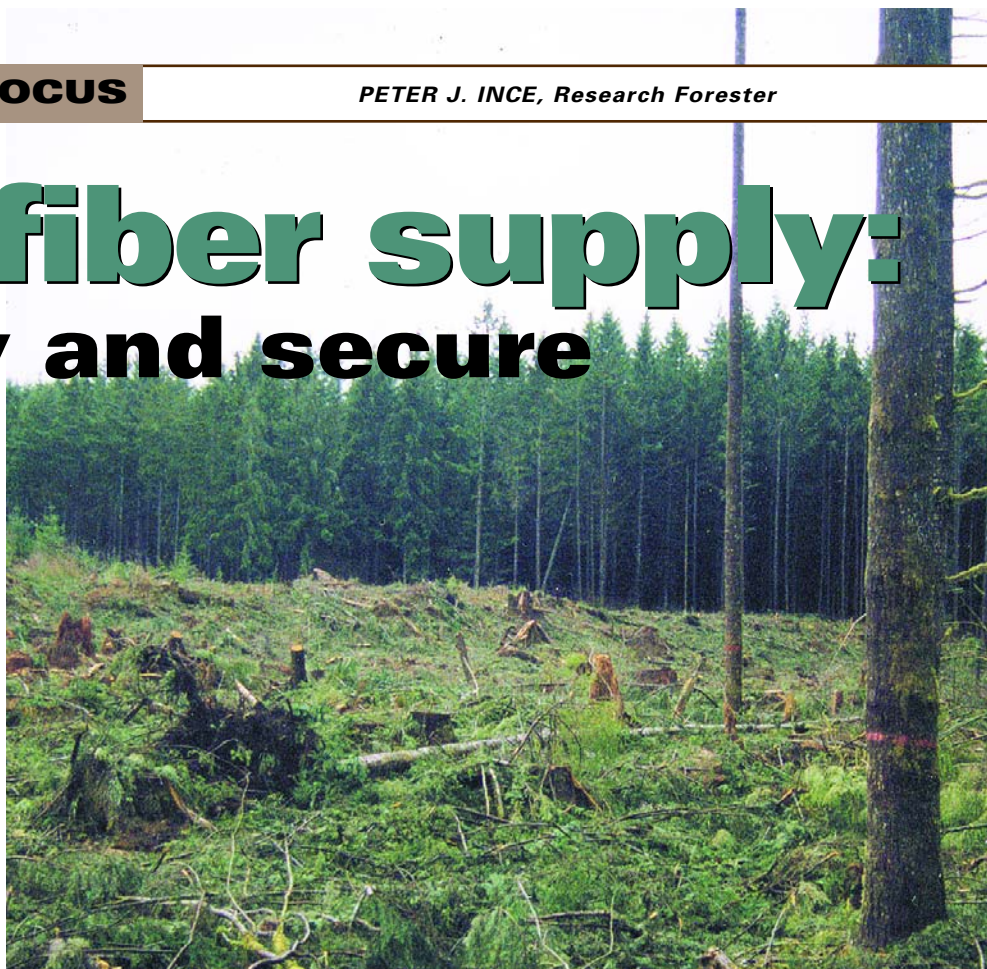


U.S. fiber supply: Steady and secure

U.S. papermakers should have plenty of available fiber due to expanding production, better forest management, and new production technology.



Ready access to wood fiber has long been a competitive advantage for the U.S. pulp and paper industry. Will that advantage still be there in coming decades? According to a recent analysis by the U.S. Forest Service, the answer is yes. Sustainable development of U.S. forest resources will produce steady growth in fiber supply. Good forest management—as well as changing markets, new international trade patterns, and improved production technology—helps assure a secure U.S. fiber outlook.

The U.S. pulp and paper industry depends almost exclusively on wood for fibrous raw material input. The industry accounts for roughly half of all U.S. industrial wood fiber consumption in the form of wood residues, recycled fiber and harvested pulpwood. Pulpwood demands in the expanding U.S. wood panel industry are also increasing. One-third of annual U.S. timber harvest is pulpwood.

