5th Intercontinental Geoinformation Days

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Utilizing GIS to select potential sites for biomass-utilizing mills in Louisiana USA

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Keywords
GIS
Biomass
Site Selection
Economic Development
Energy

Abstract

Louisiana has a well-developed oil & gas network and is rich in agricultural production, including a thriving forest industry. Situated at the mouth of the Mississippi River, it is a natural location for a biomass energy industry, yet biomass energy is clearly lacking. At the Louisiana State University Agricultural Center, researchers have been working with industry to quantify potential energy demand and supply. These activities led to identifying potential sites for mills utilizing wood and other forms of biomass. While the earliest efforts focused on creating databases of biomass users and suppliers, GIS became a critical tool in conducting analyses efficiently. Tracking biomass proved to be a constantly moving target. As GIS developed from an obscure database on someone's computer to an online, publicly accessible database, each iteration of updates mandated that we improve the way this information is distributed.

1. Introduction

Tracking complicated data has always been a challenge in all aspects of forest management and in related operations, such as logging and fire management. Even at the primary products level (pulp, lumber, plywood, etc.), selection of the proper site for mills will determine raw material cost for the life of each mill. This paper explores how Geographic Information Systems (GIS) has influenced these activities in Louisiana. Louisiana is a coastal state (largest city is New Orleans) located where the Mississippi River enters the Gulf of Mexico in an area often referred to as the Mid-South. The climate is mild and wet, so forests grow prolifically. Since the 1980s, the Mid-South and Southeastern states have been considered the "wood basket" of the country, producing more wood products than other regions. The most common commercial species are southern pine (*Pinus spp.*) and oak (*Quercus spp.*). Pine is used primarily for construction lumber and panels (primarily domestic market), while oak is used primarily in furniture and furnishings (domestic and export markets). Southern pine forests are natively fire-dependent ecosystems.

2. Forest products applications

From about the period 2005 to 2015, we were contacted twice per month by a new party that had an idea for a bio-based mill, and they were searching for a suitable site to locate and build the mill. Common requirements were a sustainable input of 500,000 to 1 million tons of biomass, dry weight basis. This is a tall order that competes with the size of major pulp/paper mills and sawmills in the region.

While they all envision utilizing sawdust, bark, rice straw, rice husks, sugarcane bagasse and other agricultural/forestry wastes, they quickly realized that these materials already have a market in which they would have to compete. Transportation costs of the waste material usually equals or exceeds the current value of the waste material, nullifying those input sources. Also, while most say they can use any kind of biomass, eventually economic realities force them to settle on one or two input products.

Since waste materials are very limited in supply, the only realistic raw material available is pine timber of pulpwood size (standing timber 12-23 cm diameter).

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Cite this study

de Hoop C., Kizha A. & Altunel A. (2022). Utilizing GIS to select potential sites for biomass-utilizing mills in Louisiana USA. 5th Intercontinental Geoinformation Days (IGD), 18-21, Netra, India

This means they have to compete directly with the pulp/paper industry for low-value standing trees. Fortunately, there is an excess supply of these trees throughout the Mid-South and Southeast. The trick is to locate a new mill as far away as practicable from existing pulp/paper mills.

The pulp/paper industry has been trending toward consolidation. In the last 30 years, 6 pulp/paper mills closed permanently in Louisiana alone. Four of them belonged to International Paper (IP). In the meantime, other mills increased their capacity – in this area, most notably IP near Texarkana, Texas, and IP in Mansfield, Louisiana. This leaves potential "holes" in the wood procurement "basket" for new mills. In other words, site your new mill where a paper mill moved out (Fig. 1).

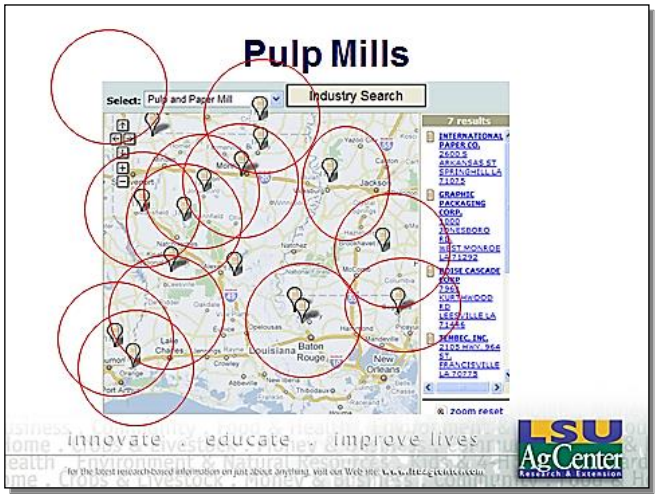

Figure 1. Site selection for a new wood-utilizing facility begins with looking at the current pulp/paper industry and searching for voids between their wood procurement areas.

