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Status of urban wood-waste and their potential use for sustainable bioenergy use in Mississippi

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ABSTRACT

Urban wood-waste is an inexpensive but underutilized feedstock for wood-based bioenergy. It includes wooden pallets and shipping containers, wood volumes in construction and demolition debris, railroad ties, given away or disposed volumes of logging residues and wood products from primary and secondary mill processing facilities. So far, little is known about the generation of urban wood-waste and current methods of disposal in Mississippi. A survey was conducted in spring 2013 to estimate the recoverable volumes of urban wood-waste for potential use in bioenergy. Results suggested that more than 321,000 tons of urban wood-waste were recoverable in Mississippi. More than 75 percent recoverable volumes were obtained from rubbish sites. Econometric analysis suggested that waste collection facilities collecting higher volumes of wood-waste and under private ownership were more likely to recover. The wood-waste recoveries in a collection facility with seasonal variation in input were 41 percent higher than others. The available urban waste feedstock was not sufficient to operate a large sized bioenergy industry independently. However, since per unit costs are relatively smaller in urban wood-waste, it can become an important supplemental feedstock to using logging residues or small-diameter trees for bioenergy generation in Mississippi. This study provided quantifiable estimates of urban wood-waste and their potential use for bioenergy production in Mississippi and other neighboring states.

Contents

1. Introduction 20
2. Method 22
   2.1. Data sources 22
   2.2. Estimates on available and recoverable volumes 22
   2.3. Econometric modelling 22
4. Results 23
   4.1. Descriptive statistics 23
   4.2. Econometric analysis 23
5. Discussion 23
6. Conclusion 25
   References 25

1. Introduction

Urban wood-waste is characterized as a potentially available volume of wood-waste in “commercial, industrial, and municipal waste landfill sites” or processing facilities (Fehrs, 1999) that could be put to more productive uses such as energy generation. Urban wood-waste includes wooden pallets and shipping containers, wood materials available in construction and demolition debris, disposed railroad ties, and any other woody materials blended with solid waste. It also includes the woody products that are otherwise not accounted as mill or logging residues (Fehrs, 1999). Forest industry generates large amount of industrial bi-products, which approximately account one-tenth of all waste generated in North

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America (Falk and McKeever, 2012; U.S. Environmental Protection Agency (USEPA), 2009; Natural Resources Canada (NRCAN), 2006). Nearly half of the 280 million metric tonnes of wood resource harvested in the United States have been used as industrial material, a significant proportion of which finally gets discarded in the form of manufacturing waste or disposal products (Falk, 1997). Falk and McKeever (2012) revealed that a total of 70.6 million tons of urban wood-waste was generated in 2010 across the United States. Out of this total, 48 percent was comprised by municipal solid waste (MSW) and 52 percent was from construction and demolition debris. This volume itself signifies that a substantial proportion of our industrial raw material and many products contain wood fiber that is recoverable.

MSW includes both biological and non-biological waste items such as:product packaging, glass, plastics, food, bottles, and wood materials (U.S. Environmental Protection Agency (USEPA), 2010; McKeever, 2004), of which biological materials constitute a substantial share (U.S. Environmental Protection Agency (USEPA), 2010). Recent estimates suggest that there were about 250 million tons of MSW generated in United States in 2010 (Falk and McKeever, 2012). About 14 percent of the MSW contained a wood component, which include discarded waste from secondary wood products such as: furniture, pallets, and wooden panels among others (Falk and McKeever, 2012). About 11.2 million dry tons[1] of MSW wood-waste was potentially available for recovery in United States (Falk and McKeever, 2012).

Construction and demolition wastes are another major source of wood-waste in the United States. While both construction and demolition wastes are disposed at the same locations, they originate from different sources (Falk and McKeever, 2012; Perlack et al., 2005). For instance, construction waste are obtained from the čonstruction, repair and remodeling of residential and non-residentialštructures (McKeever, 2004; Falk, 1997). Therefore, construction waste is relatively clean and has a higher recovery rate (Perlack et al., 2005). Given that demolition waste is contaminated with paints, fasteners, adhesives, and other dirt, its separation can be time-consuming and costly in the landfill sites (McKeever, 2004). These factors make recovery from demolition relatively difficult than from construction wastes (McKeever, 2004; Falk, 1997). In addition, factors such as type and location of facility, and the age of the demolished product also play some role in wood-waste recovery (McKeever, 2004).

