Recycling

North American Paper Recycling Situation and Pulpwood Market Interactions¹

Peter J. Ince
USDA Forest Service
Forest Products Laboratory, Madison, Wisconsin

Abstract

This paper describes key aspects of the North American paper recycling situation focusing on market interactions between paper recycling and pulpwood markets. Consumption of both recycled paper and pulpwood increased in the United States and Canada in recent decades and both are projected to increase well into the next century. Harvest of pulpwood on forest land is the largest source of fiber, followed by wood residues and recycled paper. In the United States, wood residue supplies declined during the past decade, but recovery and use of recycled paper increased rapidly. Rapid gains in paper recycling resulted from a combination of market conditions and government policies. Use of recycled paper is projected to increase more steadily in the future with slower growth in paper recovery for recycling. This paper presents projected trends in pulpwood markets associated with projected trends in paper recycling.

North American Paper Recycling Situation

In North America, there was a rapid increase in paper recycling since the mid-1980s. Total recovered paper consumption at U.S., Canadian, and Mexican paper and paperboard mills increased from 17.5 million metric tons in 1985 to around 38.6 million metric tons in 1997 (an increase of 120% in just 12 years; Fig. 1). This paper focuses on trends in the United States, but Canada and Mexico also experienced increased use of recycled paper. In Mexico, use of recycled paper in papermaking rose from 1.6 million metric tons in 1985 to around 3 million metric tons in 1997 (PPI 1997). Canadian consumption rose from 1.1 million metric tons in 1985 to 2.7 million metric tons in 1997 (CPPA 1998), while consumption at U.S. paper and paperboard mills rose from 14.8 million metric tons in 1985 to 32.9 million metric tons in 1997 (AF&PA 1997).

This rapid increase in paper recycling is understood in the United States as a rational response to favorable market conditions, partly influenced by government policies.

In the United States, costs of waste disposal increased significantly in the 1980s and early 1990s, leading to expanded local government programs for collection and recovery of paper for recycling. Increased collection and recovery led to excess supply and depressed prices for recovered paper by the early 1990s. This occurred at a time when pulpwood prices were increasing. These market conditions, especially favorable to recycling in the early 1990s, stimulated investments in new recycling technology. In the past several years, however, waste disposal costs have leveled off as higher rates of recovery were achieved. Use of recycled paper is projected to increase more slowly in the future with slower growth in rates of paper recovery for recycling.

In the United States, local governments (thousands of city and county governments) administer many functions of government, including public school systems, public libraries, and public water and sewage systems. Local governments also generally manage municipal solid waste collection and garbage disposal. By the 1980s, most solid waste was being landfilled or incinerated. However, landfills and incineration were becoming more costly in the 1980s as they became more heavily regulated for environmental and human health reasons. Trends in costs of waste disposal are reflected by trends in average “landfill tipping fees” (fees paid for disposal of waste in landfills). As shown in Figure 2, average landfill tipping fees in the United States increased from $8.20 per ton in 1985 to $32.20 per ton by 1995, according to surveys conducted by the National Solid Waste Management Association (Repa and Blakey 1996). In some densely populated regions, particularly Northeast and Mid-Atlantic states, average landfill tipping fees reached $60 to $70 per ton by 1995 (Repa and Blakey 1996).

As landfill tipping fees increased from the 1980s to early 1990s, local governments were forced to rationalize their budgets, paying more for waste disposal at the expense of other important programs such as public education. Thousands of local communities and also businesses began to divert waste materials from landfills by recovering more materials for recycling. Thus, paper collection and recovery increased significantly in the late 1980s and early 1990s. Because recovery avoids landfill tipping fees, many suppliers could afford to bring recovered paper to market at very low prices. As recovery increased, prices for recovered paper became generally depressed, creating economic incentives for investment in papermaking capacity based on recycled fiber. Expansion in recycling capacity led to greater demand for recovered paper and higher rates of recycling.