Our research of the 1990s determined that the primary forest industry sites are rural – located near their natural resource supply to minimize transportation costs (Fig. 2, 3 & 4). The secondary industry (furniture, doors, windows, etc.) is located in urban areas, where there is better access to labor and markets (Fig. 5) (de Hoop et al. 1997; Kleit et al. 1994).

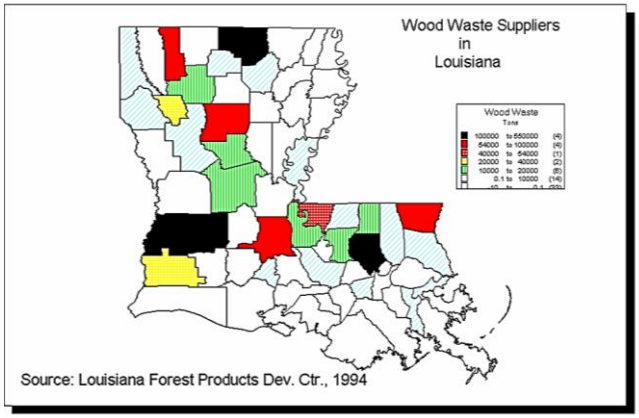

Figure 2. The primary forest products industry is located in rural areas close to the natural resource base.

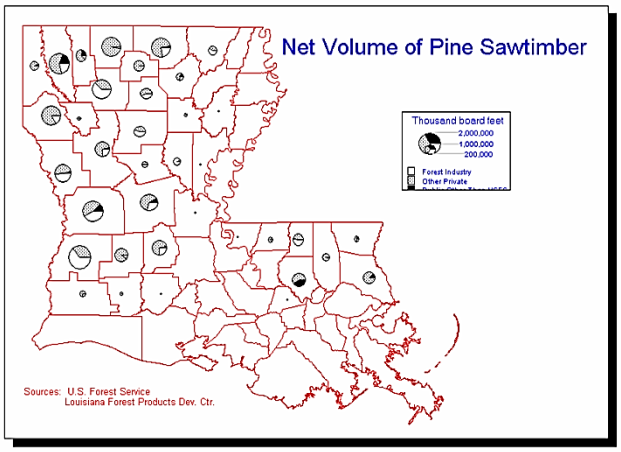

Figure 3. GIS using MapInfo to query where the usable pine timber is located. Data source is US Forest Service.

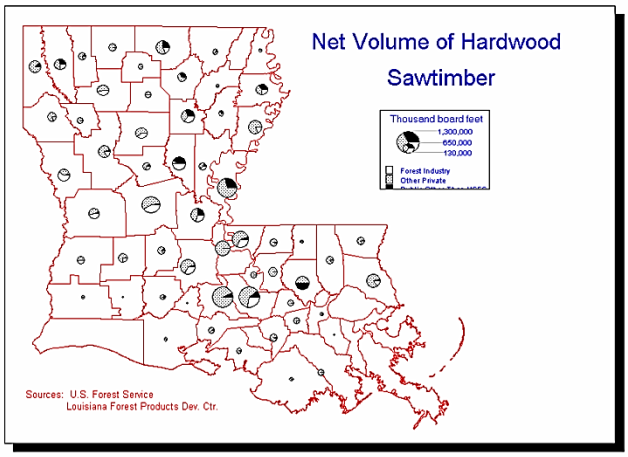

Figure 4. Usable hardwood timber and biomass supply is along the major rivers and can be sourced up to 800 km if water access is feasible.

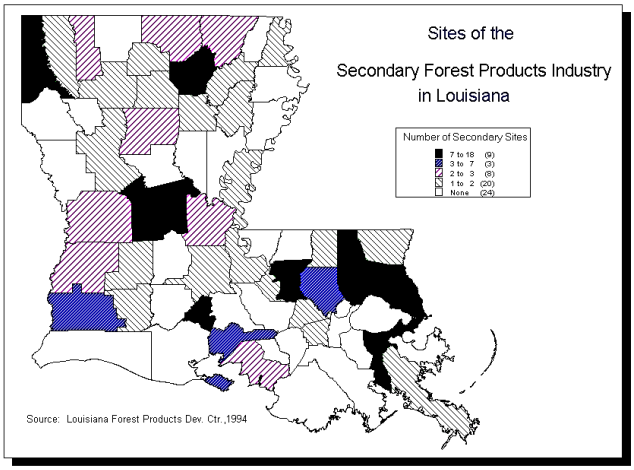

Figure 5. The secondary wood industry (e.g., furniture) is located in urban areas.