The Forest Service timber assessment is a detailed and periodic assessment of wood resource supply and demand in the United States. The assessment includes analysis of the pulp and paper sector along with pulpwood use in wood panels

as part of a broader timber supply and demand outlook. Detailed final results of the 2001 timber assessment are in the process of being published by the Forest Service. This article covers highlights of the baseline wood fiber outlook, focusing on the pulp and paper sector.

The baseline outlook was derived using economic models, including the North American Pulp and Paper (NAPAP) Model, along with a set of macroeconomic and trade assumptions. The NAPAP Model applies conventional regional market modeling techniques to compute annual market equilibria based on optimization of consumer and producer surplus in the pulp and paper sector (1–3). The American Forest & Paper Association pulp and paper data series (4) was generally the source of historical production and consumption data used in the analysis and shown in this report.

DEMAND OUTLOOK

The Forest Service analyzed and projected markets for all paper and paperboard commodities, including paper products such as newsprint, printing and writing paper, tissue/sanitary paper, and packaging paper as well as paperboard

IN THIS ARTICLE, YOU WILL LEARN:

- North America's baseline wood fiber outlook.
- Production and consumption projections through 2050.
- Whether domestic wood fiber supplies are likely to sustain projected expansions in production and demand.

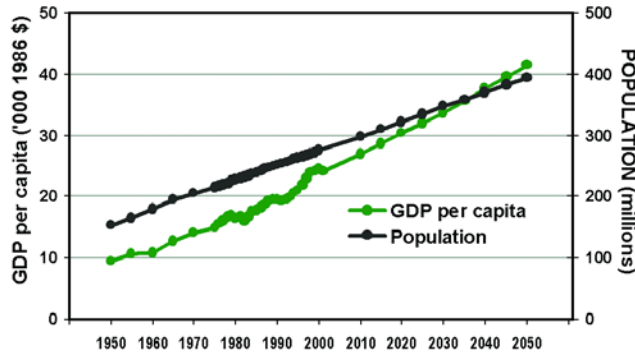
ADDITIONAL RESOURCES:

- The RPA Timber Assessment home page: <http://www.fs.fed.us/pnw/sev/rpa/index.htm>
- The American Forest and Paper Association website: www.afandpa.org
- The Society of American Foresters' website: www.safnet.org

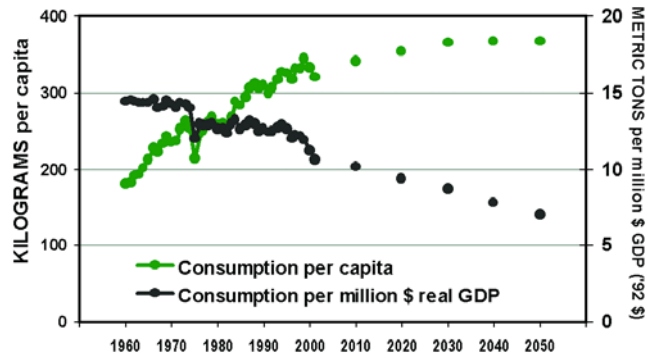
products such as containerboard, bleached board, and recycled paperboard. Domestic demand relationships vary among different commodities based on population and gross domestic product (GDP), with varying potential for product substitution by electronic media or plastics (5). Basic assumptions for the economic determinants of population and per capita GDP growth are shown in **Fig. 1**.

U.S. consumption of paper and paperboard is projected to increase at a decelerating growth rate, consistent with trends of recent decades but varying by product category. Consumption per unit of real GDP is projected to gradually decline, also consistent with historical trends since the 1950s. Paperboard consumption increased more rapidly than paper consumption in recent decades, a trend projected to continue. Paperboard consumption rose from 110 kg/capita in 1980, or 5.4 metric tons per million dollars of real GDP (in 1992 U.S. dollars), to a recent peak of 158 kg/capita in 1999 or 5.5 metric tons per million dollars of real GDP. Since 1999, U.S. paperboard consumption declined with economic recession, but per-capita consumption is projected to climb back above recent peak levels by 2010 and by 2050 reach 190 kg/capita. However, paperboard will be a smaller part of the overall economy over the long term, with consumption dropping to 3.6 metric tons per million dollars of real GDP by 2050.