Recovered paper markets in the United States were characterized by low prices throughout most of the 1990s, but there was a significant upward spike in recovered paper prices during a brief period from early 1994 to the end of 1995, coinciding with a significant upsurge in U.S. exports of recovered paper. Figure 3 illustrates the historical correlation between U.S. exports of recovered paper and average prices of recovered paper in the United States. It appears that recovered paper price trends have been linked to trends in exports, especially in recent years, even though exports account for less than 20% of total recovery. One plausible explanation for this situation is that the recovered paper market is divided between a more volatile short-term spot market (which determines spot market prices and is linked to exports) and a long-term contract market (which operates on fixed contract terms and is linked more to domestic consumption). The correlated behavior of volatile prices and export volumes in recent years provides some evidence for this type of market structure.

Economic Analysis

Economic analysis in this report is based on the 1998 version of the North American Pulp and Paper Model (NAPAP), an economic model of U.S. and Canadian pulp and paper sectors (an earlier version of the model was described in Ince 1994 and Zhang et al. 1996). The 1998 NAPAP Model is an application of the price-endogenous linear programming system known as “PELPS” that was developed for economic modeling at the University of Wisconsin and the USDA Forest Service, Forest Products Laboratory (Zhang et al. 1993). The model is run in conjunction with the Forest Service TAMM/ATLAS model, which computes equilibrium trends in U.S. lumber and wood panel markets and projects timber growth (Haynes et al. 1995). The 1998 NAPAP Model was carefully tested against historical trends and the model was found to compute fairly accurate annual production and market equilibria from a base year of 1986 to the present. Some of the
figures in this paper show how accurately the model simulates annual production and market equilibria of the past decade.

Since 1970, U.S. production of paper and paperboard increased by 41 million metric tons, while imports and exports each rose by about 6 to 7 million tons. Although recent UN-FAO projections predict declining U.S. exports of paper and paperboard to the year 2010 (FAO 1997), U.S. exports and imports are both projected to increase in the 1998 NAPAP Model after a near-term downturn stemming from the Asian economic crisis. Nevertheless, projected U.S. trade flows remain small relative to domestic production (Fig. 4). United States paper and paperboard imports are projected to increase until around the year 2020 when projected imports level off with slower growth in domestic paper consumption. Imports from Canada, primarily newsprint and printing and writing grades of paper, are projected to remain dominant (Fig. 5). Canadian domestic pulpwood supply is projected to increase, but Canadian pulpwod harvest is projected to decline as Canadian wood residue supplies increase. Wood residue supplies are projected to increase in Canada due to projected increases in Canadian softwood lumber production.

United States production of both paper and paperboard is projected to increase through the year 2020 and beyond (Fig. 6). In the longer term, beyond the year 2020, paper production is projected to gradually level off with maturing market demands, while paperboard production is projected to continue increasing on a fairly linear trend toward the middle of the next century.

The U.S. paper recovery rate (recovery for recycling relative to total paper and paperboard consumption) is projected to increase, but increases in the recovery rate will decelerate as the United States reaches higher recovery and a more balanced equilibrium between recycled fiber supply and demand (Fig. 7). The U.S. paper recovery rate is approaching 50% and will probably reach that level soon after the year 2000. Paper recovery for recycling increased significantly since the mid-1980s, but the NAPAP Model indicates that paper recovery is approaching the upper end of a sigmoid growth trend. A sustained recovery rate above 50% is projected beyond the turn of the century when U.S. recovery of paper for recycling will be in the range of current high rates of recovery in Japan and Europe, but recovery will climb only very slowly above the 50% level.

The amount of U.S. paper and paperboard produced from processes that use 100% recycled fiber is increasing, but production capacity based mainly on virgin pulp is also projected to increase (Fig. 8). The domestic recovered paper utilization rate (ratio of recovered paper use to production of paper and paperboard in U.S. mills) increased significantly during the past decade. The utilization rate is projected to increase much more gradually in the decades ahead with slower growth in equilibrium recovery rates as computed by the NAPAP Model (Fig. 9). Projected increases in U.S. paper and paperboard production coupled with decelerating rates of paper recycling imply increased demand for virgin wood fiber.

