and weed control but with use of regular unimproved seed source.

Impacts of Hardwood Control and Generics-A cooperative study in Southwest Arkansas, USA, between Weyerhaeuser Company and the University of Arkansas Southwest Research and Extension Center, Hope, Arkansas, compares incremental growth gains for planted loblolly pine (3 *x* 3 m^2 spacing) from genetics and hardwood control (9 year results) are reported (Bower and Colvin 1994). Hardwoods were controlled at age 3 using 187 grams Arsenal per 45 liters of water. Figure 3 shows an average diameter gain of 2.5 cm (16%) at age 13 from planting North Carolina improved family NC1 vs. Arkansas regular seedlings, and an additional 2.3 cm for control of hardwood competition. Similarly, average height gains for genetics are 2.1 meters, with an additional 0.5 meter gain for hardwood control (Figure 4). The diameter and height gains led to volume gains for genetics of 43 m^3/hectare, with an additional volume gain of 49 m^3/hectare for hardwood control (Figure 5).

Predicting Gains from *Intensive Management*–Incremental gains

FIGURE 3

HOPE COOP STUDY AGE 13
SEED SOURCE AND HARDWOOD CONTROL

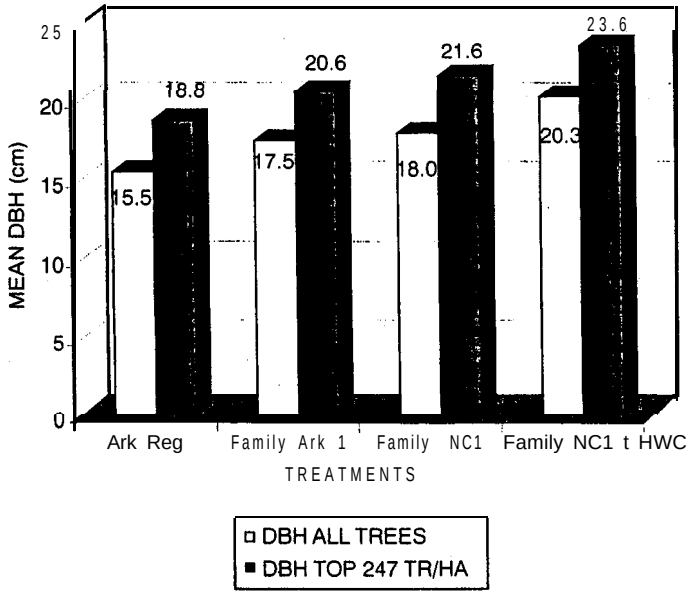


FIGURE 4

HOPE COOP STUDY AGE 13
SEED SOURCE AND HARDWOOD CONTROL

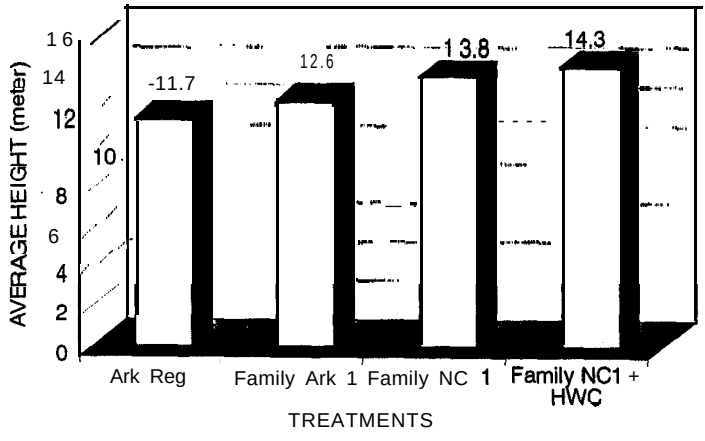


FIGURE 5

HOPE COOP STUDY AGE 13
SEED SOURCE AND HARDWOOD CONTROL TOTAL STEM VOLUME

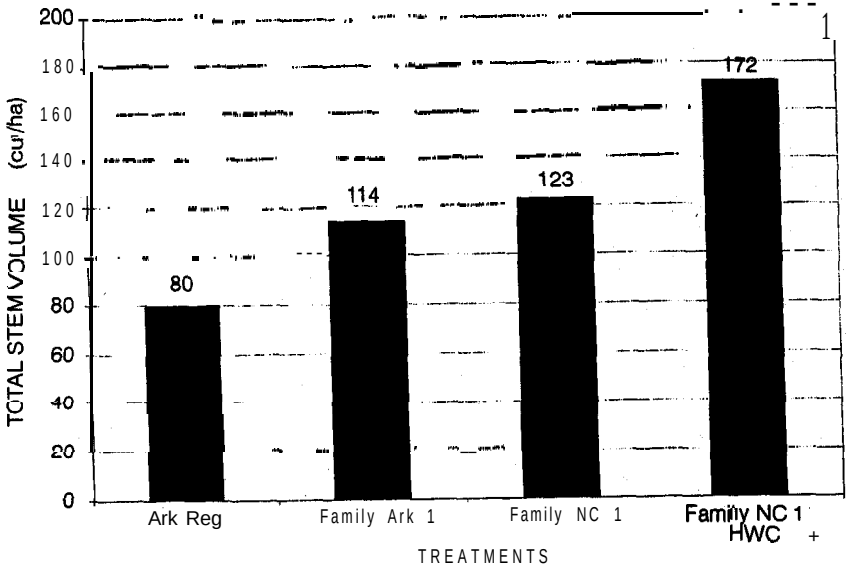


TABLE 2. Assumptions for Gains from Intensive Management

Thinning	• Thin at Age 17 to 420 Trees/ha; d/D = .95 • Thin at Age 27 to 10.4 m^2/ha BA; d/D = .95 • Use Model to Quantify Tradeoff in DBH vs. vol/ha
Hardwood Control	• Reduce % HDW BA from 20% to 5% • Assume similar competition from a unit of hardwood BA as a unit of pine BA • Site index improves by 0.5 meters
Fertilization	• Fertilize at ages 17, 22, 27, 32 • Gain expectation is ≈ 14 m^3/ha/treatment
Genetics	• Site index improves by 2.2 meters

