Project 001(E) Alternative Jet Fuel Supply Chain Analysis

University of Tennessee

Project Lead Investigator

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University Participants

University of Tennessee

- PI: Burton English, Professor
- FAA Award Number: 13-C-AJFE-UTenn, Amendments 09, 11, 13
- Period of Performance: August 1, 2019 to August 10, 2021
- Tasks:
    1. Assess and inventory regional forest and agricultural biomass feedstock options.
    2. Develop national lipid analysis.
    3. Lay the groundwork for lipid and/or biomass in Tennessee (TN) and Southeastern U.S.
    4. Biorefinery infrastructure and siting (supporting role).

Project Funding Level

Total six-year funding/This year funding
Total Estimated Project Funding: $1,075,000/$500,000
Total Federal and Non-Federal Funds: $2,150,000/$1,000,000
The University of Tennessee, Institute of Agriculture provided faculty salary in support of the project.

Investigation Team

- Tim Rials – Project Director(s)/Principal Investigator (PD/PI)
- Burton English – Co-Principal Investigator (Co-PD/PI)
- Lixia He – Other Professional
- Kim Jensen – Faculty
- Jim Larson – Faculty
- Carlos Trejo-Pech – Faculty
- Ed Yu – Faculty
- David Hughes – Faculty
- Jada Thompson – Faculty
- Bijay Sharma – Post Doc
- K. Alan Robertson – Graduate Student
- McKenzie Thomas – Masters Graduate Student
- Luis Vizcaya – Masters Graduate Student
- Patwary, A. Latif – Masters Student
- Mackenzie Gill – Masters Student
- Ty Wolaver – Masters Student

Project Overview

The University of Tennessee (UT) will lead the Feedstock Production (Task 1) component of the project. This component targets the need to assess and inventory regional forest and agricultural biomass feedstock options and delineate the sustainability impacts associated with various feedstock choices, including land use effects. UT will lead the national lipid supply availability analysis employing POLYSYS to develop information on the potential impacts and feasibility of using lipids to supply aviation fuel. The team at UT will facilitate regional deployment/production of jet fuel by laying the groundwork and developing a regional proposal for deployment. Additionally, UT will support activities in Task 3 with information and insights on feedstocks, along with potential regional demand centers for aviation fuels and coproducts, along with information on current supply chain infrastructure, as required.

Major goals include:

1. Develop a rotation-based oil seed crop scenario and evaluate potential with POLYSYS.
2. Develop database on infrastructure and needs for the Southeast U.S.
3. Organize and convene workshop on the alternative jet fuel supply chain for Appalachia stakeholders (completed).
4. Initiate aviation fuel supply chain studies in the Southeast using pine and oilseeds.
5. Continue with sustainability work for both goals 1 and 4.

A journal manuscript will be prepared based on the biochar survey data in this project. McKenzie Thomas will complete her M.S. thesis using this data.

Task 1– Assess and Inventory Regional Forest and Agricultural Biomass Feedstock Options

University of Tennessee

Objectives

As the markets for lignocellulosic biomass (LCB) feedstock (i.e., grasses, short-rotation woody crops, and agricultural residues) are currently not well-established, it is important to evaluate the feasibility of supplying those LCB feedstocks. The opportunity cost of converting the current agricultural lands to LCB feedstocks production will be estimated. In addition, the production, harvest, storage, and transportation cost of the feedstocks are included in the assessment. A variety of potential crop and biomass sources will be considered in the feedstock path, including:

Oilseed crops: Potentials include mustard/crambe (*Sinapsis alba/Crambe abyssinicia*); pennycress (*Thlaspi arvense*); rapeseed/canola (*Brassica napus/B. campestris*); safflower (*Carthamus tinctorius*); sunflower (*Helianthus spp.*); soybean (*Glycine max*); camelina (*Camelina sativa*); carinata.

Perennial grasses: switchgrass (*Panicum virgatum*); miscanthus (*Miscanthus sinensis*); energy cane (*Saccharum complex*).

Short-rotation woody crops: poplar (*Populus species*); willow (*Salix species*); loblolly pine (*Pinus taeda*); sweetgum (*Liquidambar styraciflua*); sycamore (*Plantanus occidentalis*).