The Louisiana Department of Natural Resources was interested in developing/improving the utilization of biomass, as were several local economic development agencies. Our team developed a publicly-accessible database of potential biomass supply. Using data from the US Forest Service's Forest Inventory & Analysis

program, we were able to overlay this with areas where timber growth exceeded drain (de Hoop et al. 2007).

Transportation access is another obvious concern. While road access is generally good throughout the country, rail and water access are obviously more limited. Through conversations with industry personnel, we determined that trucking is the cheapest mode of transportation if the haul distance is under about 150 km. Between 150 and 300 km, rail is the cheapest. Between 300 and 800 km, water (barge) is the cheapest. Of course, that is assuming that rail and water are available. Louisiana is well-situated with rail and water networks.

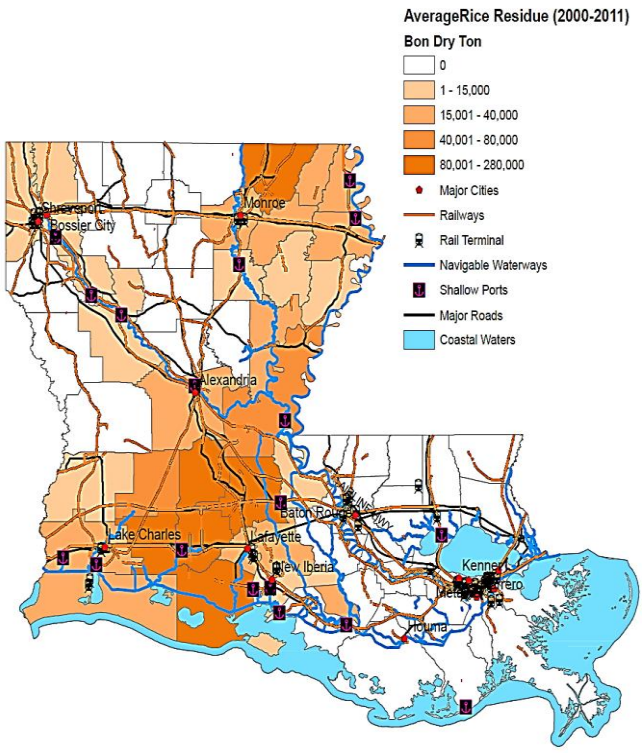

Figure 6. Port, rail and major highway network in the state. This map happens to be an overlay with potential rice crop residue production (Kizhakkepurakkal, 2012).

The final product was an online public database with a geographic component (Fig. 6). Through this, one could quickly collect the following information:

1. Where in Louisiana are the "holes" in the wood procurement areas of the current industry?
2. What is the volume of timber available in the parishes (counties) of interest?
3. What are the timber growth/drain ratios in the parishes of interest?
4. What is the potential volume of wood waste or agricultural waste (Fig. 7) in the parishes of interest?

This product is intended for people who are taking a "first look" at the state to help them focus quickly on a few potential sites. After this point, they typically hire a consultant to conduct a more detailed investigation.

