Ban on landfiling of wooden pallets in North Carolina: an assessment of recycling and industry capacity

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1. Introduction

Pallets play an important role in today’s economy by aiding in efficient and reliable transportation of goods. Pallets are rigid horizontal platforms that are easily portable by special equipment. They serve for storing, stacking, handling and transporting goods as a unit load [1]. A unit load describes “a single item, a number of items, or a bulk material, that is arranged and restrained so that the load can be stored, picked up, and moved between two locations as a single mass [2, p. 8]”. Without pallets, many products would have to be manually lifted and kept together, resulting in higher handling costs or the necessity to use other, more expensive devices, thus increasing economic transaction costs.

Different materials are used for the production of pallets, such as solid wood, wood-based composites, paper, plastic and metal. While material preferences vary based on performance requirements and costs, solid wood pallets account for an estimated 90–95% of all pallets in use in the U.S. [3]. Low material and production costs combined with the relative abundance of solid wood are major reasons for wood’s dominance. In fact, the pallet industry often represents a critical market for the lower grades of hardwood lumber produced by sawmills, which might otherwise be difficult to sell. Other materials are used for technical or regulatory reasons. For example, the grocery industry uses plastic pallets to conform with sanitary regulations, while metal pallets are used in closed loop material systems for their durability.

Pallet size standards vary widely throughout the world. In Asia, the most widely used pallet size is 1100 × 1100 mm, in Europe 1200 × 800 mm (called a Euro pallet) and in the U.S. 1219 × 1016 mm (48 × 40 inches). The International Organization for Standardization (ISO) guideline 6780 [4] concerning flat pallets for intercontinental materials handling lists six sizes (the three mentioned before and 1067 × 1067 mm, 1140 × 1140 mm and 1200 × 1000 mm) as the accepted standard for intercontinental material handling. White [5, p. 5], realizing the logistical problems created by six different sizes, pointed out that six is “five too many”. In contrast, U.S. companies rely on more than 400 different pallet sizes [5], with the 48 × 40-inches pallet being the most common [6]. Indeed, because of the varying size standards, unit loads often need to be unloaded and reloaded at borders of destination countries to accommodate local pallet size standards [7].

However, due to the lack of standardization and efficient pallet cycling systems (e.g., unload incoming material and reload with outgoing material), large numbers of pallets become unusable well...
before the end of their potential time of obsolescence and are discarded in landfills, ground into mulch, used for boiler fuel, or left to rot. In the U.S., an estimated 450 million new pallets are produced annually [3] and 1.9 billion pallets are in use at any moment in the U.S. [8], most of them wooden pallets. Thus, the U.S. pallet stock is replenished every four years, leaving the pallet industry and end-users with a large amount of material, mostly wood, to dispose of.

To produce 450 million new pallets annually, the pallet industry consumes vast quantities of resources. In 2005, it was estimated that 33% (3.8 billion board feet) of the total hardwood lumber produced in the United States was used for pallet manufacturing, making it the single largest use of hardwood lumber [9]. It is also known that wooden pallets represent 2% of all Municipal Solid Waste (MSW) and over 3% of all Construction and Demolition Waste (C&D) landfilled [10,11]. Technologies exist that allow for reusing and recycling of these discarded pallets, thereby improving the use of harvested forest resources and landfill space, creating opportunities to produce value added wood products, and adding employment opportunities to rural economies [12].

Wood, an environmentally friendly, sustainable and versatile raw material [13–15] with uncounted fields of applications [16], is easily recycled [17,18]. Landfilling discarded pallets thus is not foreordained [12]. Recycled products from wooden pallets include remanufactured pallets [19,20], wood flooring [21,22], wood-cement panels and bricks [23,24], mulch [25], boiler fuel [26,27] and alcohols like ethanol [28,29]. The increasing demand for cement panels and bricks [23,24], mulch [25], boiler fuel [26,27] and alcohols like ethanol [28,29]. The increasing demand for pallets, thereby significantly lowering the amount of wood that is used for mulch or boiler fuel [37]. Thus, 282,000 tons of wood were either used as fuel, mulch, or disposed of in landfills. Yet, many of the pallets that are discarded need only minor repairs to be reusable or can be easily disassembled and recycled into new pallets, thereby significantly lowering the amount of wood that is discarded. North Carolina, like many other states, faces limits on landfilling space due to more stringent environmental restrictions and a more critical public. Thus, the state is working on legislation that would reduce the amount of materials landfilled in the future.