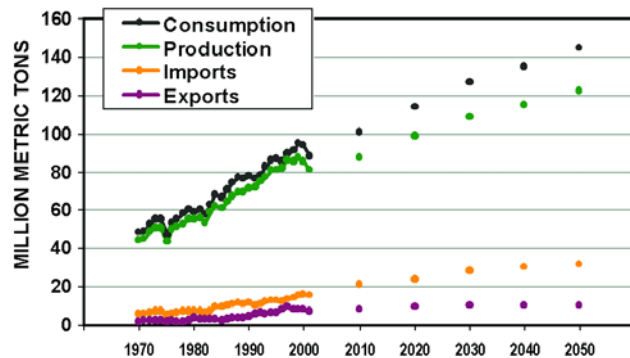
Paper consumption (excluding paperboard and building paper) increased from 148 kg/capita in 1980 or 7.3 metric tons per million dollars of real GDP, to a recent peak of 191 kg/capita in 1999 or 6.6 metric tons per million dollars of real GDP, a gain in per capita consumption but a decline relative to real GDP. Under the influence of economic recession, U.S. paper consumption dropped to around 175 kg/capita in 2001, but paper consumption is projected to gradually



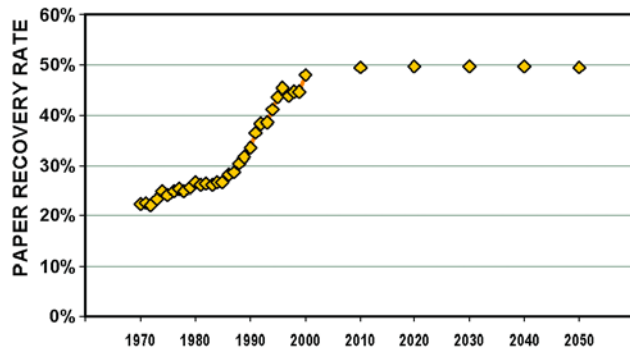
1 Historical and projected trend assumptions for U.S. population and GDP per capita.



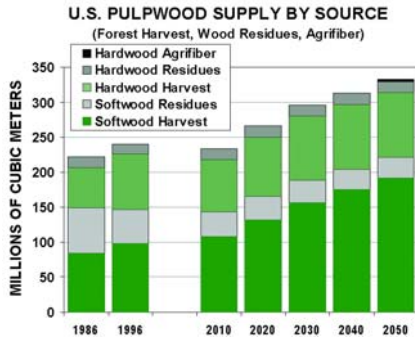
2 Historical and projected trends in U.S. per-capita paper and paperboard consumption and consumption per unit of real GDP (in 1992 U.S. dollars).



3 Historical and projected trends in U.S. paper and paperboard production, consumption, and trade.



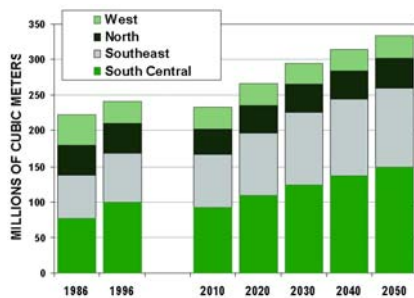
4 Historical and projected trends in U.S. discarded paper recovery rate.



5a. U.S. pulpwood supply by source, historical and projected.



5b. U.S. pulpwood supply by destination, historical and projected.



6. Projected annual U.S. pulpwood supply by region, 2010–2050.

recover, peaking again at 188 kg/capita in 2030 and then receding to 176 kg/capita by 2050, or 3.4 metric tons per million dollars of real GDP.