Agricultural residue: wheat straw; corn stover.

Forest residue: logging and processing residue.

POLYSYS will be used to estimate and assess the supply and availability of these feedstock options at regional and national levels. This U.S. agricultural sector model forecasts changes in commodity prices and net farm income over time.

County level estimates of all-live total woody biomass, as well as average annual growth, removals, and mortality will be obtained from the Forest Inventory and Analysis Database (FIADB). Mill residue data will be obtained from the U.S. Forest Service's Forest Inventory and Analysis (FIA) Timber Product Output (TPO) data. The ForSEAM model will be used to estimate and predict logging residues. ForSEAM uses U.S. Forest Service FIA data to project timber supply based on the U.S. Global Forest Product Model module of the Global Forest Product Model (USFPM/GFPM) demand projections. Specific tasks related to this objective are outlined below. These supply curves will be placed in both ForSEAM and POLYSYS and estimates into the future will be made.

Task 1 Goals (support/continue ongoing work from previous year)

- Complete the economic viability analysis on switchgrass, short rotation woody crops, crop residues, forest residues, and cover crops.
- Assist risk-reward profit sharing modeling by providing information from past work on cellulosic supply chains to PSU.
- Assist the Pennsylvania State University (Penn State) in a national survey of current and proposed programs that incentivize ecosystem services.
- Finish environmental impact analysis for the aforementioned crops looking at soil, water, greenhouse gas emissions and sequestration, and direct land use change.

Research Approach

1. Completed developing a consistent set of budgets for pennycress, camelina, and carinata as cover crops.
2. Yields for camelina, carinata, and pennycress have been estimated. Camelina and carinata were estimated using the Environmental Policy Integrated Climate (EPIC) model and pennycress from secondary source information.
3. Initiated a risk analysis for the three cover crops.
4. Developing two articles on carinata and switchgrass.
5. Taking information from a project titled *Next Generation Logistics Systems for Delivering Optimal Biomass Feedstocks to Biorefining Industries in the Southeastern US* (LEAF) funded by the Bioenergy Technologies Office (BETO) on pine and switchgrass blend examine the potential in the Southeast. Completed 100% pine scenario and initiated the 75% pine, 50% pine, and 25% pine scenarios (Figures 1 and 2). We found the average transportation cost, average feedstock cost, the distance feedstock had to travel, and the location of potential biorefineries of the 2000/million (M) dry short tons (t) and 2500 Mt/day capacities. The results are displayed in Table 1.

Table 1. Average transportation cost, average feedstock cost, the distance feedstock had to travel, and the location of potential biorefineries of the 2000/Mt and 2500 Mt/day capacities

2000 Mt/day Biorefinery				
Location Indicator	Tons	Average Feedstock Cost	Average Transportation Cost ($/t)	Average Distance (ton-mile
24746	723,456	$52.19	$21.19	68
39134	723,538	$52.39	$21.39	69
56464	724,124	$55.82	$24.82	80
110865	721,866	$58.30	$27.30	88
44009	722,242	$58.75	$27.75	90
2500 Mt/day Biorefinery				
Location Indicator	Tons	Average Feedstock Cost	Average Transportation Cost ($/t)	Average Distance (ton-mile)
39134	902,214	$56.16	$25.16	81
24746	901,099	$57.10	$26.10	84
51468	904,468	$59.44	$28.44	92
110865	899,182	$63.08	$32.08	103

