Where have all the logs gone? A spatial analysis of timber exportation in Illinois

Eric M. White 1, Andrew Carver, and John Phelps

ABSTRACT

The southernmost 43 counties in Illinois produced 157,216 mcf of sawtimber in 1996, 74% of the total sawtimber production in Illinois. Data suggests that 65.4% of this sawtimber production is exported to neighboring states for processing. This loss of potential value-added creates the basis for this study. A 147-county study area was delineated from an ellipse centered on southern Illinois. A spatial data layer of FIA and TPO data was created for counties within the study area. Statistical comparisons were completed for two adjacent Forest Survey Units in Illinois. A GIS was used to quantify the distribution of timber mill procurement influence throughout the study area. Analysis suggests that the distribution of mill influence throughout the study area is not uniform, with discrete zones of high procurement influence occurring in Missouri and Indiana. Counties located in Illinois are under moderate to high levels of out-of-state procurement influence. This out-of-state procurement influence, coupled with lack of in-state processing facilities, may lead to increased rates of exportation from Illinois.

The southern Illinois region is commonly defined as those counties within and to the south of the Interstate-64 corridor. The economy of this region has long been based upon natural resource extraction and traditional agriculture. Timberland within southern Illinois can be typified within the broad category of oak-hickory forest. This forest type produces timber that is widely used as grade lumber and in secondary processing firms in the production of flooring, moldings, cabinetry, furniture etc. A 1993 study by McCurdy and Phelps listed 51 sawmills operating within the southernmost 23 counties of Illinois region in 1987 (McCurdy and Phelps 1993). Data collected by Pye and Prestemon (1999) in the late 1990’s found 29 sawmills operating within this same region.

While a moderate volume of timber is currently being harvested from the southern Illinois region, much of it is being exported for processing. Hackett and Sester (1998) quantified the extent of sawlog exportation for three Forest Survey Units within Illinois: Prairie Unit, Claypan Unit, and Southern Unit. Of interest to this study are the exportation rates of the Claypan and Southern Units. In 1996, the 43 counties composing the Claypan and Southern Forest Survey Units produced a combined 26,337 thousand cubic feet of sawtimber, 74% of the state’s total production (Hackett and Sester, 1998). The exportation rate of the Claypan and Southern Units is 65.4% of the total sawlogs harvested. The Southern Unit contributes a substantial exportation rate of 46.5% to this total rate of exportation (Table 1). This loss of in-state processing through exportation represents a loss of potential value-added to the regional economy. Capturing this value-added would potentially yield increases in regional employment, earnings, and economic multipliers (Kroenke et al. 1996; Marcouiller et al. 1995; Janke and Deller 1995).

The exportation rates from Illinois give rise to two general questions: 1) What factors may contribute to the substantial volume of timber being exported from Illinois, and 2) What factors may contribute to the divergence in rates of exportation for two adjacent Illinois Forest Survey Units?

In an effort to answer these questions, this study has the following specific objectives:

1. To build a geo-referenced database of forest resources and timber production in southern Illinois and the surrounding region
2. To determine what biological and timber production differences exist between the Claypan and Southern Units within Illinois
3. To use a GIS to quantify the influence of mill procurement zones within the study area

METHODS

The study area was delineated via an ellipse having a maximum radius of 180 miles. The centroid of the ellipse was Johnson County, Illinois. Any county through which the ellipse passed was included in the study area. In total, 147 counties from the states of Illinois, Missouri, Indiana, and Kentucky were included (Figure 1). Utilizing an ellipse as opposed to a traditional circular study area created the means to

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Illinois where the economy is based primarily on agriculture, and 2) exclude counties located in Tennessee for which Hackett and Sester did not identify any sawlog exportation.

Forest Inventory and Analysis (FIA) and Timber Product Output (TPO) data were obtained from the Southern Research Station for all 147 counties. Only those variables measured at the county level and related to forest characteristics, timberland ownership and extent of timber production were of interest. The TPO and FIA variables of interest were transferred into 4 state-specific databases. These databases (in dBASE IV format) were joined to the spatial database of counties within the study area using ArcView 3.2. ANOVA was used to test for statistical difference (df= 42, alpha=0.05) between those counties located within the Claypan Unit and counties within the Southern Unit. Six null hypotheses were developed that related to differences between the Claypan and Southern Forest Survey Units. Null hypotheses were designed to test for differences related to timberland classification, extent of desirable forest-type (oak-hickory), site production capacity, and the extent of timber volume harvested.

A spatial data layer depicting the location of timber mills within the study area was created from a Pye and Prestemon (1999) database. A 100-mile radius of procurement was delineated for each timber mill in the study area. The density of mill procurement zones was calculated throughout the study area within the GIS environment. The resulting map depicted the spread and dispersion of timber mill procurement influence throughout the study area.

RESULTS

Creation of a geo-referenced database of FIA and TPO data created the opportunity for the analysis of 66 variables within a spatial environment. The FIA data that perhaps best describes current and potential opportunities for forest operations are 1) volume of growing stock per county, and 2) site classification (or site production potential). Figure 2 depicts the distribution of growing stock throughout the study area. Moderate to high volumes of growing stock are present in southeastern Missouri and south-central Indiana. Moderate volumes of growing stock occur throughout much of Illinois and southwestern Kentucky.