Figure 2 illustrates the historical and projected trends in total U.S. paper and paperboard consumption per capita and consumption per million dollars of real GDP. While per capita consumption doubled from less than 170 kg in the early 1950s to a peak of 344 kg in 1999, the growth

rate has been decelerating and consumption per million dollars of GDP has steadily declined. The historical pattern of decelerating growth in demand observed in the latter half of the 20th century is projected to continue, with compound growth in per capita consumption averaging just 0.2%/year over the next 50 years. In general, growth in consumption is maturing and less robust than overall U.S. economic growth; with the recent economic recession, consumption fell to less than 320 kg per capita in 2001. Nevertheless, per capita consumption is projected to recover from the recession and projected to climb back to historical peak levels by 2010 and reach 367 kg in 2050. Consumption of paper and paperboard per million dollars of real GDP (in 1992 dollars) is projected to decline from about 11 metric tons in 2000 to 7 metric tons in 2050.

On a tonnage basis, the analysis indicates that U.S. paper and paperboard consumption (including building paper) should increase from 95.8 million metric tons in 1999 to 102 million metric tons by 2010 and 145 million metric tons by 2050 (after having dipped amid economic recession to less than 90 million tons in 2001). Population, economic growth, and end-use assumptions drive projected demand. The projected growth rate in annual consumption during the next 50 years is under 1%. The analysis finds that projected shifts in fiber supply exert only modest influence on equilibrium demand levels, as indicated by a flat projected trajectory for product price cycles, despite increased consumption.

PRODUCTION AND TRADE OUTLOOK

The analysis projects increased U.S. imports of pulp, paper, and paperboard commodities in the decades ahead, with modest growth in exports. This is consistent with recent trends. The U.S. trade deficit in paper and paperboard widened in

recent years, with weakness in Asian export markets and a stronger U.S. dollar. Paper and paperboard commodity exports (excluding converted products) declined by more than 20% from their recent peak in 1997. U.S. imports of paper and paperboard surged in recent years, attracted by the strong U.S. dollar.

In the long run, projected expansion in U.S. pulpwood supplies should help paper and paperboard exports recover to 1997 levels (9 to 10 million metric tons per year in the decades ahead). Although the import share of domestic consumption has climbed from 14% in 1996 to 17% in 2000, imports are projected to level off after 2010 at around 21 to 22% of domestic consumption as U.S. softwood pulpwood supplies become more abundant. However, without significant weakening in the dollar value the baseline analysis assumes that imports will continue increasing at a decelerating pace, rising from 16 million metric tons in 2000 to 21 million metric tons by 2010 and 32 million metric tons by 2050.

Figure 3 illustrates historical and projected U.S. paper and paperboard production, consumption, and trade on a tonnage basis. Even though the analysis assumes that imports will continue to make inroads to U.S. markets and despite the economic recession in 2000 and 2001, the analysis indicates that domestic production will still account for the bulk of projected increases in domestic demand, as in past decades.

WOOD FIBER OUTLOOK

The U.S. wood fiber supply and demand outlook is characterized by a projected expansion in softwood roundwood pulpwood supply, decelerating growth in paper recovery for recycling, and limited growth in hardwood pulpwood and wood residue supplies. The analysis also includes projected expansion of roundwood demand at wood panel

RAW MATERIAL	1986	1996	2010	2020	2030	2040	2050
Softwood pulpwood	62.6	62.9	61.1	70.9	81.1	88.1	95.7
Timber harvest	35.5	41.9	46.2	57.2	67.6	76.1	83.7
Wood residues	27.1	20.9	14.9	13.7	13.5	12.0	12.0
Hardwood pulpwood	34.9	45.8	44.4	50.0	53.8	54.7	55.6
Timber harvest	27.5	38.8	36.7	41.8	45.6	46.3	45.8
Wood residues	7.4	6.9	7.7	8.2	8.2	8.2	8.2
Hardwood agrifiber	0.0	0.2	0.0	0.0	0.1	0.1	1.6
Total pulpwood	97.5	108.8	105.6	120.9	134.9	142.8	151.4
Recovered paper	20.4	39.1	50.6	57.1	63.3	68.0	72.3
Pulpwood and recovered paper	117.9	147.9	156.2	178.0	198.2	210.7	223.7

Table I. U.S. domestic supply of wood fiber raw materials, historical and projected, in millions of metric tons (dry weight basis).

mills [such as oriented strandboard (OSB)] in the total pulpwood supply and demand outlook.

