COST ESTIMATION OF A BIOREFINING NETWORK FOR FOREST RESIDUES IN IRELAND

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The forestry sector in the Republic of Ireland (ROI) is mainly focused on harvesting timber from the stems of spruce trees. The remaining 30-35% of unharvested wood volume, typically known as forest residues or brash, is left on the forest floor. Only a small geographically specific portion of forest residues are bundled and sold at low cost as fuel for industrial combined heat and power (CHP). The volume of unused forest residues in ROI is estimated to be 700 thousand $m^3 a^{-1}$, and its distribution is shown in Figure 1[1]. This significant quantity can be mobilized as biomass feedstock to biorefineries for high value bio-products. The composition, quantity and type of feedstock available in Ireland indicate that pyrolysis and hydrothermal liquefaction (HTL) are the most effective biorefining pathways. Bio-oils produced from pyrolysis have high energy value and HTL uses forest residues with high moisture content as feedstock saving the cost of drying. Both of these technologies have the capability to be energy neutral and therefore have potential at the small, distributed scale found in Ireland [2]. The highly dispersed nature of forest residues coupled with low energy density presents challenges in sustaining substantial availability of feedstock to the biorefinery. Selection of an optimum location for building a biorefinery can help design an efficient supply chain to reduce transportation cost and environmental impact. Multi-criteria decision analysis (MCDA) coupled with geographic information system (GIS) analysis is a popular and effective method to analyse location suitability. Localised criteria can either be factors, which influence location suitability, or constraints, which limit development in that vicinity. These criteria are weighted using the analytical hierarchy process (AHP) and combined in GIS to give a final site suitability map. Selection of the most cost-effective location out of all suitable sites requires a cost estimation model that will compare the operational cost for both technologies and transportation cost of the resources and final product.

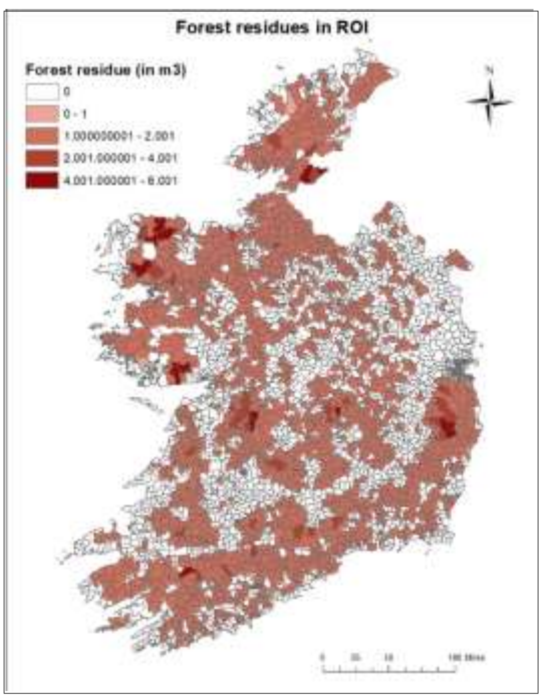

Figure 1 – Forest residue distribution in ROI

This work will (1) present a decision support tool (DST) for siting a biorefining infrastructure in Ireland, (2) assess the economic aspects of pyrolysis and HTL for conversion of forest residues in Ireland, and (3) develop a cost estimation model to determine the most cost-effective site. The DST is map-based and employs MCDA using ArcGIS software, which involves defining, evaluating and weighting economic and environmental criteria, followed by a sensitivity analysis. The cost estimation model will be based on step cost method. The site with the lowest operational and transportation costs will be selected as the location for building the biorefinery. The results of the present work will be used to conduct life cycle assessments of specific high-potential bio-products in future work.

References

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