Evaluating a Stochastic Optimized Sustainable Aviation Fuel Supply Chain from Winter Canola and Its Carbon Intensity

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Introduction

- Aviation CO_2 is projected to continue increasing and to be over 20% of global emissions by 2050.
- Sustainable Aviation Fuel (SAF) has been identified as a crucial means to decarbonize the aviation sector.
- Winter canola has a higher oil yield and lower carbon intensity and is a potential feedstock for the HEFA pathway.
- However, the yield information is limited in the Southeast United States. The variation in feedstock supply could adversely influence SAF production cost, supply, and carbon intensity (CI).

Objectives

- Determine the stochastic cost of SAF production from winter canola
- Identify the optimal SAF supply chain configuration under feedstock yield uncertainty.
- Quantify the carbon intensity of winter canola-based SAF in different yield scenarios.

Study Assumptions

- To prevent overestimating the available production area, we assumed winter canola could be grown in areas where winter wheat has been grown for at least one year in the last decade.
- Winter canola is grown in alternate years to avoid secondary pests and disease infestation.

Analytical Model

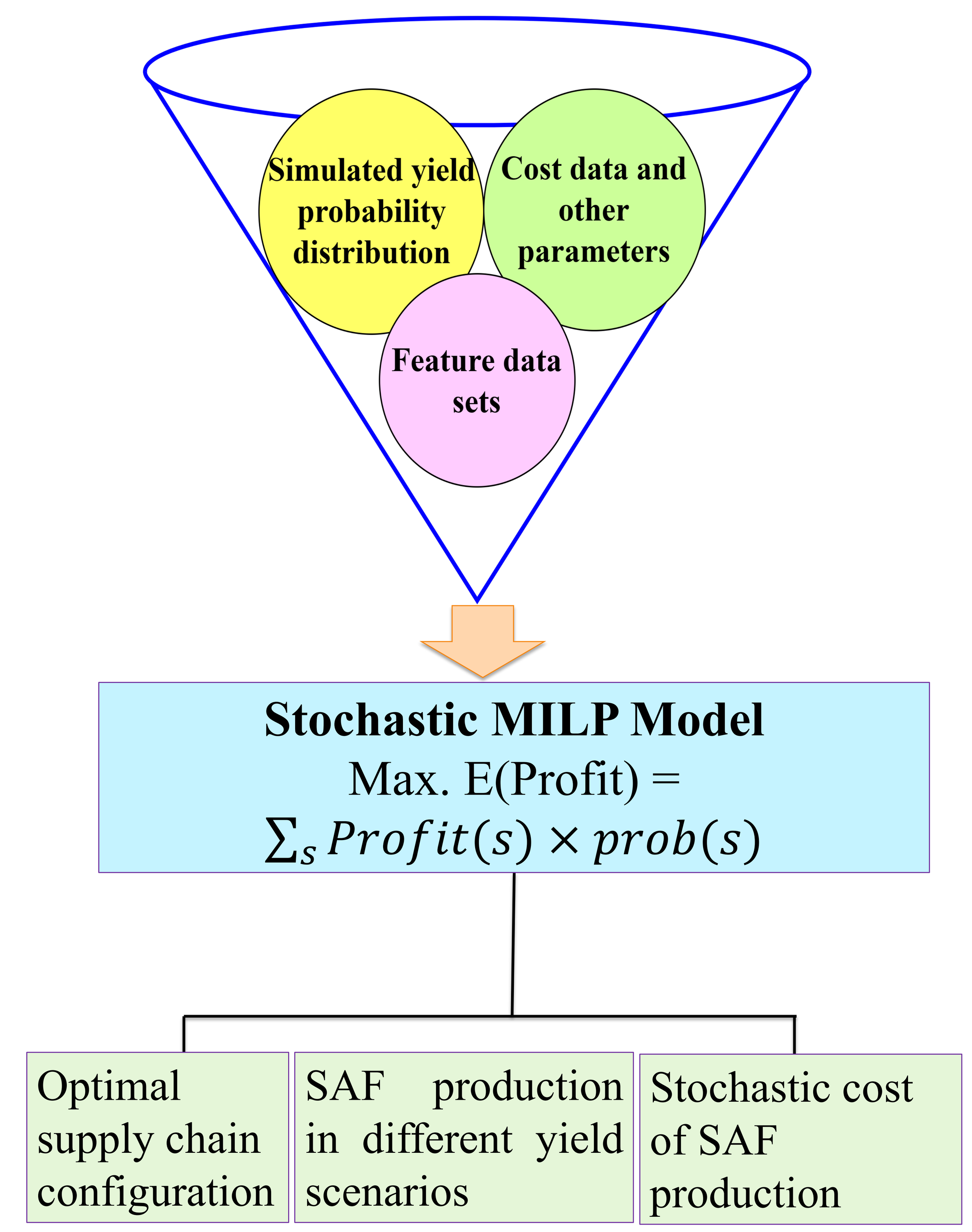

Figure 1. Model framework

Yield Simulation

- Monte Carlo simulation for canola yield using PERT distribution is shown in Figure 2.

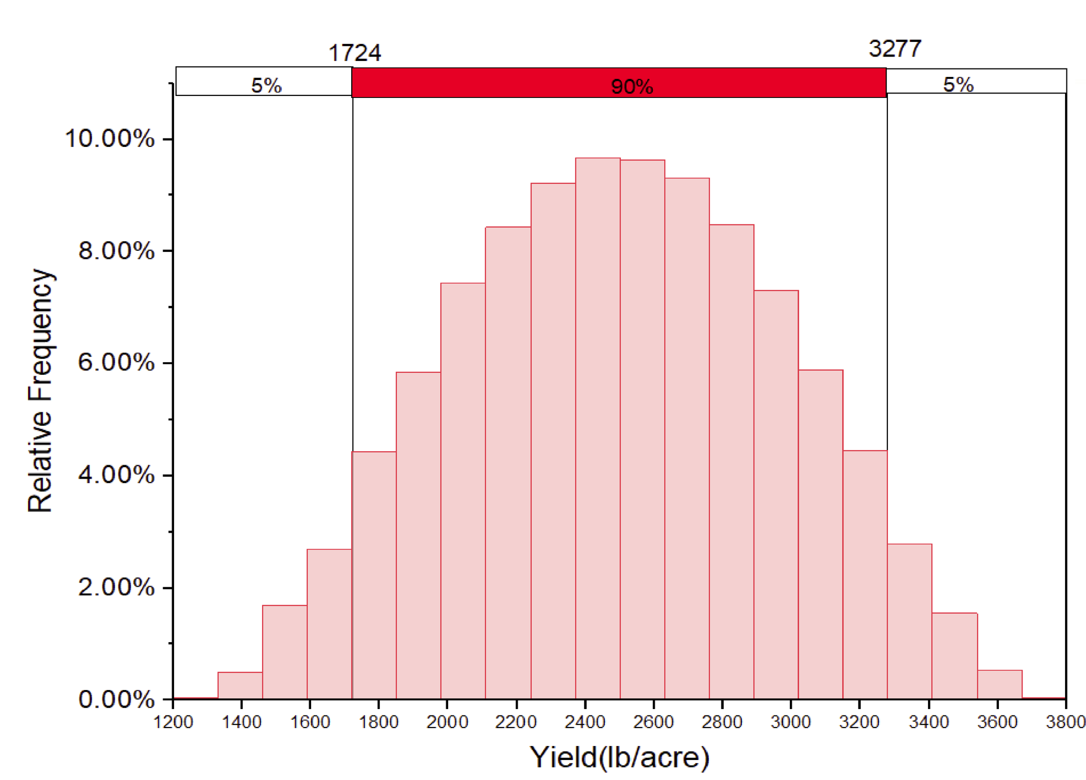

Figure 2. Probability distribution of simulated yield

Results

Optimal supply chain

- Figure 3 depicts the SAF supply chains for Memphis and Nashville International Airports.