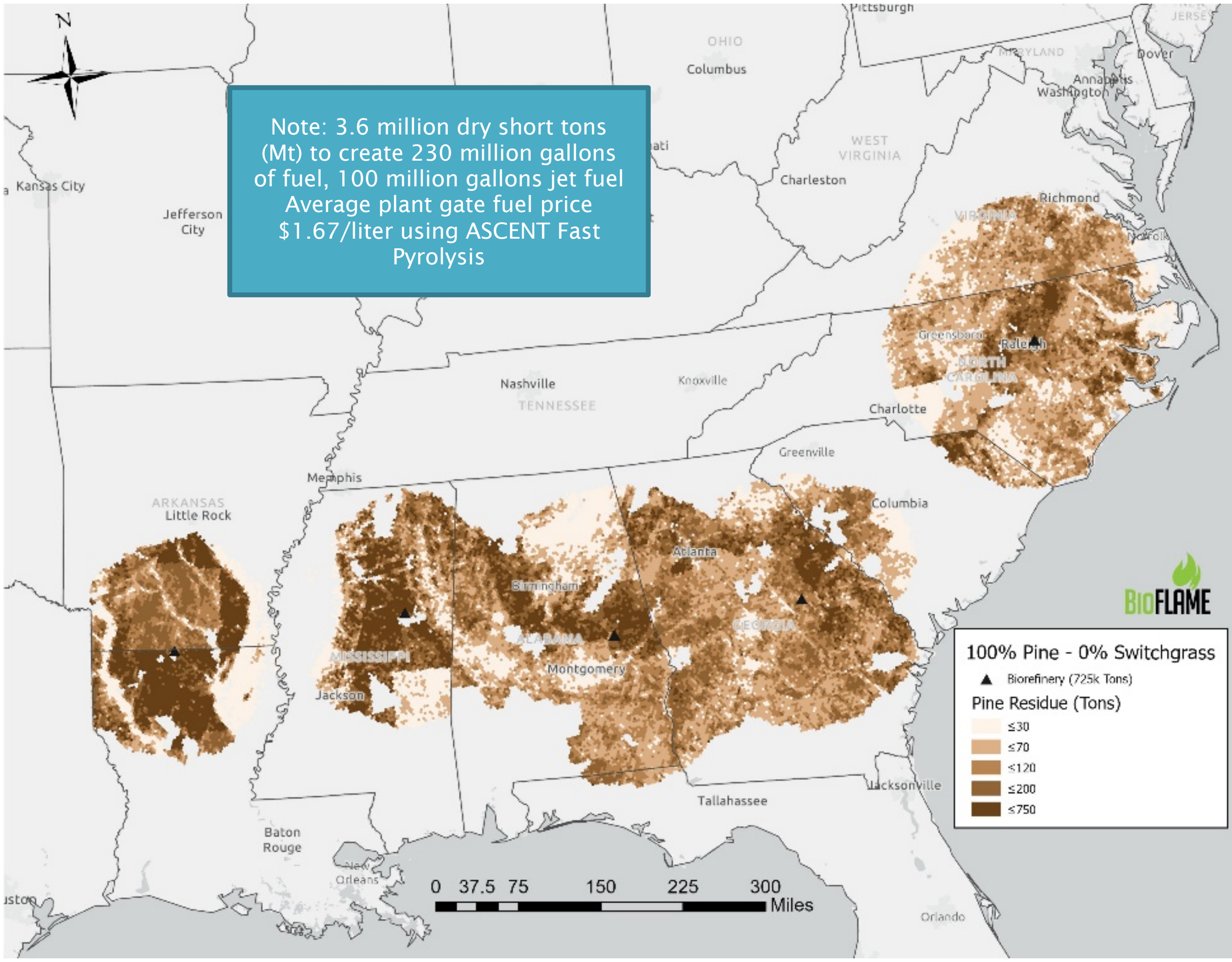


Figure 1. Projected biorefinery locations and their feedstock draw area; 2000 dry Mt/day.

