Enze Jin et al., Innov Ener Res 2018, Volume 7
DOI: 10.4172/2576-1463-C2-005

Spatial agent-based modeling for dedicated energy crop adoption and cellulosic biofuel commercialization

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Dedicated bioenergy crops, such as perennial grass and short rotation trees, are qualified as cellulosic biofuel feedstocks to meet the requirement for advanced biofuel in the expanded Renewable Fuel Standard. The utilization of dedicated energy crops for cellulosic biofuels is still in the early stage or pilot scale, and the existing cellulosic biorefineries are yet to be commercialized. This study develops an agent-based model to simulate the spatial diffusion of switchgrass (*Panicum virgatum L.*) adoption in Indiana cropland from 2015 to 2027 under various biofuel market scenarios. Results indicate that it is only economically viable to produce 1,115 million gallons (4220.7 million liters) cellulosic ethanol from switchgrass annually in Indiana from 2015 to 2023 given an average annual farm gate price of $123.93 t-1 for feedstock. This study also finds that the high productivity of switchgrass can increase farmers' adoption rates and secure a stable feedstock supply. Moreover, it reveals that the high equipment costs required for scaling up production capacity and the highly variable operating cost of cellulosic biofuel production will inhibit the viability of commercializing cellulosic biofuels with a stable supply of feedstock. Financial incentives for cellulosic biofuel production have a significant impact on promoting the adoption of dedicated energy crops in Indiana. This paper provides useful insights for biorefinery inventors and policymakers to facilitate the commercialization of cellulosic biofuels by understanding the effects of farmers' decisions on the adoption of dedicated energy crops.

Biography

Enze Jin is a PhD candidate in Environmental and Ecological Engineering in Purdue University. He has a Master degree of Biosystems and Agricultural Engineering from Oklahoma State University and a bachelor degree of Mechanical Engineering from China Agricultural University. His research focuses on the sustainability assessment of bioenergy systems in terms of environmental, economic, and social impacts.

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