Pallet Recycling and Material Substitution: How Will Hardwood Markets be Affected?

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Abstract

An estimated 4.53 billion board feet of solid hardwood and 1.79 billion board feet of solid softwood were used in the production of pallets and containers in 1995. When compared to estimates for 1992, the use of both softwoods and hardwoods has decreased. Use for pallets and containers, as a percentage of total lumber production, also decreased for both materials between 1992 and 1995. Decreasing use of new solid wood for pallets can be attributed to stagnant production of new pallets, increased recovery of pallets and pallet material, higher quality pallets, and the use of pallets made from materials other than solid wood. In 1995, 171.1 million pallets were recovered by firms in the pallet industry, a 160 percent increase from recovery in 1992. Eighty-seven percent of the recovered pallet material is used again in a pallet. Pallets also were recovered at landfills, although usually for use in products other than pallets. Plastic and corrugated paperboard pallets have gained some market share previously held by wood. However, the success of these products is usually linked to the total product offered to the pallet user rather than to inherent material superiority. Third-party management systems may result in decreased use of solid hardwood for pallets. overall, the use of new solid hardwoods for pallets is likely to decrease.

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Introduction

This paper discusses trends in the U.S. pallet and container industry and how these trends may affect markets for hardwood lumber. We begin with discussions of new wood use by the industry and the magnitude of this market as compared to other uses of hardwoods. Next, we discuss two of the most important factors affecting hardwood use for pallets: pallet recovery and the use of nonwood materials. Finally, we discuss changes in the industry which may affect the use of hardwoods .

The information provided in this paper concerning new wood use and recycling[1] by the pallet and container industry is based on a series of studies conducted by the Center for Forest Products Marketing and Management at Virginia Tech. The studies investigated activity in 1992, 1993, and 1995. The results are based on surveys of U.S. manufacturers in the pallet and container industry, which was defined to include Standard Industrial Classifications 2441, 2448, and 2449. Information concerning the recovery and disposal of pallets at landfills resulted from a 1995 study of municipal solid waste and construction / demolition waste landfills in the contiguous United States.

Trends in the use of new wood materials

Firms in the U.S. wood pallet and container industry used 4.53 billion board feet (BBF) of solid hardwood in 1995 (Fig. 1). Lumber and cants accounted for 3.87 BBF (85% of the total) and the remaining volume consisted of parts.

A comparison of the results of our 1992, 1993, and 1995 studies shows that the use of hardwood lumber and cants decreased slightly over this period. From 1992 to 1993, estimated use dropped approximately 105 million board feet (MMBF). However, between 1993 and 1995 it increased by 15 MMBF. Overall, from 1992 to 1995 hardwood lumber and cant use decreased by 2 percent based on volume.

The use of hardwood parts increased from 1992 to 1993 by 24 percent but decreased 32 percent between 1993 and 1995. Overall, hardwood part use in 1995 was down by over 100 MMBF compared to use in 1992.

The *1996-97 North American Factbook* (5) lists 1995 U.S. production of hardwood lumber as 11.88 BBF. Using this figure, the volume of solid hardwood use by the pallet and container industry was equivalent to 38 percent of production. Using the same source of production figures, the industry used a volume equivalent to 48 percent of production in 1992 and 46 percent in 1993.

While pallets and containers account for a large proportion of hardwood lumber use (and, in particular, lower grade lumber use), they are not the largest use of hardwoods. For example, fuelwood accounted for 38.5 percent of the volume of U.S. hardwood roundwood harvests in 1991 (6). Sawlogs and pulpwood accounted for 28.6 and 29.5 percent of harvests, respectively. Since pallet and container use accounted for no more than half of the sawlog use and a smaller percentage of pulpwood use, fuelwood was the largest single use of hardwood roundwood harvests in 1991.

One of the advantages of the pallet and container industry-from a wood utilization perspective—is its ability to utilize a wide variety of

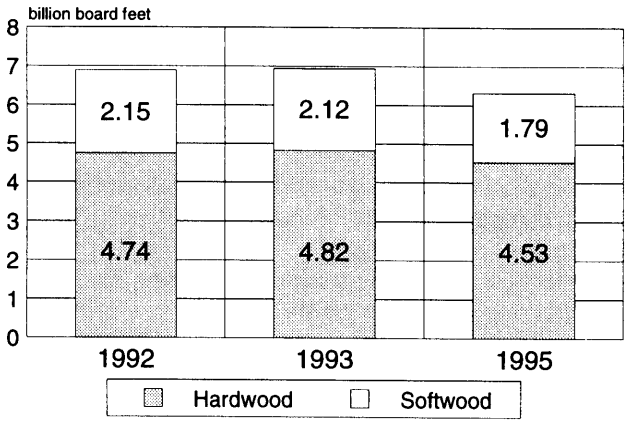

FIGURE 1. Volumes of solid wood used for the production of pallets and containers in the United States in 1992, 1993, and 1995.

