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Pallet Use in Grocery Distribution Affects Forest Resource Consumption Location: A Spatial Model of Grocery Pallet Use

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Abstract

To assess the impact of grocery pallet production on future hardwood resources, better information is needed on the current use of reusable pallets by the grocery and related products industry. A spatial model of pallet use in the grocery distribution system that identifies the locational aspects of grocery pallet production and distribution, determines how these aspects influence the demand and supply of grocery pallets, and assesses the overall impact of grocery pallet consumption on the forest resource is described. Also presented is a method for estimating the overall quantity of new grocery pallet consumption by grocery distribution centers. This method is useful in assessing the effect of changes in grocery pallet consumption on the hardwood resource in a particular region.

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Introduction

Pallet production quadrupled during the last 2 decades, from 126 million pallets in 1970 to over 504 million pallets in 1989. The pallet industry's use of wood raw material increased from 3.1 billion board feet in 1970 to 7.9 billion board feet in 1989. Hardwood pallets now account for nearly 50 percent of total hardwood lumber production or more than 6.0 billion board feet of hardwood raw material in 1989.

Part of this growth can be attributed to pallet use by the grocery and related products industry. An estimated 75 million hardwood pallets were consumed by this industry in 1989, or more than 1.4 billion board feet of hardwood raw material. Reported growth in retail sales dollar volume of grocery and related products, measured in real dollars, averaged about 2.5 percent from 1980 to 1989. And projected growth in manufacturer's production in the grocery industry, measured in real dollar volume of products shipped, can be expected to equal or exceed this reported growth through 1995.

If current pallet use continues and construction methods do not change, the resulting demand for pallets by the grocery and related products industry might have an uneven effect on the availability and price of the hardwood resource in various regions of the country. Some regions have large quantities of currently under-utilized hardwood resources that are available to meet the needs of increasing demand for pallet raw material (Anderson 1986, 1987). And because raw material costs are a substantial portion of the production cost of pallets, regions that can provide lower cost raw material will have a decided advantage in future pallet production.

To assess the impact of grocery pallet production on future hardwood resources, better information is needed on the current use of reusable pallets by the grocery and related products industry. In this paper, I describe a spatial model of pallet use in the grocery distribution system that can be used to identify the locational aspects of grocery pallet production and distribution, determine how these aspects influence the demand and supply of grocery pallets, and assess the overall impact of grocery pallet consumption on the forest resource.

As an intermediate product, grocery pallets are not demanded directly by the final consumer in the sense that grocery and related products are. However, the final demand for the latter directly affects pallet demand by the grocery distribution system. The link between the final demand for grocery and related products and for pallets is the movement of grocery and related products from point of manufacture to point of retail sales. The distinction between pallet demand and supply points and the movement of pallets between grocery demand and supply points is the key element in understanding the locational aspects of grocery distribution.

Locational Aspects of Grocery Production and Distribution

The location of grocery production and distribution activities within various regions of the country is determined by factors such as regional endowment of resources, production costs for intermediate and final products, transfer costs, and demand for the final products. The relative level of these factors determines the comparative advantage of one region over another, which, in turn, influences both the direction and extent of the growth and development of grocery production and distribution in a region (Nichols 1969). For example, the 1987 Census of Manufactures (U.S. Department of Commerce 1990) reported more than 20,600 establishments that manufacture food and kindred products (SIC Code 20). However, only 33 companies are reported as manufacturing cereal breakfast foods (SIC Code 2043). The 8 largest of these 33 firms account for more than 90 percent of the value of shipments, which are reported to exceed \$6.5 billion in 1987. More important, cereal breakfast food companies in the North Central Region account for more than 70 percent of the value of shipments. Thus, the firms in this region have a comparative advantage over those located in other areas in resource availability, lower costs for raw material inputs, and lower production costs resulting from economies of scale. The comparative advantage for cereal breakfast food manufacturers in the North Central Region results in a concentration of firms in that region.

As shown in the preceding example, grocery production activities often are centered in regions spatially separate from the location of demand for grocery products. Because food production, distribution, and consumption tend to be separated geographically in the food production chain, each stage in processing generates a demand for the movement of products (Fig. 1). This demand is satisfied, particularly in the latter stages, by materials handling devices that include pallets. In relating the demand for movement of grocery products to the demand for pallets, it is necessary to understand how pallets are used within each stage of the chain, that is, by grocery manufacturers, distribution centers, and retail stores.

Grocery Manufacturers

In the initial stage of grocery production, raw materials frequently are shipped to manufacturing facilities using bulk material handling devices other than pallets. However, finished products leaving the manufacturing facility are moved almost exclusively on pallets. This means that the more than 20,600 establishments that manufacture food and kindred products are all pallet demand points or potential purchasers of new pallets.