Pulpwood receipts at wood panel mills are projected to more than double over the next 50 years, but wood panel mills account for just a fraction of total pulpwood receipts. Receipts at wood panel mills are expected to increase from around 9% of total U.S. pulpwood supply at present to 14% by 2010 and 18% by 2050, due mostly to OSB production capacity expansion in the North and South. Expansion of softwood pulpwood harvest, primarily in the South, accounts for most of the projected long-term increase in U.S. pulpwood supply. **Table I** shows historical and projected wood fiber supply (encompassing receipts at domestic pulp mills, roundwood receipts at wood panel mills, and exports).

In the absence of new policy incentives, the baseline analysis indicates that paper recovery for recycling will continue to follow the typical pattern of a sigmoid (S-shaped) industrial expansion curve, as shown in **Fig. 4**. The U.S. paper recovery rate for recycling has doubled since the mid-1980s, but growth in paper recycling has been gradually slowing in recent years. Paper recovery for recycling

reached a level of 48% in 2000, up from 22% in the early 1970s. The recovery rate should climb gradually to 50% by 2010, a level where it is projected to remain over the projection period to 2050.

Figures 5a. and **5b.** show projected trends for pulpwood, balancing U.S. supply quantities by source and destination. Resource categories include hardwood and softwood (forest harvest and wood residues) and hardwood agrifiber. Destinations include pulpwood receipts at domestic wood pulp mills (by far the largest category), roundwood pulpwood receipts at wood panel mills (such as OSB mills), and pulpwood exports. Pulpwood receipts at pulp mills receded along with receding wood pulp production since the mid-1990s, but receipts should climb back above historical levels beyond 2020. Pulpwood receipts at wood panel mills account for nearly half of the projected growth in pulpwood demand. U.S. pulpwood exports are projected to decline due to worldwide expansion of global fiber supply from wood fiber plantations.

PULPWOOD OUTLOOK

Projected expansion in U.S. pulpwood supply and demand is concentrated in the South. **Figure 6** shows projected pulpwood supply by

region. Intensified timber management will yield expansion in Southern pulpwood supply as the area of southern pine plantations (mostly loblolly pine) increases and as plantations mature. Annual timber harvest for all wood products nationwide (including sawlogs, fuelwood, etc.) should increase by 125 million cubic meters, from 510 million in 1996 to 635 million in 2050. Timber harvest on managed softwood plantations is expected to increase from 48 million cubic meters in 1996 to 195 million in 2050. Pulpwood harvest, projected to increase by 107 million cubic meters over the same period, accounts for most of the projected growth in timber harvest, and plantations account for most of the expansion in pulpwood supply. Nationwide timber harvest on non-plantation forestland will decline slightly.

The area of managed softwood plantations is projected to increase from just 6% of timberland area nationwide to 9% of U.S. timberland area by 2050. At about 500 million acres or 200 million hectares nationwide, “timberland” represents two-thirds of forested land area in the United States (it excludes parks, forest preserves, designated wilderness, and other non-commercial forestlands). Thus, the future of U.S.

timber supply will be characterized by increasing output through intensification of management on a relatively small share of total forested land area (plantations), while average harvest levels will remain stable or decline on the vast majority of forested land areas (non-plantations).

Based on projections and assumptions used in this analysis, real stumpage prices for softwood pulpwood should remain at or below peak levels of the 1990s for several decades. Hardwood pulpwood stumpage prices are also projected to remain relatively weak, but are then projected to increase beyond 2020 with conversion of land use from forestry to other uses and more limited availability of hardwood sites for harvest. As hardwood stumpage prices increase, they will enhance commercial feasibility of growing short-rotation woody crops on agricultural land (agrifiber). The baseline analysis projected that significant expansion of agrifiber would not begin to occur until several decades from now, but this outlook could change with future developments in biotechnology or with unexpected developments in pulpwood markets or trade.