[1]Recycling is defined as the reuse of a pallet or the wood in a pallet through inspection and reuse; repair and reuse; chipping for mulch, animal bedding, and furnish; or use as fuel. Activities that result in no useful output (e.g., landfilling, burning without capturing the energy) are excluded. This definition of recycling includes primary, secondary, and tertiary activities and may not correspond to some definitions of the term.

timber species. Among the hardwoods, oak was the most commonly used single species in 1995, accounting for 27 percent of total hardwood use (Fig. 2). Yellow-poplar was the second most commonly used hardwood species (8% of hardwood use). However, the majority of hardwood used by the industry (56%) was not segregated by species and instead was used as mixed hardwoods. The mixed hardwood group includes both select and nonselect species.

Compared to 1992, the use of oak in 1995 as a proportion of total hardwood use decreased over 10 percent. Yellow-poplar and alder use each decreased by approximately 4 percent. Increases occurred in the use of mixed hardwoods and other species.

In addition to hardwoods, the industry uses large volumes of solid softwoods (lumber, cants, and parts). Consumption was an estimated 1.79 BBF in 1995 (Fig. 1). Most of this use (86%) was in the form of lumber and cants rather than parts.

Mirroring hardwood trends, the use of softwood lumber and cants decreased from 1992 to 1993 and increased slightly between 1993 and 1995. Overall, from 1992 to 1995, softwood lumber and cant use decreased by 5.5 percent. During the same period, softwood parts use decreased by 275 MMBF, a dramatic 52 percent reduction. Based on these results, it is clear that solid softwoods are not being widely substituted for solid hardwoods in pallets and containers.

Solid softwood use in 1995 (Fig. 2) was dominated by southern pine (41% of total softwood volume), the Spruce-Pine-Fir group (31%), Douglas-fir (1l%), and the Hemlock-Fir group (10%). The remaining volume of softwoods used by the industry was split among several species including imported radiata pine. When compared to 1992, southern pine use as a proportion of total softwood use was essentially unchanged in 1995. The use of Douglas-fir, however, decreased by over 17 percent.

Unlike hardwoods, pallets and containers do not represent a large part of the market for solid softwoods. With 1995 U.S. softwood lumber production at 32.2 BBF (5), use for pallets and containers was equivalent to only 5.6 percent of total volume. In 1992, softwoods used for pallets and containers represented 6.2 percent of production.

The pallet and container industry uses wood panel products (principally softwood plywood and oriented strandboard) in addition to lumber or solid wood. Much of this use (64% of softwood plywood and 60% of oriented strandboard) is for containers. However, panel deck and even panel block pallets are not uncommon. In 1995, the industry used 187 million $ft.^2$ (3/8-in. basis) of softwood plywood, and 21 million $ft.^2$ (3/8-in. basis) of oriented strandboard.

Trends in the recovery of pallets

The previous sections described recent trends in the use of many types of new wood for pallets and containers. These trends support the belief that pallet production in recent years has been level. They may be attributed to increased recovery of used pallets and pallet parts, to higher quality pallets (which offset greater wood content with longer life), and (to a lesser extent) to the use of pallets made from alternative materials.

Pallet recovery and recycling occurs at several levels in the use cycle. Pallet users, new pallet manufacturers, recycle-only businesses, and landfill operations are all involved. Two segments of this activity were studied:

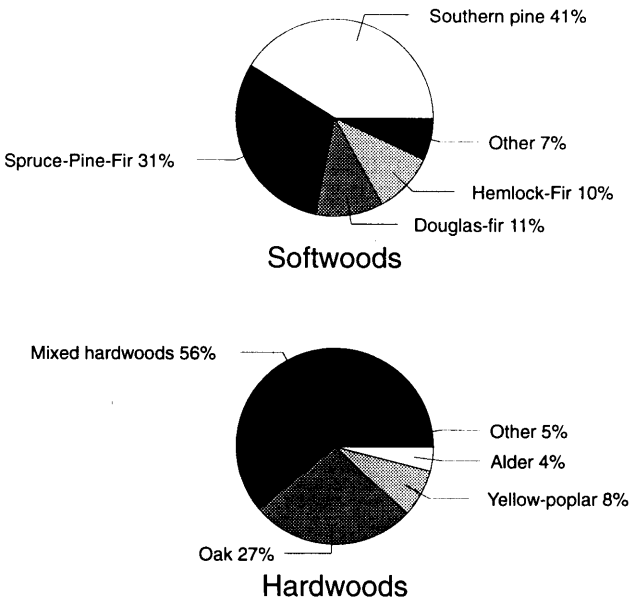

FIGURE 2. Types of solid wood used to produce pallets and containers in the United States during 1995.

