



How is wood-based pellet production affecting forest conditions in the southeastern United States?



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ABSTRACT

Exports of woody pellets from the southeastern United States (US) for European power plants have expanded since 2009, leading to concerns about major negative environmental effects. US exports of wood pellets have grown from essentially nothing in 2008 to 4.6 million metric tons in 2015, with 99% of US pellets being shipped to Europe. To examine effects of this recent expansion of the pellet industry on forest conditions, we use US Department of Agriculture Forest Service (USFS) Forest Inventory and Analysis (FIA) annual survey data for 2002–2014 to analyze changes in timberland trends since 2009 for two fuelsheds supplying pellets to the ports of Chesapeake, Virginia, and Savannah, Georgia. This analysis reveals that the Chesapeake fuelshed had significant increases in acreage of large trees and harvestable carbon after 2009. Furthermore, the timberland volume within plantations increased in the Chesapeake fuelshed after 2009. The Savannah fuelshed had significant increases in volume, areas with large trees, and all carbon pools after 2008. Increases in carbon in live trees for the Chesapeake fuelshed and all carbon pools for the Savannah fuelshed for the years before and after 2009 provide empirical support to prior estimates that production of wood-based pellets in the southeast US can enhance greenhouse gas sequestration. Both fuelsheds retained more naturally regenerating stands than plantations; however the number of standing dead trees increased within naturally regenerating stands and declined within plantations (but only significantly for the Savannah fuelshed). While the decrease in the number of standing dead trees per hectare for the Savannah fuelshed plantations after 2009 warrants investigation into its effects on biodiversity, others have recommended thinning and hardwood mid-story control within pine plantations to provide habitat for regionally declining bird species, which is consistent with use of biomass for energy and reducing the risk of fire. While all energy use affects the environment, these results show that benefits accrue when sustainable forest management provides wood pellets for energy that keep fossil fuel in the ground. By contrast urbanization is the greatest cause of forest loss in the SE US. It is essential to consistently monitor and assess forest conditions to assess changes, for exports of wood-based pellets for the southern US are expected to grow. Even though use of pellets for energy has more than doubled, the pellet industry constitutes < 1% of US forest products by weight. Therefore, any recent changes in SE US forest conditions are more likely related to the 2008 declines in the housing market. Continued analysis of annual FIA data using the methods outlined in this manuscript provides a scientifically valid approach for ongoing assessment.

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1. Introduction

Using wood-based pellets for bioenergy provides opportunities to replace consumption of fossil fuel with a renewable resource.

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Spurred by climate and renewable energy goals, several European nations have been using wood pellets to displace coal as fuel in large electric power plants. From 2009 to 2015, almost all wood pellets exported from the United States (US) were sourced from the southeastern US (SE) and transported across the Atlantic Ocean by tankers, to generate electricity in the United Kingdom, the Netherlands and Belgium (USITC, 2016). The global trade in pellets has doubled from 2012 to 2016 (Walker, 2016).

Wood pellets in the southeast (SE) US are sourced either from byproducts of timber harvested for lumber, paper and pulp or from timberlands that would have been harvested for pulp but are left without a market where local pulp mills have shut down (Abt et al., 2014) (Fig. 1). Historic land use, ownership, slope, and other social, biophysical and environmental conditions influence current forest types, structures and age classes (forest biomass supply). Investments in site preparation, fertilization and thinning also influence biomass supplies. Investment decisions are made by forest landowners who vary from corporation to individuals and families, the latter representing about 85% of private timber area in the southeast US (Wear and Greis, 2013). For commercial harvesting, non-corporate owners typically rely on external loggers who determine which trees to harvest. All pellet mills in the SE US that export pellets require feedstock to originate from sites supervised by logging professionals (National Association of State Foresters, 2015). Trees and residues considered unprofitable to transport are left in the forest to slowly decompose or are burned. The harvested timber is sold preferentially to highest value markets: e.g., solid lumber, pulp and paper, and specialty markets such as small logs exported to China for scaffolding. Sawmill residues are often used onsite to generate electrical energy or sold for mulch, animal bedding, or making particle board and fiberboard. Woody material that cannot be sold more profitably elsewhere is available at low cost for pellet mills. This type of woody material is available in the SE US, where pulp mills have closed and feedstocks are left economically stranded. Uncertainty about future markets can inhibit investments in systems to more efficiently and fully utilize available woody resources.