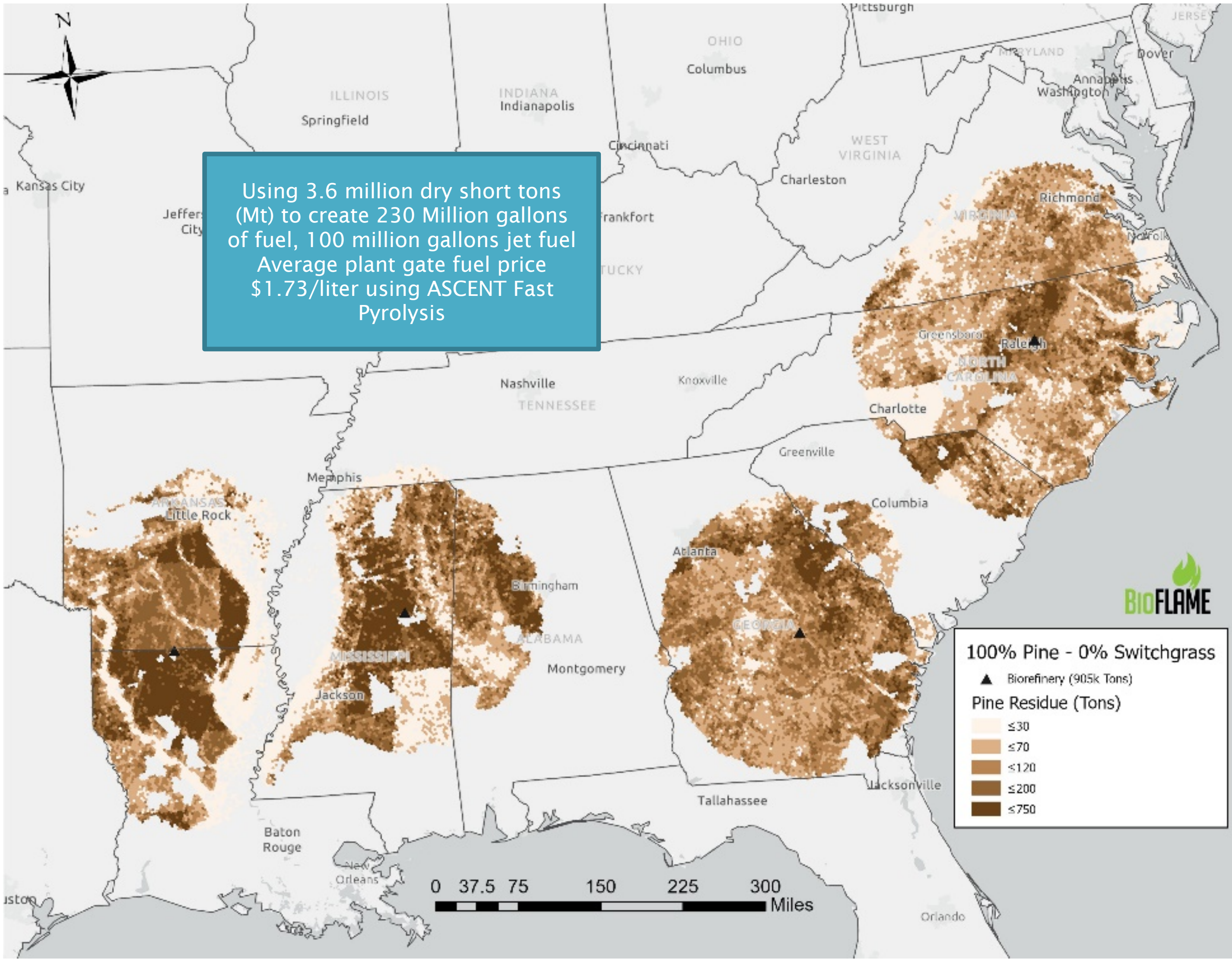


Figure 2. Projected biorefinery locations and their feedstock draw area; 2500 dry Mt/day.

With a 50% pine and 50% switchgrass blend, the region has the capability of using 4.7 million dry short tons of forest residues to produce 225 to 258 million gallons of sustainable aviation fuel (SAF) with the average price ranging from $1.74 to $1.78 per liter for the two different plant sizes.

