Research in Progress

Forest Products Laboratory

Mid-Atlantic Sustainable Biomass for Value-Added Products Consortium (MASBio)

The U.S. Mid-Atlantic region has abundant natural resources that can facilitate an expanded bioeconomy and sustainable growth. Abundant mined and marginal agricultural lands can be reclaimed to produce biomass crops (Sahoo et al. 2019). However, many other critical factors will ultimately determine whether this industry can prosper (e.g., conversion technologies, competitive bioproducts, landscape-level constraints, commercialization and marketing strategies, environmental sustainability, and sociopolitical support). The key to long-term success of a sustainable biomass production system for value-added bioproducts is maintaining and enhancing soil and water quality and optimum economic and environmental performance of the system. Mid-Atlantic Sustainable Biomass for Value-added Products Consortium (MASBio) is designed to transform sustainable biomass resources and conversion technologies into agricultural and industrial enterprises with clear economic benefits. This consortium of regional universities, industry, businesses, and governmental organizations is dedicated to developing regional biomass for value-added product systems that grow the rural bioeconomy in an economically and environmentally sustainable fashion.

Background

Bioenergy, biofuel, and bio-based products are advocated to counter climate change, provide energy security, and grow the bioeconomy (Langholtz et al. 2016). Renewable biomass resources such as forest and crop residues and energy crops are used to produce bio-based chemicals and materials.

Objective

The main objective of this project is to deliver sustainable and economically feasible biomass for value-added product systems in the U.S. mid-Atlantic region. This project will focus on producing advanced biofuel and industrial chemicals and materials. The focus of this phase of the project (Figure 1: Task 5) is to conduct system and scale-up analyses using robust artificial-intelligence- (AI-) based data analytics.

Approach

The overall project consists of innovative and integrated research, education, and extension components (Fig. 1). For this phase, integrated modeling and predictive analytics will be used to calculate landscape-level estimates of environmental impacts and costs, conduct scale-up analyses, and build a decision support system. Experimental data from various locations in the study area will be used to build and validate biogeochemical models. Machine learning tools will be used to generate high-spatial life-cycle inventories and costs of producing products from hybrid willow, switchgrass, and forest residues. The cradle-to-grave life-cycle assessment (LCA) and techno-economic assessment (TEA) will be used to estimate environmental impacts and economic feasibility of producing bio-based products (Sahoo et al. 2020). Further, an integrated environmental and economic decision support tool will be developed using landscape big-data analytics for bioproducts produced on a plant-level scale (Sahoo et al. 2018). We will develop a cost-efficient and continuous feedstock supply chain through advanced techniques and models for optimizing harvest and logistics. The project will

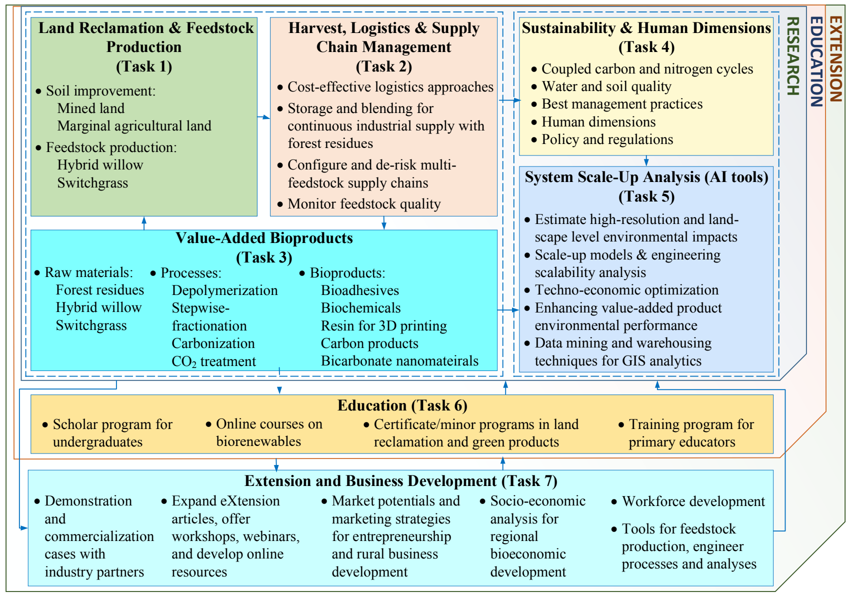

Figure 1. Framework of the integrated sustainable biomass for value-added products system.

develop biomass conversion platforms with high demand and market potential, evaluate environmental impacts, and explore scale-up strategies.

Expected Outcomes

Major goals are (1) a structured database with deep machine learning tool for biomass to bioproducts; (2) capital, operational, and maintenance costs of various scenarios for biomass supply chains and bioproduct conversion facilities; and (3) an integrated environmental and economic decision support tool using landscape big-data analytics for bioproducts produced on a plant-level scale.

Timeline

The project will span five years from September 2020 to August 2025. AI tools for data collection and model development will be completed by August 2024. Scale-up and TEA and LCA model development and application will be completed by August 2025.

Cooperators

USDA Forest Service, Forest Products Laboratory; West Virginia University; Virginia Polytechnic Institute & State University; Penn State University; State University of New York; West Virginia State University; USDA Forest Service; Oak Ridge National Laboratory; and Idaho National Laboratory

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