Urban wood-waste has the potential to become an important reusable resource though it has long been regarded as a cumbersome disposal problem (Minnesota Department of Natural Resources (DNR), 1994). Puettmann and Lippke (2013) conducted a life cycle assessment of wood-waste in Washington using woody waste materials such as: mill residues, forest residues, and clean demolition materials for energy production. They found that the energy production from urban wood waste reduced the global warming potential by 57% compared to all natural gas boilers. Along with some concerns, Youngs (2011) also found several positive environmental benefits of waste-to-energy technologies including the decreased volumes transported to landfills, reduction in greenhouse gas reduction, production of low-carbon energy, etc.

Urban wood-waste is an inexpensive but underutilized feedstock in wood-based bioenergy. In the Billion Ton vision document, U.S. Department of Energy (2011) estimated the potentially available urban wood-waste for bioenergy use in United States. About 32 million dry tons of feedstock is potentially available for bioenergy from urban wood-waste, 75 percent of which was projected to be available at $20/ton (U.S. Department of Energy, 2011). Of importance, given the population growth, more recoverable wood-waste volumes were expected in the future and the rate was estimated to be one half of the population growth (U.S. Department of Energy, 2011). MacFarlane (2009) also reported that currently underutilized dead urban trees are available for bioenergy use in Michigan.

Nzokou (2009) estimated recoverable volumes of urban wood-waste in southern Michigan and found that 84 percent of total wood yard volumes came from large residential properties. While recoverable wood-waste contributions were mostly from large facilities, small facilities having four to five employees on average were deemed flexible in producing diverse product line in the state of Michigan (Nzokou, 2009). In a related note, Falk (1997) cited various factors such as: type and available volumes of wood-waste, sorting and cleaning expenses, and the cost competitiveness with the alternative raw materials available in market being the primary factors affecting recoverability in waste processing facilities.

Recovery rate varies widely for different urban wood-waste sources. For instance, almost all of wood-waste coming from primary timber processing industry is recovered due to relative cleanliness. As explained earlier, recoverable volumes of demolition debris, which largely depend upon factors such as: type, location, and age of the demolished structure, are small and even difficult to estimate (McKeever, 2004). Falk and McKeever (2012) reported that about 48 percent of the total construction and demolition wood-waste were available for recovery. Similarly, total available volumes for recovery in case of municipal wood-waste were approximately 33 percent (Falk and McKeever, 2012). Research also suggests that there are regional variations in the rate of wood-waste recovery as well. For example, Camas Creek Enterprises (2009) found that 45 percent of the wood-wastes in disposal sites were processed in Kansas. In contrast, average conversion rates were 30 percent in the state of Michigan (Nzokou, 2009). Inefficient sorting mechanisms were cited as a primary reason for very small wood-waste recovery rate (Nzokou, 2009). Staley and Barlaz (2009) also found significant variations in the amount of collected waste volumes and recovery rates within various regions of the United States. While all disposed MSW in the Delaware and Kansas were land filled, the rate was only 60% in Minnesota (Staley and Barlaz, 2009). Given such variations in recovery rates, one size fits all formula might not work to estimate recoverable urban wood-waste. Therefore, research in smaller geographical extent is important.

The state of Mississippi has abundant forest resources and proper waste management could provide an opportunity to generate energy from these sources. Perez-Verdin et al. (2009) estimated that approximately 4.0 million dry tons of woody biomass is available in Mississippi and seven percent of it can be available from urban wood-waste sources. While this study provided general information on recoverable urban waste, these estimates utilized secondary data sources conducted in other states for generating recoverable waste. As Kittler and Beauvais (2010) cautioned, recoverability of urban wood-waste varies by product types and region. Therefore, accurate estimates are difficult to obtain without having a region specific study (Kittler and Beauvais, 2010). Moreover, conversion of urban wood-waste volumes to a viable product such as bioenergy is a substantial financial investment and hence requires careful insights related to condition and availability of woody raw materials (Nzokou, 2009). Similarly, as Nzokou (2009) acknowledged, factors affecting availability and utilization of wood-waste in disposal yards and potential alternatives are critically important for maximizing economic benefits. Therefore, the focus of this study was to estimate the quantity of urban wood-waste in Mississippi solid waste management facilities for different product classes and to evaluate the factors affecting recoverable volumes for potential bioenergy use in the study area.

[1] Information available in US ton can be converted into Tonne (SI Unit) by a conversion factor of 1 tonne = 1.102311 ton.