An example of raw material movement is the shipment, by railcar, of bulk grain products from grain elevators in the North Central Region to Kellogg Company in Battle Creek,

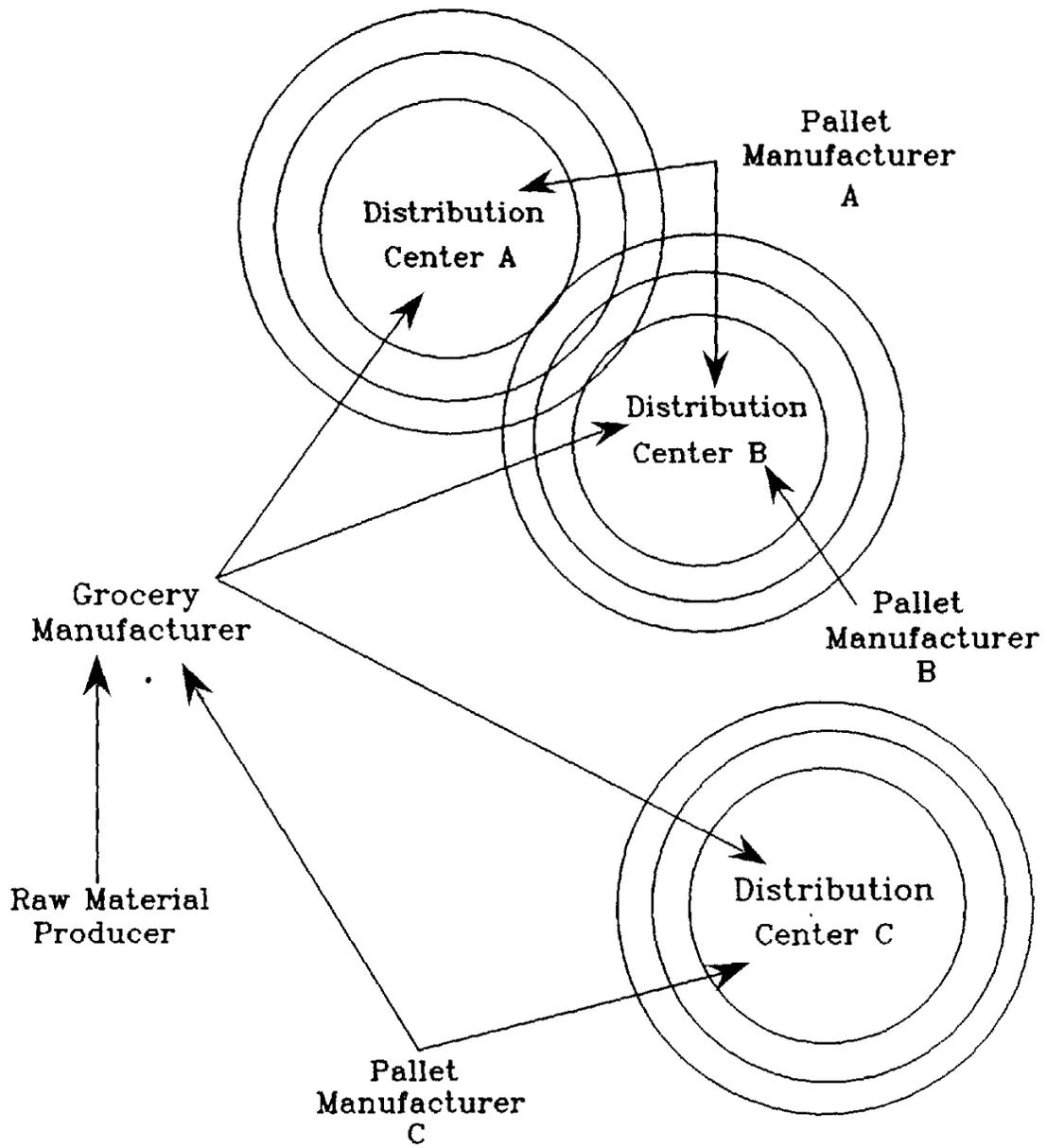


Figure 1.—Product movement in grocery distribution.

Michigan, and Ralston Purina Company, in Cincinnati, Ohio, both manufacturers of cereal breakfast foods located in the North Central Region that distribute their products nationally. Finished products leaving these two manufacturing facilities are shipped on pallets to grocery distribution centers throughout the country.