- recycling by firms in the industry (Standard Industrial Classification 2448 includes firms primarily engaged in manufacturing wood or wood / metal combination pallets and skids, including firms using new wood and firms using recovered pallet materials); and
- recovery / recycling at landfills.

These segments account for a large percentage of pallet recovery. However, they do not represent all pallet recovery activity. In particular, pallet users may repair and recycle pallets within their operations. Our study did not include this activity.

Recovery and recycling by the pallet industry

Pallet recycling is not a new activity. In fact, the industrial recycling of pallets emerged in the 1960s and grew rapidly in the 1980s and 1990s. In his 1976 book (2), *Wood Pallet Manufacturing Practices,* Eichler states that "The pallet repair and recycling business has now become an integral part of the pallet industry."

However, pallet recovery and recycling, once a secondary or tertiary activity, has in recent years become primary to many firms. The National Wooden Pallet and Container Association reports that pallet recycling is now the most profitable sector of the pallet industry.

Several factors have contributed to the recent, rapid growth of pallet recycling by the industry:

1. Increased awareness of the environment and activities that affect the environment have caused a previously unconcerned public to question the use of new wood for pallets.
2. Pallet producers, concerned with the availability and price of new lumber and cants, have found it economically advantageous to repair pallets and salvage material from used pallets.
3. Pallet users have turned to recycled pallets as a way of decreasing their product handling costs.
4. Pallet disposal costs can be significant, and increasing attention is being paid to reducing or avoiding these costs.
5. Barriers to entry into pallet recycling are relatively low.
6. Public concerns over the capacity and cost of landfills have resulted in some facilities banning pallets.

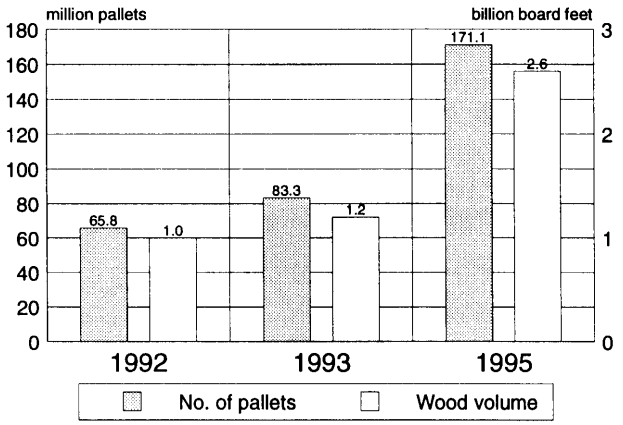

FIGURE 3. Number and estimated wood content of pallets recovered by the pallet industry (SIC 2448) in 1992, 1993, and 1995.

Firms in the pallet industry recovered an estimated 171.1 million pallets for recycling in 1995. The wood content of these pallets was estimated to be 2.6 BBF. Previous studies estimated that the industry recovered 65.8 million pallets in 1992 and 83.3 million in 1993 (Fig. 3). Between 1992 and 1995, the number of pallets recovered by the industry grew by 160 percent.

Eighty-seven percent of the wood contained in pallets recovered by the industry in 1995 was used again in pallets. This amount includes pallets that were salvaged intact or repaired and reused. It also includes the wood content of parts that were dismantled and used to repair pallets or build complete pallets. Less than 1 percent of the wood in pallets recovered by the industry was eventually landfilled.

In 1995 approximately 10 percent of the wood (by volume) in recovered pallets was ground or chipped for nonpallet products such as animal bedding, mulch, and furnish for composite products. A large portion of the ground pallet material, 43 percent in 1995, was used as fuel.

Pallet recovery at landfills

Recycling by firms in the industry constitutes one portion of pallet recycling activity. We investigated another portion by contacting over 1,200 municipal solid waste (MSW) landfills and almost 600 construction and demolition (C&D) waste landfills selected from a list of all state licensed facilities in the United States (excluding Alaska

and Hawaii). We used mail surveys and telephone contacts to collect data rather than the direct examination of waste delivered to landfills. Consequently, we sacrificed some information depth for breadth. We believe this to be an appropriate trade-off, however, as our goal was to estimate nationwide totals.