**Equilibrium Fiber Raw Material Consumption**

Figure 10 shows historical and projected trends in wood and fiber raw materials consumed annually in the entire U.S. pulp and paper sector during a long time frame. Decelerating growth in equilibrium supply-demand quantities is apparent in the historical and projected trends, attributable to maturing market demands and limitations on fiber supply, but the upward momentum of demand results in robust projections of fiber consumption well into the next century. Imports of fiber (pulpwood and wood pulp) are projected to increase but remain small relative to domestic sources of wood fiber. Use of recycled fiber has increased and is projected to increase at a somewhat slower pace in the future. Use of wood residues (chiefly byproducts of sawmills and plywood mills) peaked in the mid-1980s and is projected to continue declining as the United States relies heavily on imported Canadian softwood lumber, as sawmills and plywood mills become more efficient and generate less wood residues, and as expansion occurs in newer composite wood panel products that do not generate wood residues, such as oriented strandboard (OSB), which is replacing plywood. The U.S. pulpwood harvest is projected to increase in the future, although slower growth is projected in rates of paper recycling and a decline is projected for wood residue supplies.

Softwood pulpwood harvest on forest land is projected to increase as U.S. softwood residue supplies decline. Hardwood pulpwood harvest on forest land is projected to increase for several decades but then de-
cline in the longer run with increasing fiber supply from agricultural short-rotation woody crops. Canada is projected to remain the principal source of U.S. pulp and paper imports, although imports from other countries are also projected to increase. Most Canadian domestic pulpwood supply is projected to remain wood residues, whereas Canadian lumber production and residue output are projected to increase in the future.

As shown in Figure 11, fiber raw material use per ton of pulp, paper, and paperboard production has declined in the United States since the 1950s. A continued gradual decline is projected into the future and is associated with a shifting mix of production technologies and product markets (gradually shifting toward higher levels of recycling and from paper to paperboard, for example). Of particular note is the decline in use of pulpwod per ton of product output, with total domestic pulpwod input (roundwood and residues) declining historically from around 3 m\(^3\) per metric ton in the late 1950s to around 2.3 m\(^3\) per ton today. Domestic pulpwod input (including timber harvest, residues, and short-rotation woody crops (SRWC) supply) is projected to be only about 1.9 m\(^3\) per ton of product output by the year 2020. This declining trend in pulpwod use per ton of product output is partly the result of the continued interaction between paper recycling and pulpwod markets. Recycled fiber use per ton of product output is projected to increase in the future.

U.S. Pulpwood Market Outlook

Historical and projected equilibrium pulpwod supply-demand quantities are shown by region in Figure 12. The South has dominated U.S. pulpwod supply and demand in recent decades, and the South is projected to remain dominant in the future. The South Central region in particular has accounted for the largest share of growth in U.S. pulpwod supply and demand, and the South Central region is projected to account for most projected growth in the future. (States in the South Central region include Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas. Pulpwod quantities discussed in this paper exclude wood use in OSB.)

Increased pulpwod supply and demand in the U.S. South has been associated with increased pulpwod stumpage values since the mid-1980s. Figure 13 shows historical and projected trends in real pulpwod stumpage prices in the U.S. South, comparing hardwood and softwood stumpage prices. In the U.S. South, pulpwod stumpage prices are determined by the market interaction of supply and demand.

Both hardwood and softwood stumpage prices increased in the past decade, but the percentage increase was much greater for hardwood than for softwood (in real prices, hardwood stumpage approximately tripled in value since the early 1980s, and hardwood now exceeds the market value that soft wood pulpwod had 10 years ago). Hardwood and softwood equilibrium stumpage prices are both projected to more than double in the U.S. South in the next 10 years, according to the 1998 NAPAP Model. This analysis is linked to the TAMM/ATLAS assessment of timber growth and timber supply, and results are sensitive to timber growth assumptions in the U.S. South. The Forest Service is in the process of revising and updating RPA timber growth assumptions for private timberlands in the U.S. South, and higher growth assumptions may result in somewhat smaller projected increases in pulpwod stumpage market value.