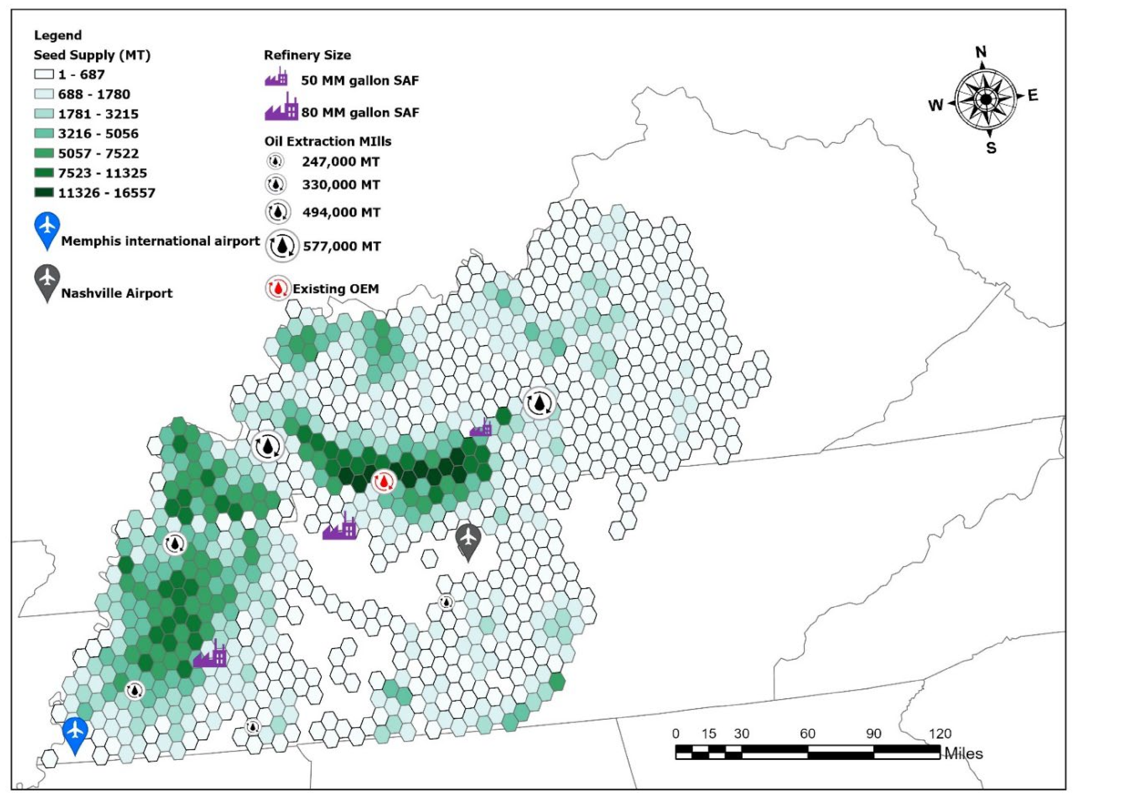

Figure 3. Optimal supply chain configuration

SAF supply

- Figure 4 shows an additional 39,000-836,000 MT of oilseed would be required to meet the target SAF volume when canola yields were low.