An exception to this movement of finished products on pallets directly to distribution centers is found with grocery and related products manufacturers that maintain regional warehouses, spatially separated from their manufacturing facility, from which products are supplied to grocery distribution centers. Examples of these include General Foods, Morton-Norwich, and Quaker Oats Company. Thus, the shipment of a palletized product from grocery manufacturer to grocery distribution center may involve a transshipment through a grocery manufacturer's regional warehouse. But the shipment is originally palletized at the grocery manufacturing facility (the pallet demand point) and the palletized product moves through the manufacturer's regional warehouse without being unloaded from the pallet. Thus, movement of grocery and related products to grocery distribution centers requires the same number of pallets even though the palletized product may not proceed directly from a manufacturer to a grocery distribution center.

Grocery Distribution Centers

The 1990 Progressive Grocer's Marketing Guidebook (1989) identifies 373 distribution centers located throughout 53 areas of the country. These distribution centers, along with the grocery manufacturing facilities, are pallet demand points or potential purchasers of new pallets. The location of these grocery distribution centers is independent of the location of grocery manufacturing facilities in terms of transfer costs using pallets and the demand for grocery products. However, both the demand for grocery products and the cost of transportation are critical in determining the location of grocery distribution centers.

The demand for grocery products must be sufficient to justify the investment needed to operate a distribution center. From values reported by Kaylin (1968), adjusted to reflect current prices, it is estimated that a distribution center can be operated profitably with the value of products shipped by the center as low as \$20 to \$26 million annually. Thus, the retail stores served by the distribution center must be expected to generate sales equal to or exceeding this range to justify establishing a distribution center in a particular location. However, transfer costs place a limit on the area that can be profitably served by a distribution center. The maximum distance that a retail store can be located from a distribution center and still be profitably served varies according to the transfer costs for each distribution center. However, Kaylin (1968) noted that 150 miles is the average limit on distance between distribution center and retail store to maintain acceptable ratios of expense to total volume of products transported. Industry sources indicate that this distance is still valid in

transportation of grocery products to retail stores in the current market, particularly in the eastern half of the United States (Anderson 1988).

Shippers of grocery products must consider the full transport cost and not just the freight rate. The full transport cost is the freight rate plus any nonprice costs associated with the service quality offered by the mode of transportation. These characteristics include speed, reliability, flexibility regarding scheduling, routing, shipment size, load-handling and monitoring characteristics, and claims handling procedures (Beilock and Casavant 1984).

The magnitude of the full transport cost is determined by the cost and availability of a dependable and flexible transportation system, the cost of labor and other materials handling techniques, and the distances between shippers and receivers. To minimize transport costs and maintain the flexibility required in grocery distribution to retail stores, most distribution centers maintain their own fleet of trucks, commonly referred to as a captive fleet. However, products are shipped to the distribution center by common carrier truck, captive fleet truck, or railcar, depending on cost efficiencies.

Retail Stores

The final link in the grocery distribution system is the retail store that provides grocery and related products to the consumer. While retail stores are demand points for the movement of grocery products, they are not directly demand points for pallets. Palletized products are shipped to retail stores to satisfy consumer demand for grocery and related products. At the retail store, products are moved from the pallets onto retail shelves. Empty pallets are returned from the retail stores to the distribution center where they are recycled for further shipments of products to retail stores.

The locations of retail stores served by each distribution center can be illustrated as a circle around each distribution center (Fig. 1). In reality, the distance of retail stores from the distribution center is not as uniform as the distance from the center of the circle to its circumference; however, the circle serves to indicate the geographic area within which a distribution center operates. Distribution centers may serve some retail stores located in the same geographic area, which can be illustrated by overlapping circles. However, few distribution centers serve retail stores in exactly the same geographic area even though their service areas frequently overlap.

It is important to note that retail stores typically are served by a single distribution center. Thus, even though retail stores are located in the same geographic area, they may or may not be served by the same distribution center; whether they are or are not depends primarily on the corporate affiliation between the retail store and the distribution center.

Locational Aspects of Pallet Production and Distribution

In general, pallet manufacturers are located near the purchaser of their pallets, primarily because of the limits that transportation costs place on pallet distribution. The average limit on the distance between pallet manufacturer and purchaser is 50 miles.¹ However, the average distance between distribution centers within the same corporate organization is approximately 300 miles based on the fact that distribution centers may serve retail stores located 150 miles away. Thus, it is likely that a pallet manufacturer serving one distribution center in a corporate chain like Kroger would not serve another distribution center in the same chain.

Pallet Supply and Demand Points

Pallet supply points are identified by the location of pallet manufacturers that produce grocery pallets. Although 2,470 pallet manufacturers were reported in a recent survey,² the number of pallet manufacturers actually producing grocery pallets is not available but is considered to be less than the total number of pallet manufacturers in the industry. The market for grocery pallets is considered to be highly competitive primarily because pallet manufacturers have considerable ease of entry and exit in the market for grocery pallets, and the technology for producing pallets is relatively constant regardless of the type of pallet produced.