Approximately 32 percent of responding MSW landfills and 33 percent of C&D landfills do not accept pallets for landfilling without processing. However, 38 percent of MSW and 32 percent of C&D landfills operate a wood/yard waste processing facility. These facilities at MSW landfills processed 880 thousand tons of pallets in 1995. At C&D landfills, 161 thousand tons of pallets were processed. Pallets accounted for approximately 12 percent of the wood/yard waste processed at MSW facilities and 4 percent of wood/yard waste processed at C&D facilities.

Most of the pallet material processed at landfills was ground for mulch, bedding, compost, soil amendments, and fuel (Fig. 4). Some pallets were used as fuel without grinding and some ground material was used as landfill cover. At MSW facilities, 3 percent of the pallets were recovered for reuse as pallets. At C&D facilities, 1 percent were repaired and reused and 12 percent were reused as pallets without repair. Figure 5 summarizes the results of our studies concerning the use and recovery of pallets.

Trends in the use of alternative materials

Solid wood continues to claim the largest share of the pallet materials market. McCurdy and Phelps (4) studied several pallet using industries and found that, in all cases, over 90 percent of the firms used solid wood pallets. A recent article in *Pallet Talk* (1), a newsletter of the National Wooden Pallet and Container Industry, reported that only 15 percent of pallet users used any nonwood pallets. However, pallets made with alternative materials such as corrugated paperboard, plastic, and wood-based panels have increased their share in some markets.

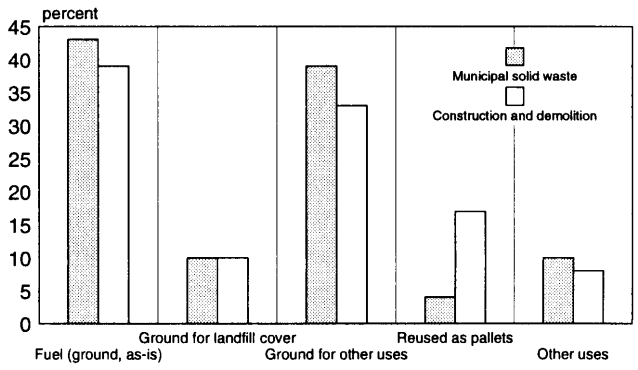

FIGURE 4. Use of pallets received for recycling at municipal solid waste and construction/demolition landfills in 1995.

Plastic

In 1967, Dustin Hoffman as Ben Braddock in "The Graduate" was advised that his future was in plastics. Thirty years later, many would say the same regarding the pallet industry. Indeed, plastic pallets are gaining favor in some market segments. Plastic pallets are used by 20 percent of firms in the meat industry, 17 percent of firms in the food industry, and 12 percent of firms in the construction industry (4). A study conducted in 1994 found that 22 percent of a sample of grocery distribution companies used plastic pallets and 6 percent predicted that they would discontinue the use of wood pallets by 1997 (3). Thirty-seven percent of the companies predicted they would use plastic pallets in 1997.

Plastic pallets are manufactured from a variety of resin formulations (sometimes including recovered materials) and in a variety of designs. plastic pallets, in general, enjoy perceived advantages in quality, durability, cost per use, and handling safety (3). Debating the merits of a particular design or resin formulation, however, is to miss the major reason for the success of some plastic pallets. They are offered as part of a total

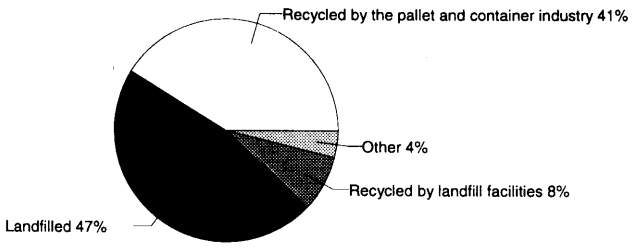

FIGURE 5. Recovery and disposal of pallets in 1995 (percentages based on estimated production of 410.9 million pallets).

particular design or resin formulation, however, is to miss the major reason for the success of some plastic pallets. They are offered as part of a total product that meets users' needs better than wood pallets.

The mistake made by some pallet manufacturers is believing that the needs they serve begin and end with supporting and protecting a load. Some pallet manufacturers (both wood and plastic) have recognized that customer needs may go beyond this point. These manufacturers may offer to buy back pallets at a specific price to eliminate the need for a customer to dispose of the pallets. They may offer a warranty covering broken pallets and they may offer financing of pallet purchases. These manufacturers emphasize the recyclability of the product to serve the buyer's need for a socially acceptable product. They provide pallets that nest (fit together to facilitate storage), meet tight dimensional tolerances so that the pallet will work consistently in automated handling systems, and are lighter than a similar wood pallet, thereby reducing the stress on the employees who must lift the pallet. In short, successful plastic pallet manufacturers view their product as a service to the customer rather than a thing onto which a product is loaded and into which forklift tines are placed.