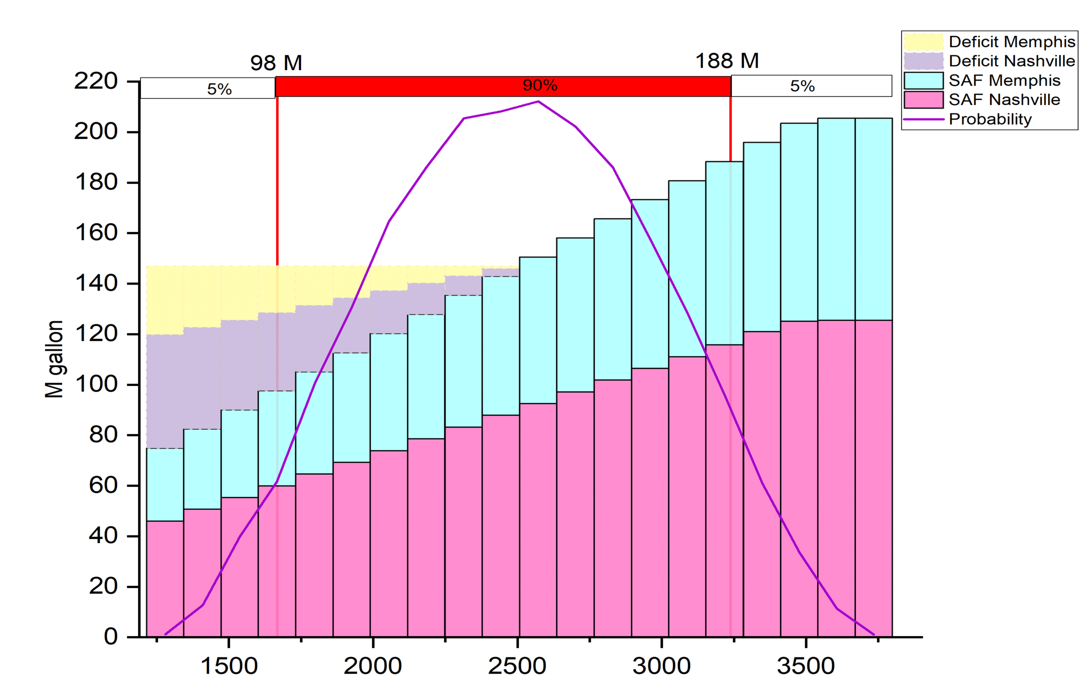

Figure 4. SAF production in different yield scenarios

Production costs

- Under the 90% likelihood, the SAF production cost ranged from \$2.7 to \$6.5 per gallon.
- Expected production cost was around \$4.0 per gallon after considering co-products revenue
- The RINs credits and tax credits were not included

Stochastic carbon intensity

- Figure 5 illustrates the CI range for the SAF produced from winter canola in west TN and KY.

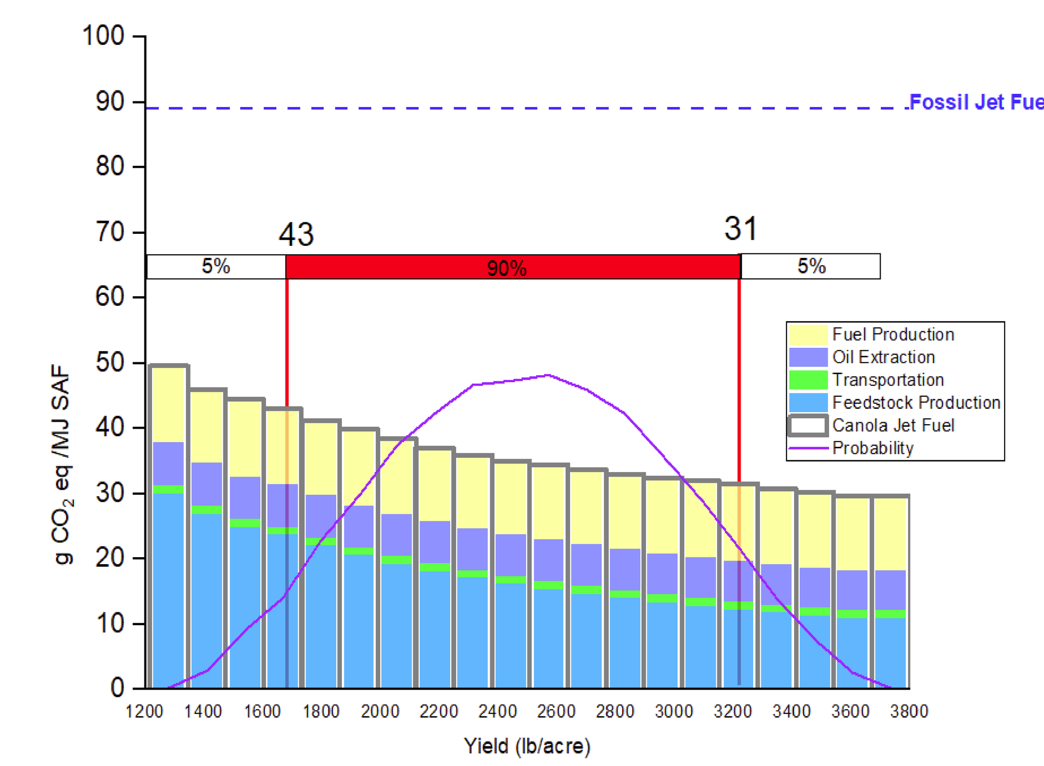

Figure 5. Carbon intensity of SAF in different yield scenarios

Conclusions

- It could be economically feasible to produce SAF from winter canola with government support.
- Feedstock yield uncertainty could impact SAF production costs and CI substantially.
- Using winter canola for HEFA-SAF presents an opportunity to lower the aviation CI.
- Results suggest it is crucial to mitigate the feedstock supply uncertainty for a robust and sustainable winter-oilseed SAF supply chain.

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