Feedstock supply for SE US wood pellet exports primarily consists of woody residues, thinnings and other trees that do not meet specifications for higher value markets. Forest thinning entails harvesting to reduce tree density, which improves the health and growth of remaining trees and reduces risk of insect damage or fire (Agee and Skinner, 2005). Thinning also improves soil carbon sequestration by increasing stand productivity (Jandl et al., 2007) and benefits biodiversity by reducing risks from pests, disease and intense wildfire (Thomas et al., 1999).

Yet concerns are still raised about the effects of wood-based pellet production on forest conditions in the SE US (Dale et al., 2017). Some environmental groups worry that, with rising wood based pellet production, native forest ecosystems and bottomland

forests with high biodiversity will be jeopardized and that greenhouse gas (GHG) emission reduction objectives will be undermined (Cornwall, 2017). In addition, there is strong interest in ensuring that water quality, biodiversity, and scenic and recreational values of forested lands are maintained (Evans et al., 2013). For example, environmental groups claim “that burning trees for energy ... destroys our forests” (Dogwood Alliance, 2016). Hence documenting how the production and export of wood-based pellets has affected SE US forest conditions to date can provide evidence to help address these concerns.

This analysis uses the United States Department of Agriculture Forest Service (USFS) Forest Inventory and Analysis (FIA) annual inventory data (Miles, 2016; O’Connell et al., 2014) to examine effects of the expanding wood pellet market on SE US forest conditions by asking the question, “How does the expanding SE US pellet production industry differ from a business-as-usual case for two fuelsheds in the SE US?” Our null hypothesis is that no significant changes have occurred in timberland volume, timberland stand size distributions, number of standing dead trees, or carbon storage for our study area, either for naturally regenerating stands or plantations, since the rapid increase in the SE pellet industry around 2009.

2. Methods

This study evaluates trends in forest conditions for two forest production areas or “fuelsheds” that supply wood-based pellets to the ports of Savannah, Georgia, and Chesapeake, Virginia (Fig. 2). The fuelsheds were defined as counties containing land within a 120 km (75 mile) radius of mills producing export pellets as of September 2014, the typical sourcing distance for pellet mills in this region (Stewart, 2015). The Savannah fuelshed encompasses 10.6 million ha and contains 22 South Carolina counties, 54 Georgia counties, and 7 Florida counties. The Savannah fuelshed timberlands are primarily pine, or softwood, plantations. The Chesapeake fuelshed encompasses 8.5 million ha and includes 33 North Carolina counties and 69 Virginia counties. The Chesapeake fuelshed biomass is derived primarily from mixed hardwood timberlands that, until recent mill closures, supplied pulp for the paper industry in the region.

To investigate forest changes in these study fuelsheds, conditions pre- and post- development of the trans-Atlantic wood pellet

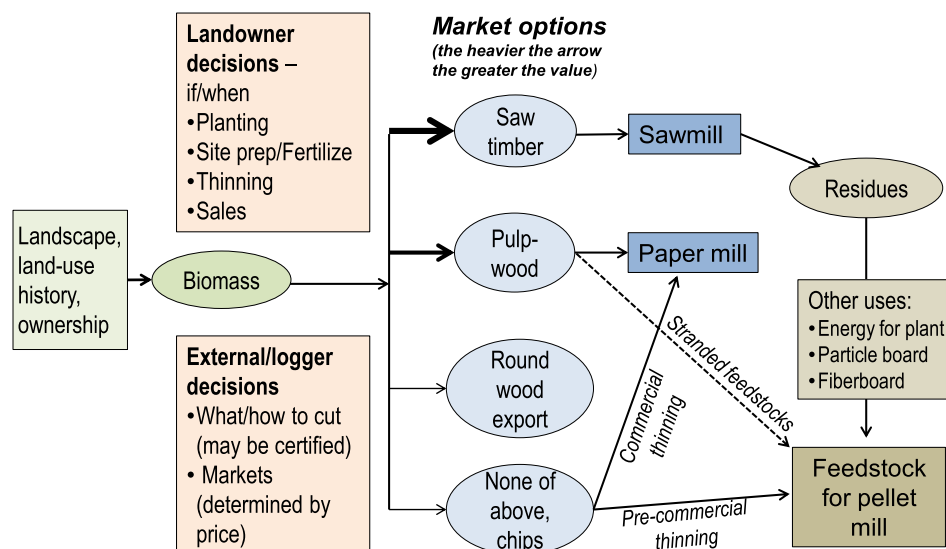


Fig. 1. Factors affecting availability of woody feedstocks for pellets in the SE US. The heaviness of the line indicates the size of the flow.

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