EMERGING REALITIES AND OPPORTUNITIES

This analysis finds that domestic wood fiber supplies will be adequate to sustain significant projected expansion in domestic production and consumption of pulp, paper, and paperboard products. This is based on the assumption that projected development of forest management and plantations will continue, particularly on private forestland in the South.

Paper consumption and paperboard consumption should follow the historical pattern of decelerating growth. Pulpwood supply projections are similar to those of the 1993 Renewable Resources Planning Act (RPA) timber assessment base scenario (6, 7) and are much lower than

projections in earlier Forest Service assessments of the 1970s and 1980s (8–10), largely because of increased paper recycling since the mid-1980s (1). The recent economic recession and the rising tide of paper and paperboard imports have also dampened the demand outlook for pulpwood. However, after receding for a number of years, pulpwood harvest is still projected to increase—primarily in the eastern United States. This will be due to slower growth in paper recovery for recycling, increased demand for roundwood pulpwood at OSB mills, and a relative decline in wood residue supplies.

The analysis highlights some emerging realities and opportunities: Although hardwood pulpwood harvest will probably increase over the next several decades, growth in southern hardwood pulpwood supply appears likely to be limited by available timber inventories beyond 2010. This presents opportunities for expansion in southern softwood pulpwood supply, as well as in hardwood agrifiber supply. Southern softwood pulpwood harvest is projected to expand significantly beyond 2010, partly displacing growth in hardwood pulpwood supply. Nevertheless, hardwood pulpwood stumpage prices are still projected to increase, eventually leading to commercial feasibility of expanded hardwood agrifiber supply. The South should remain the dominant U.S. region in the production of wood fiber products and in total pulpwood supply and demand.

CONCLUSIONS

Based on reasonable economic assumptions and projections, continued growth and sustainable development of fiber supply in the U.S. pulp and paper sector appears to be assured for decades to come. This is due to ongoing improvements in forest management, along with projected shifts in product markets, international trade, and production technology. Among U.S. regions, the South will continue to

experience more growth in fiber supply and pulp, paper, and paperboard production than any other region. The North will remain important but will experience slower growth, and the West will gradually recede in importance in terms of pulpwood supply and demand (although capacity based on recycled fiber will continue to grow in all regions). Although fiber markets will undoubtedly continue to experience cycles of adjustment and change, including development of new fiber resources such as agricultural short-rotation woody crops, this analysis concludes that wood fiber supplies will be adequate to sustain foreseeable future economic development and growth in the U.S. pulp and paper sector. **S!**

LITERATURE CITED

1. Ince, P. J., Proceedings of The Society of American Foresters 1998 Annual Convention, Society of American Foresters, 1999, Bethesda, Maryland, USA, pp. 330–343.
2. Zhang, D., Buongiorno, J., and Ince, P.J., Research Paper FPL-PP-526, U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, 1993, Madison, Wisconsin, USA.
3. Zhang, D., Buongiorno, J., and Ince, P.J., *Annals of Operations Research* 68: (109)1996.
4. Anon., "Statistics of Paper, Paperboard & Wood Pulp," AF&PA, Washington DC, 2001.
5. Zhang, Y., "Analysis of Demands for Paper and Paperboard Products in the United States," Ph.D. dissertation, University of Wisconsin, Department of Forestry, Madison, 1995.
6. Ince, P. J., General Technical Report RM-242, U.S. Department of Agriculture, Forest Service, Fort Collins, Colorado, USA, 1994.
7. Haynes, R. A., Adams, D. M., and Mills, J. R., General Technical Report RM-GTR-259, U.S. Department of Agriculture, Forest Service, Fort Collins, 1995.
8. Haynes, R. A. (coordinator), General Technical Report RM-199, U.S. Department of Agriculture, Forest Service, Fort Collins, 1990.
9. Anon., Forest Resource Report No. 24, USDA Forest Service, Washington, 1988.
10. Anon., Forest Resource Report No. 23, USDA Forest Service, Washington, 1982.

About the author: Peter Ince is a research forester at the USDA Forest Products Laboratory, 1 Gifford Pinchot Dr., Madison, WI 53705-2366. Address correspondence to him by email at pince@fs.fed.us.