The average pallet recycler in North Carolina employed nearly 34 people and recycled approximately 326,000 pallets per year (Table 2). Plants ran at an average capacity utilization rate of 58.3%, assuming that the average capacity was approximately 559,000 pallets per year. While the variance was quite large for both the recycling and capacity distributions (Table 2), and the median was somewhat lower than the mean for both distributions (132,500 and 190,000, respectively), the skewness values for both distributions were not substantial (i.e., less than 2.0). Further, only three of the largest values in the recycling distribution and one in the capacity distribution were classified as mild outliers (using the typical definition of $1.5 \times$ the interquartile range or IQR) and none were considered extreme outliers (typically defined as $3.0 \times$ the IQR). Thus the mean was considered a reasonable measure of central tendency.

Of the pallets received for processing, responding firms indicated that, on average, 20% were reused, 45% were refurbished, 19% were recycled and 15% were ground (Table 3). Interestingly, when measured as a proportion of total pallets recycled by respondents, the figures are similar to the firm averages, although reuse volume is slightly lower than the firm averages, while the remaining pallets were either used as fuel, mulch, or disposed of in landfills. The remaining pallets were either used as fuel, mulch, or disposed of in landfills.

### 3. Results and discussion

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average (suggesting smaller firms are engaged more in reuse), and recycling volume is slightly higher than the company average (suggesting that larger firms are more engaged in recycling). More than 70% of the residual material was converted to either mulch or boiler fuel (Table 4), with larger companies engaged more in mulch production and smaller companies engaged more in boiler fuel production.

Seventy-seven percent of all pallets resold are furnished to manufacturing industries, followed by private customers (8%) and food retailers (8%). Over 85% of respondents indicated that they could sell more pallets if they were available. Of these 29 companies, over half indicated they could sell at least 50% more than current volume.

Nearly 56% responded that a landfill ban on pallets in North Carolina was a good idea, with 18% each indicating it was not a good idea or that they did not care (Table 5). The remainder (9%) had other ideas or opinions, ranging from surcharges on pallets to mandatory grinding of pallets. Thus, pallet recyclers were not unanimous in their favorability toward a ban on pallets in North Carolina’s landfills. There was general agreement from comments that nearly 56% of the companies surveyed plan to expand their recycling volume over the next few years.

Results from this survey suggest that the NC pallet industry could recycle more pallets than it does at present: by extrapolating from the study sample, approximately 33.6 million pallets (range of 20.1–47.1 million based on the 90% confidence interval) are recycled each year in North Carolina with a full capacity of 57.6 million pallets (range of 34.6–80.6 million), or 58% average capacity utilization. If the recyclers ran closer to 80% capacity, then nearly 46 million pallets potentially could be recycled. Given that nearly 56% of the companies surveyed plan to expand their pallet recycling capacity in the near future (Table 2), North Carolina could soon be recycling close to 50 million pallets a year. In fact, nine companies stated that they intend to at least double their capacity in the near future. Given the existing capacity and plans for expansion of the pallet recycling companies surveyed and the ease of implementing additional recycling capacity, a ban on landfilling pallets would not seem to lead to an overburden on recyclers.

The capacity utilization rate found in this study is well below the historical (1972–2006) overall industry average (81%) [39]. The pallet industry’s low capital investment into plant and equipment and the low training costs for their employees help explain this observation. When capital and training investment in plant, equipment and labor are low, an industry (company) can afford to have excess capacity without paying a steep financial penalty. Most workstations in the typical pallet recycling operations are relatively simple. Thus, the industry can afford to have excess capacity, an observation that was confirmed by this study. Pallet recyclers, thus, can expand their production volume by increasing their utilization rate with relatively little financial and human resources investment, allowing them to absorb a potential surge in volume in the near term.