Grocery pallet demand points are identified by the location of grocery manufacturers and distribution centers that use pallets to move and store grocery and related products. The 373 distribution centers identified earlier are considered pallet demand points in that they all use pallets to move and store grocery products within the distribution center warehouse and to distribute products to retail stores. In addition, the location of these distribution centers can be specified by region and by market area within a region.

On the other hand, the more than 20,600 grocery manufacturers can be identified only as potential pallet demand points. The number of grocery manufacturers actually using pallets is not known, and the locations of grocery manufacturers that use pallets cannot be identified as precisely as with distribution centers. This creates a major obstacle in determining grocery pallet demand and identifying forest resource consumption based on the demand for grocery pallets.

The movement of grocery and related products from grocery supply points to grocery demand points generates the demand for grocery pallets at each point of shipment origin. Had this demand for grocery pallets been satisfied by supply of grocery pallets from pallet manufacturers each time the demand occurred, a simplified demand model would have been possible. However, grocery pallets are considered a durable input to the production and distribution of grocery products, that is, there is an inventory quantity of pallets in the grocery distribution system. While an aggregate level of demand for grocery pallets results from the movement and storage of grocery products, the demand for new grocery pallets supplied by pallet manufacturers is a function of the quantity of pallets available in the system and the overall level of aggregate pallet demand. The circular nature of pallet flows in the system is indicated simply because grocery pallets are recycled through the system so long as they remain in serviceable condition.

Forest Resource Consumption

To assess the effect of new grocery pallet demand on forest-resource consumption, the quantity of new pallets entering the grocery distribution system must be known. However, neither the quantity of new grocery pallets nor the total inventory quantity of pallets in the grocery distribution system can be identified from published data. It is possible to estimate the quantity of new grocery pallets consumed based on assumptions about the relation between the dollar value of retail grocery sales and the quantity of pallets in inventory (Anderson 1988). Based on these estimates of new grocery pallet consumption, the 1.4 billion board feet of hardwood raw material used to produce grocery pallets in 1989 represents more than 23 percent of the estimated 6.0 billion board feet of hardwood raw material consumed in the manufacture of all types of pallets.³

Consumption of pallets by the grocery distribution industry is important in overall new pallet production, but it has a disproportional effect on the hardwood resource in relation to the quantity of grocery pallets consumed. With more than 23 percent of the total hardwood consumption for all types of pallets attributed to the manufacture of grocery pallet parts, the effect on the hardwood resource in a particular region resulting from changes in grocery pallet consumption can potentially be greater than that resulting from changes in the consumption of other pallet types, particularly those produced from softwood raw material. However, until more precise estimates of the regional production levels for pallets of all types are available, such a comparison cannot be quantified.

¹Anderson, R. B., and Wisdom, H. W. 1990. Pallet inventory estimation for the grocery distribution system. (In preparation)

²Emanuel, D. M. 1985. Wooden pallet manufacturers. Unpublished report on file at USDA Forest Service, Northeastern Forest Experiment Station, Rt. 2, Box 562-B, Princeton, WV 24740.

³Wallin, W. B. 1977. Characteristics of the U.S. pallet industry. Unpublished report on file at USDA Forest Service, Northeastern Forest Experiment Station, Rt. 2, Box 562-B, Princeton, WV 24740.

Summary

To determine the effect of demand for new or reconditioned pallets used in grocery distribution on forest resource consumption, one must first consider how pallets move through the grocery distribution system. The movement of pallets between grocery demand and supply points does not represent trade in pallets but rather the utilization of pallets. The trade is in grocery items. As a result of grocery trade, pallets move from place to place, thereby influencing the net demand for pallets at a given point. It is the geographic movement of pallets in the course of their use that makes the estimate of pallet demand unique from, say, the demand for construction lumber where the demand for lumber at one point cannot be satisfied by the supply of lumber at another point.

The movement of food from place to place influences the demand for pallets at each point of shipment origin, which may be either a grocery manufacturer or a grocery distribution center. If at each point of shipment origin the supply of pallets from incoming cargo, including pallets involved in backhaul shipments, is inadequate to handle outgoing cargo, the deficit must be met by new or reconditioned pallets.

Estimation of the overall quantity of new grocery pallets consumed is possible based on assumptions about the relation between the dollar volume of retail grocery sales and the quantity of pallets in the grocery distribution system's inventory. Although the regional impact on forest resource consumption attributable to new pallet consumption by grocery distribution centers can be identified, this is only a partial solution to the identification of regional forest resource consumption resulting from grocery pallet production. Additional information is necessary to include the impact on forest resource consumption from pallet demand by grocery manufacturing facilities. Once this information is developed, it will be possible to estimate the effect on the hardwood resource in any region that results from changes in grocery pallet consumption.

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