Many plastic pallet designs are at a disadvantage compared to wood in two areas: racking and purchase price. Some designs are unable to hold an acceptable load at an acceptable deflection when supported on two edges (racking). plastic pallets may cost five times the cost of a similar wood pallet. The former problem can and is being overcome with new designs and changes to racks. The price problem often limits plastic pallet use to systems where users can maintain control of the pallet (e.g., the closed loop from a grocery distributor to captive retail stores). In this setting, however, the value of the total product often outweighs the lost value embodied in the higher price.

Corrugated paperboard pallets

Successful plastic pallet designs have found a niche at the high end of the market. In contrast, corrugated paperboard pallets are developing a niche at the low end where low cost and reduced disposal problems are most important. Accordingly, corrugated pallets are most often found in open-loop systems. McCurdy and Phelps (4) found that fiber (corrugated) pallets were used by 24 percent of firms in the health/pharmaceuticals industry, 6 percent of firms in the construction industry, and 4 percent of firms in the food industry. Engle et al. (3) found that 0.5 percent of grocery distributors used corrugated pallets for shipping dry goods in 1994.

Corrugated paperboard is most often used to construct relatively lightweight pallets and, consequently, they enjoy a perceived advantage in handling safety (3). Their primary advantage, however, is that they greatly reduce disposal and recycling problems. Some users, such as grocery retailers, do not wish to become involved in the pallet business. Ideally, their pallets would be available at minimal cost when needed and "disappear" without effort or cost when not needed. Corrugated pallets come closer than wood to achieving the latter as they can be placed into existing, and often well-established, corrugated recycling systems. Corrugated paperboard, in the form of boxes, is the single most recovered type of paper, both in tons and in the percentage of generation (7).

As with plastic, it is misleading to debate the merits of corrugated paperboard versus solid wood as pallet materials. Each have advantages and disadvantages. Such a debate focuses people on the materials and the real reason for the success of corrugated paperboard in some markets has little to do with load-carrying capability. Corrugated pallets provide a total package of benefits that fits certain users' needs better than do wood pallets.

Third-party management and other trends

Users of pallets often wish to avoid dealing with pallets. Third-party management programs serve this need by providing pallets to users at a set fee. Under this arrangement, users do not need to dispose of or repair the pallets, or pay associated costs. A known and predictable fee reduces their perceived risk and provides convenience. One of the most prominent companies providing this service is Chep USA.

Third-party management companies can affect hardwood demand because they are not tied to wood pallets and they tend to use a high-quality pallet. For example, Chep USA maintains softwood pallets in Europe and has produced softwood and softwood/hardwood combination pallets for use in the United States. Since third-party management companies may contract with manufacturers to have pallets produced, they have the ability to shift relatively easily to alternative materials. Because the large number of pallets that Chep USA controls, a change in materials by this company could have a large effect on hardwood use for pallets. Chep USA is an opinion leader within the industry. Accordingly, the effect could be magnified if other companies followed their lead to alternative materials.

Other changes in the industry affect hardwood use, however the direction of change is not always clear. The trend toward higher quality pallets and toward more multiple-use and fewer limited-use or disposable pallets could reduce the demand for hardwoods. Increased standardization (if it occurs) will lead to efficiencies which are likely to decrease hardwood demand. Company consolidation will result in fewer family-owned businesses with "sawdust in their veins" and more companies which see themselves as providers of materials handling solutions rather than wood pallet manufacturers. Finally, the public's aversion to cutting down a tree for such a lowly product may shift production to nonsolid wood and nonwood materials, even if the environmental impact of using these products is no better than that of wood.

Conclusions

The pallet market remains in transition. Some trends may be dead ends and others may affect the use of hardwoods in ways that cannot yet be predicted. Our time series is short and, as such, unreliable for long-term predictions. Our best guess, however, is that the use of new hardwood material for pallets will decline, although not rapidly. Such a decline will result in greater availability of lower grade hardwoods for markets such as flooring, ties, and furniture. Whether these markets will be able to use the extra material is unknown and will depend on economics.

The most likely scenario is that lumber manufacturers will continue to struggle to find profitable markets for low-grade material as they compete with alternatives. In pallets, as in many wood markets, the only substantive competitive advantage enjoyed by wood will be lower price. This is a real but tenuous advantage that may not last.

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