The site classification (production potential) for counties within the study

<table>
<thead>
<tr>
<th>FOREST SURVEY UNIT</th>
<th>SAWLOG PRODUCTION</th>
<th>INDIANA EXPORT</th>
<th>KENTUCKY EXPORT</th>
<th>MISSOURI EXPORT</th>
<th>TOTAL EXPORT</th>
<th>PERCENT EXPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLAYPAN UNIT</td>
<td>98,634</td>
<td>1,467</td>
<td>0</td>
<td>559</td>
<td>2,026</td>
<td>18.9%</td>
</tr>
<tr>
<td>SOUTHERN UNIT</td>
<td>58,582</td>
<td>10,967</td>
<td>5,533</td>
<td>10,850</td>
<td>27,350</td>
<td>46.5%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>157,216</td>
<td>12,434</td>
<td>5,533</td>
<td>11,409</td>
<td>29,376</td>
<td>65.4%</td>
</tr>
</tbody>
</table>

Adapted from Hackett and Sester, 1998
Figure 2. Volume of growing stock (mmcf)

Figure 3. Moderate to high production potential (thous. acres)

Figure 4. Current levels of harvest
area is depicted in figure 3 as the acres of timberland (in thousands) per county reported as being able to produce greater than 50 cubic feet/acre/year. Missouri counties have substantially less acreage producing greater than 50 cubic feet/acre/year than Illinois and Indiana. Current timber harvesting levels within the study area are depicted in figure 4. Harvesting levels throughout the region vary greatly (a range of 10,383 cubic feet). Only 12 counties harvested greater than 3130 mcf of timber annually. Moderate volumes of timber are being harvested throughout much of Indiana, Kentucky and Missouri. The current timber harvest volumes in Illinois are low.

ANOVA was used to describe differences between the two Forest Survey Units within Illinois—Claypan Unit and Southern Unit. Table 2 lists the variables for which the null hypothesis of equality was rejected. All significant differences are in the direction of the Southern Unit. Table 3 lists those variables for which the null hypothesis of equality was not rejected. These results suggest that no statistical differences exist between the Claypan Unit and Southern Unit in relation to the extent of quality/desirable timber species and/or the volume of timber harvested; suggesting that factors related to quality or desirability of timber species do not contribute to the divergence in exportation rates between the two Illinois Forest Survey Units.

The distribution and influence of timber mills within the study area was analyzed using a GIS. There are 511 mills operating within the study region; the majority of which are classified as “sawmills” (Figure 1). The density of timber mill procurement influence throughout the study area is depicted in figure 5. Areas classified as being “high density” are those areas that are under substantial procurement influence from timber mills. Those areas that are classified as “low density” describe portions of the study area that have little procurement influence.

Table 2. Significant results of ANOVA

<table>
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<th>VARIABLE</th>
<th>F-STATISTIC</th>
<th>P &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIMBERLAND</td>
<td>4.66</td>
<td>0.03</td>
</tr>
<tr>
<td>VOLUME GROWING STOCK</td>
<td>5.00</td>
<td>0.03</td>
</tr>
<tr>
<td>PERCENT OF LAND CLASSIFIED TIMBERLAND</td>
<td>17.34</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Two discrete areas of high density emerge: 1) southeastern Missouri; 2) southwestern Indiana. Moderate levels of procurement influence spread out from these discrete areas into Illinois and Kentucky. A substantial area of low-density procurement influence exists in the northern portion of the study area.

CONCLUSIONS

Ageo-referenced database of forest and harvesting characteristics creates the opportunity for spatial analysis of harvesting trends and opportunities for forestry operations. Illinois has less land acreage classified as timberland and a smaller volume of growing stock compared to Indiana and Missouri. However site production classification numbers suggest that Illinois counties have the capacity to produce a great volume of desirable tree species. The majority of Illinois counties included in the study have low volumes of timber being harvested compared to other counties; suggesting that Illinois counties are capturing very little of the potential timber resource.

No significant differences were found between the Claypan and Southern Forest Survey Units relating to the volume of quality/desirable species. Lacking these differences, differences in the extent of procurement influence from out-of-state timber mills may have a pivotal role. Figure 6 compares the procurement influence for the two Illinois Forest Survey Units. The Southern Unit appears to be under much greater influence from Missouri and Indiana than the Claypan Unit. Extensive areas of moderate to high procurement influence extend from out-of-state into the Southern Unit. Two potential contributing factors to divergence in exportation not addressed in this study are 1) the average distance from county center to a neighboring state, and 2) the number of in-state mills in operation per county.

Table 3. Non-significant results of ANOVA

<table>
<thead>
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<th>VARIABLE</th>
<th>F-STATISTICS</th>
<th>P &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>OAK-HICKORY FOREST</td>
<td>0.45</td>
<td>0.5074</td>
</tr>
<tr>
<td>MODERATE-HIGH SITE CLASS</td>
<td>1.39</td>
<td>0.2445</td>
</tr>
<tr>
<td>HARVEST VOLUME</td>
<td>1.68</td>
<td>0.202</td>
</tr>
</tbody>
</table>
The spread of mill influence throughout the study area has the appearance of being sub-optimal. Discrete zones of high procurement influence suggest over-competition while low-density zones suggest under-competition and lack of economic incentive for forestry operations. A more regular pattern of procurement influence would potentially result in optimal levels of competition and a greater extent of economic incentive for forestry operations throughout the study area. Discrete zones of high mill influence may suggest excessive transportation distances resulting in greater transportation costs.

Figure 5. Timber mill procurement influence

Illinois counties possess a similar level of timber resources and a high degree of site production potential compared to other counties within the study area. Harvest levels, however, are low when compared to other counties within the study region. Lack of in-state procurement influence, coupled with high rates of exportation, suggest that Illinois is losing much of the potential value-added created by timber processing operations from the timber which it does harvest. The existing zones of procurement influence throughout the study area suggest that a substantial portion of the study area is under low to moderate degrees of procurement influence. The addition of high-capacity timber mills within these zones of timber mill influence may alleviate problems related to lack of in-state procurement, loss of value-added, lack of economic incentive for forestry operations and excessively high exportation rates.

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