from thinning, hardwood control, fertilization, and genetics were projected to age 42 via a proprietary growth and yield model. This projection assumed an initial stocking of 990 trees per hectare at age 7, and a base site index of 19.8 meters. Table 2 provides a summary of the assumptions for thinning, hardwood control, fertilization, and genetics, which were based on the Hope study, described in this report, as well as on other studies. Figure 6 shows substantial gains in diameter ranging from 27.9 cm for the unthinned base case to 42.2 cm for the most intensive treatment, a 51% gain! Similarly volumes in Figure 7 range from 266 m^3/hectare (6.3 m^3/ha/year) to 397 m^3/hectare (9.5 m^3/ha/year) a 49% gain! Results show a tremendous opportunity for plantations to meet forest products needs, while freeing other areas for alternative uses!

CONCLUSIONS

Growth and yield simulations showed that with intensive management, including thinning, hardwood control, fertization and genetics; medium site loblolly pine plantations can produced 9.5 m^3/ha/year. With wide spread adoption of intensive management practices, only a small fraction of global forests would be needed to meet the world's annual industrial wood production needs and pressure to produce wood in forests set aside for other dominant uses would be reduced.

FIGURE 6

GAINS FROM INTENSIVE MANAGEMENT-AGE 42
BASE AGE 25 SI = 19.8 M; AGE 7 STOCKING = 990 TR/HA

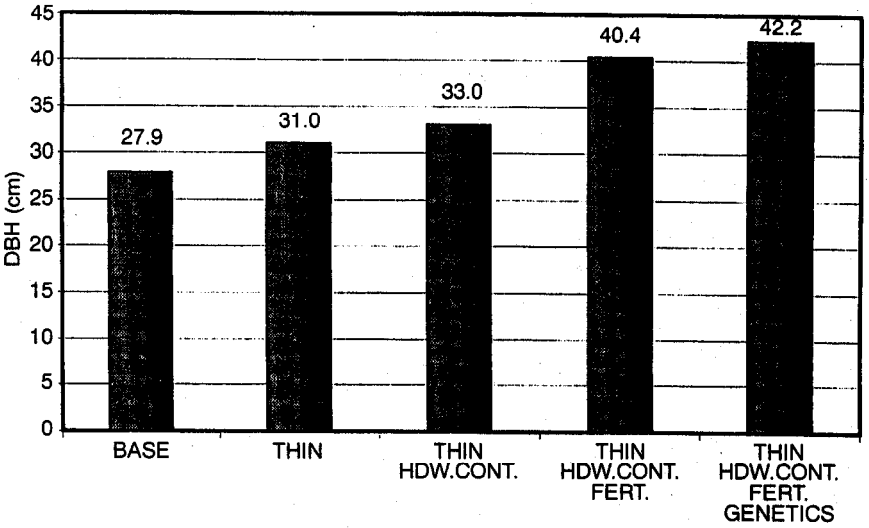
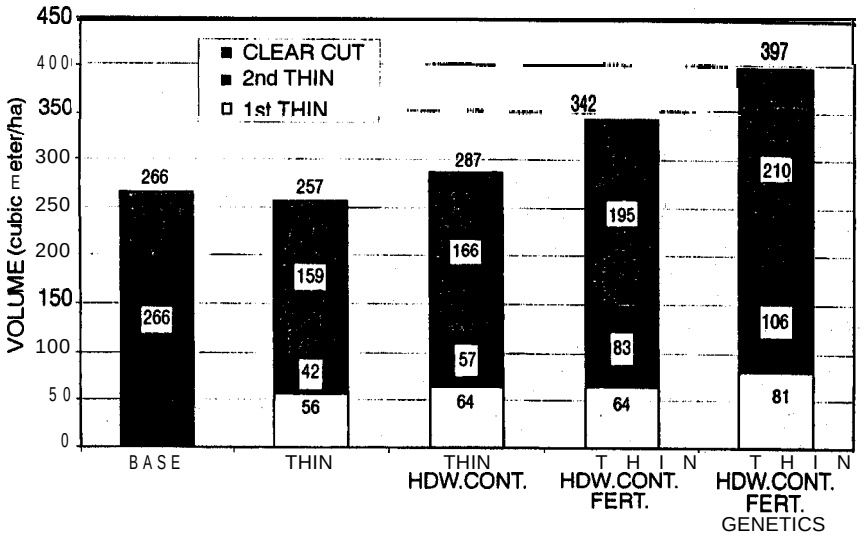


FIGURE 7

GAINS FROM INTENSIVE MANAGEMENT-AGE 42
BASE AGE 25 SI = 19.8 M; AGE 7 STOCKING = 990 TR/HA



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