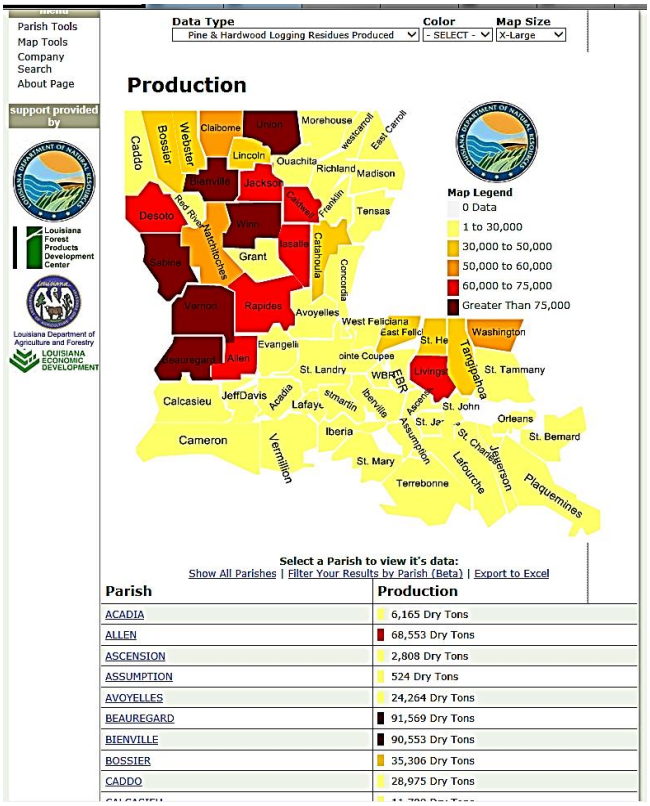

Figure 6. An online query result showing potential logging residues (tops, limbs) availability. Wood mill residues are 97% utilized, while very little of logging residues are currently utilized, although they do have nutrient value in the forest.

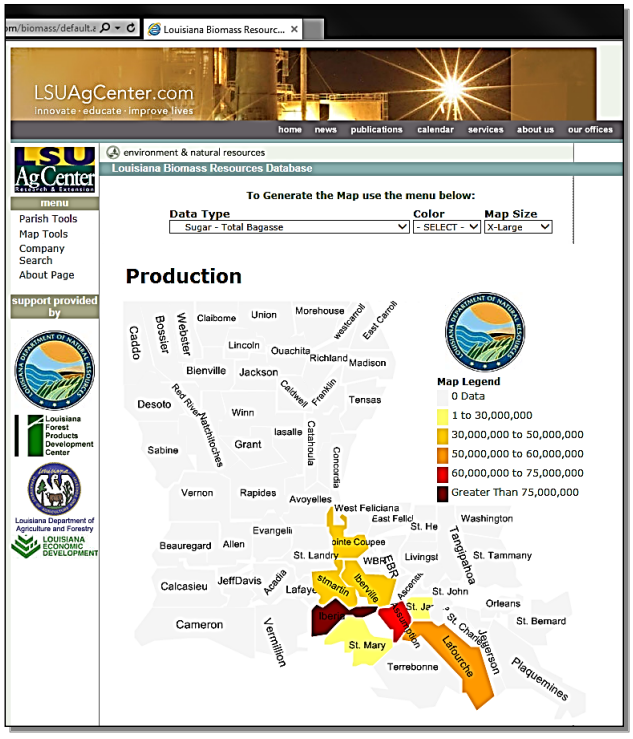

Figure 7. Query of sugar mill bagasse production, which has the potential as a biomass feedstock for other products.

3. Discussion

The development of a biomass supply database has been an iterative process. Our data collection in the 1990s started with the assumption that much wood mill residue was unutilized. By contacting the mills directly, we learned that practically all wood waste generated by the primary wood-utilizing industry was already utilized and bore an intrinsic value. While some of it was used for energy (especially the bark), much of it was used to make other products, such as particleboard. The amount of wood waste produced by the secondary industry was so small that it was economically infeasible to collect and transport. In addition, it contained many contaminants such as melamine and nails.

In the 2000s and 2010s, the attention turned from bioenergy to bio-based products, with their greater potential for economic growth. Thus, more attention was given to proximity to raw materials and to transportation networks. There were several success stories, such as a succinic acid plant and a biofuels plant. All the larger facilities were located on the Mississippi River network. The most notable success story is Drax LLC siting several wood pellets manufacturing facilities and exporting pellets out of the Port of Baton Rouge (also on the Mississippi River). The pellets are utilized in the UK to generate electricity.

4. Conclusion

The initial motivation to quantify wood and agronomic residues was two-fold: the federal government was interested in developing energy sources that were an alternative to coal, oil and natural gas, while the state government was interested in anything that improved economic development. Because products are usually more valuable than fuels, the search for bioenergy sources always turned into a search for potential bioproducts sites.

Biomass databases are quickly outdated. At the same time, GIS products evolve rapidly. Thus, there is constant quest to update data while presenting it in a more accessible and user-friendly format.

Today, perhaps the major disadvantage of a publicly accessible database is that we obtain less natural feedback about how valuable this information is and how it is utilized.

Acknowledgement

This work has been supported over the years by several programs then-sponsored by the US Dept. of Energy, and through several state entities, including the Louisiana Dept. of Agriculture & Forestry, Louisiana Dept. of Natural Resources, Louisiana Economic Development, and several local economic development organizations. Consistent backup support was provided by the National Institute of Food and Agriculture, U.S. Department of Agriculture, currently McIntire Stennis project # LAB94417.

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