Conversations with industry participants brought to the forefront that their concerns are not with manufacturing capacity issues, but a general uneasiness about the market for recycled pallets. Industry participants fear that prices for recycled pallets could drop with an increase of recycled pallets coming to the market. However, several recyclers also pointed out that opportunities might arise regarding the pallet “disposal” fees charged to industry, as landfilling will no longer be an option.

A ban on pallets would alleviate some of the strain on NC’s available landfill space. A ban might also stimulate increased recovery of the value of the material contained in used pallets. Depending on the quality and the size of a pallet, recyclers may either charge users to pick up used pallets, pick them up for free, or pay up to $1.50 for good quality, standard size pallets. Assuming a median selling price of $4.75 per recycled pallet (prices range from $3.00 to $6.50 according to various industry participants), the industry’s current annual business volume (based on a recycling volume of 33.6 million pallets) is nearly $160 million, excluding the value generated from products made from ground pallets. Assuming that roughly 50% of pallets in North Carolina are recycled today, the industry potentially could grow to over a $300 million business over the next few years.

### 5. Subsequent outcomes and conclusion

On September 7, 2005, approximately two years from the onset of this study, North Carolina enacted House Bill 1465, which is “an act to prohibit the disposal of motor oil filters, rigid plastic containers, wooden pallets, and oyster shells in landfills” [40]. This law will take effect on October 1, 2009.

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2 From data provided by respondents (Table 2), a ratio of 9682 recycled pallets per employee per year was developed. Assuming there were 103 pallet recyclers with an average size of 33.7 employees, there were approximately 3471 total employees. Multiplying total employment (3471) by the ratio of pallets recycled per employee (9682) resulted in 33,606,222 recycled pallets.
While debating the proposed ban in the NC legislature, homebuilder-related interests sought to obtain an exemption to the ban for builders. Their argument goes that small builders doing small jobs would face challenges finding an outlet for their pallets used on the job site. The legislature agreed with this exception. At the same time, the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Pollution Prevention and Environmental Assistance, has started cooperating with local C&D landfills to collect and recycle those pallets at the landfilling sites.

Two large pallet recyclers in NC were visited in December 2007 to review their preparations and concerns about the landfill ban. Only one operation was aware of the upcoming ban; the other operation had not yet heard of this ban. However, both pointed out that they are not concerned about the pallet ban, as their operations are flexible enough to adapt. However, one pointed out that smaller operations do not have the financial resources to deal with the unusable pallet parts, may still need to landfill those unusable parts. With pallet parts still being accepted at C&D landfills, there should be an alternative for those industry participants. Ultimately, time will tell what impacts the NC pallet ban will have on the pallet recyclers and on the overall pallet industry in the state. However, based on available data and observations, recyclers should be positioned to deal with the increased volume once those pallets can no longer be discarded at a landfill.

Actions relating to addressing climate change, as well as increasing energy costs, are introducing a new dynamic into the issue of landfills as natural resources such as wood fiber from discarded pallets. While wood covers up to 90% of total energy demand in some developing nations, it provides only 2% of total energy demand in developed nations. Plans for CO2 emissions reductions, especially in Europe, call for significant increases in the use of wood (biomass) as a fuel. As a consequence, demand for wood chips and pellets has increased throughout the world, including the U.S.

Table 4

<table>
<thead>
<tr>
<th>Product</th>
<th>Percent (mean) by company</th>
<th>Percent of total volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler fuel</td>
<td>42.6</td>
<td>22.0</td>
</tr>
<tr>
<td>Mulch</td>
<td>29.6</td>
<td>48.2</td>
</tr>
<tr>
<td>Animal litter</td>
<td>0.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Other</td>
<td>27.7</td>
<td>29.3</td>
</tr>
</tbody>
</table>

Table 5

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Percent of respondents</th>
</tr>
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<tbody>
<tr>
<td>Good idea</td>
<td>55.9</td>
</tr>
<tr>
<td>Do not care</td>
<td>17.6</td>
</tr>
<tr>
<td>Not a good idea</td>
<td>17.6</td>
</tr>
<tr>
<td>Other ideas or opinions</td>
<td>8.8</td>
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</tbody>
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and provide new opportunities for the increasing supply of recycled pallet material in North Carolina and elsewhere.

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