Projected increases in pulpwod prices indicate that development of hardwood SRWC on agricultural land will become more economically feasible in the future. Hardwood SRWC technology has been applied by a number of U.S. forest product companies, primarily growing hybrid poplars on leased agricultural land with harvest rotations of around 6 to 8 years. Beyond the year 2000, there is a projected increase in U.S. supply of hardwood pulpwod from agricultural lands (hardwood SRWC). Although hardwood SRWC supply is projected to remain relatively small at least until the year 2020, the analysis projects that hardwood SRWC supply will eventually displace a more significant volume of hardwood pulpwod harvest on forest land beyond the year 2020. Figure 14 shows the historical and projected distribution of total U.S. pulpwod supply and indicates that timber harvest will continue to provide the bulk of pulpwod supply for years to come.
Consumption of wood and fiber raw materials in pulp, paper, and paperboard increased in the United States during the past century and is projected to increase gradually in the future at a decelerating rate of growth (Fig. 10). Harvest of pulpwood on forest land in the United States is the largest single source of wood fiber, followed by recycled fiber and wood residues. In the past decade, residues declined in supply while use of recycled fiber increased. Pulpwood harvest is projected to continue increasing as wood residue supplies continue to decline. Recycled fiber use is projected to increase more steadily in the future with slower growth in rates of recovery and utilization of recycled paper.

Based on supply-demand analysis, equilibrium pulpwood stumpage values are projected to increase in the United States, and particularly in the U.S. South. Projected increases in the market value of pulpwood would improve economic prospects for growing SRWC on agricultural land, and fiber supply from SRWC is projected to increase. Harvest of pulpwood on forest land is nevertheless projected to provide the bulk of total U.S. pulpwood and wood fiber supply through the first half of the next century (60% to 70% of total pulpwood supply) as supplies of wood residues are projected to decline. Softwood pulpwood harvest on forest land in particular is projected to increase as supplies of softwood residues decline.

Most future growth in pulpwood equilibrium supply-demand quantities is projected to occur in the U.S. South, and particularly the South Central region. The South is projected to remain the dominant region in pulpwood supply and in production of pulp, paper, and paperboard products. Pulpwood supply and demand quantities are projected to remain relatively static in the U.S. North and U.S. West.

Literature Cited


Figure 1.--Recovered paper consumption at paper and paperboard mills in the United States, Canada and Mexico, 1985 and 1997.

Sources: AF&PA, CPPA, PPI

Figure 2.--National average landfill tipping fees in the United States, 1985 and 1997.

Source: NSWMA
Figure 3.--Annual U.S. recovered paper exports and recovered paper price index.

Figure 4.--U.S. paper and paperboard annual production and trade, historical and projected, 1970 - 2020.
Figure 5.--U.S. annual imports of paper and paperboard, historical and projected, 1970-2020.

Figure 6.--U.S. annual production of paper and paperboard, historical and projected, 1970-2020.
Figure 7.--U.S. rate of paper recovery for recycling, historical and projected, 1970-2020.

Figure 8.--Total U.S. paper and paperboard annual production capacity by type of process, historical and projected, 1970-2020.
Figure 9.--U.S. recovered paper utilization rate, historical and projected, 1970-2020.

Figure 10.--Annual consumption of wood and fiber raw materials in pulp, paper and paperboard production in the United States, 1900-2020.
Figure 11.--Average fiber raw material use per ton of pulp, paper and paperboard produced in the United States, historical and projected, 1900-2020.

Figure 12.--Annual pulpwood equilibrium supply and demand quantities by region in the United States, historical and projected, 1960-2020.
Figure 13.--Historical and projected pulpwood stumpage market trends in U.S. South, hardwood and softwood, 1950-2050.

Figure 14.--Annual pulpwood equilibrium supply quantities by species group and category in the United States, historical and projected, 1960-2020