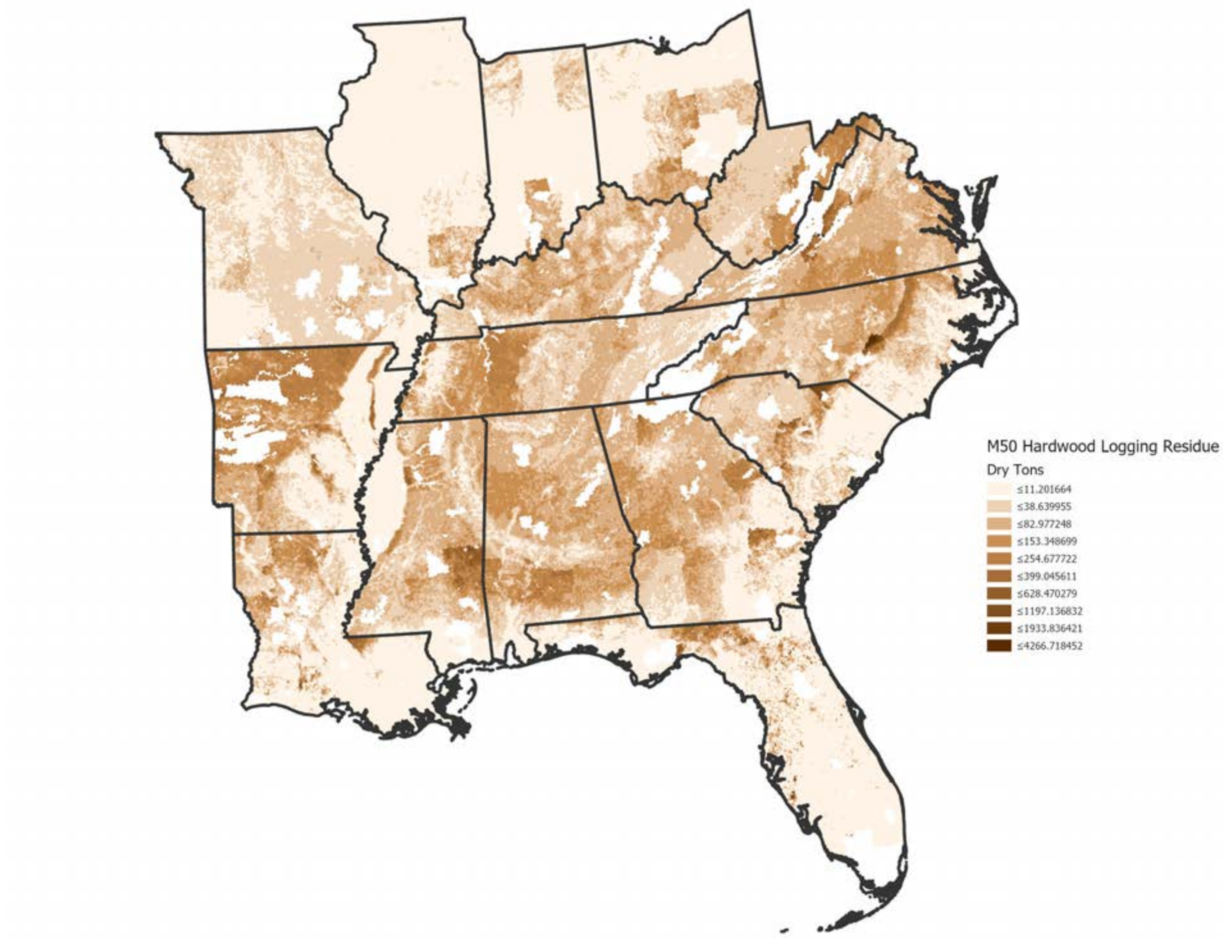
6. Developed new forest layer for the nation. Focus is the cellulosic pathway potential of the southeast and in Appalachia area specifically. Forest residues for the United States have been re-estimated and quantities have been evaluated.

Two scenarios were used. The initial analysis uses the Department of Energy's 2016 Billion-Ton Report assumptions, with medium demand for traditional forest products and a sustainable, 50-million-ton demand for forest residues. The model ForSEAM was rerun from 2015 to 2040 with the bioenergy demand for forest residues initiated in 2020 and continued to 2040. The model met this level of forest demand indicating that U.S. forests can produce the 50 million tons of forest residues sustainably. The second scenario assumed that harvest could extend beyond the limit of one mile from the road used by the2016 Billion-Ton Report. With this assumption, it was found that the nation’s forests can provide 75 million tons of forest residues for energy production over the same 20-year period (Table 2). The cost varies between $20 to $70 per ton delivered in chipped form with logging residues on the low end and pulpwood on the higher end. Locations of the hardwoods are shown in Figure 3, panels 1 and 2.

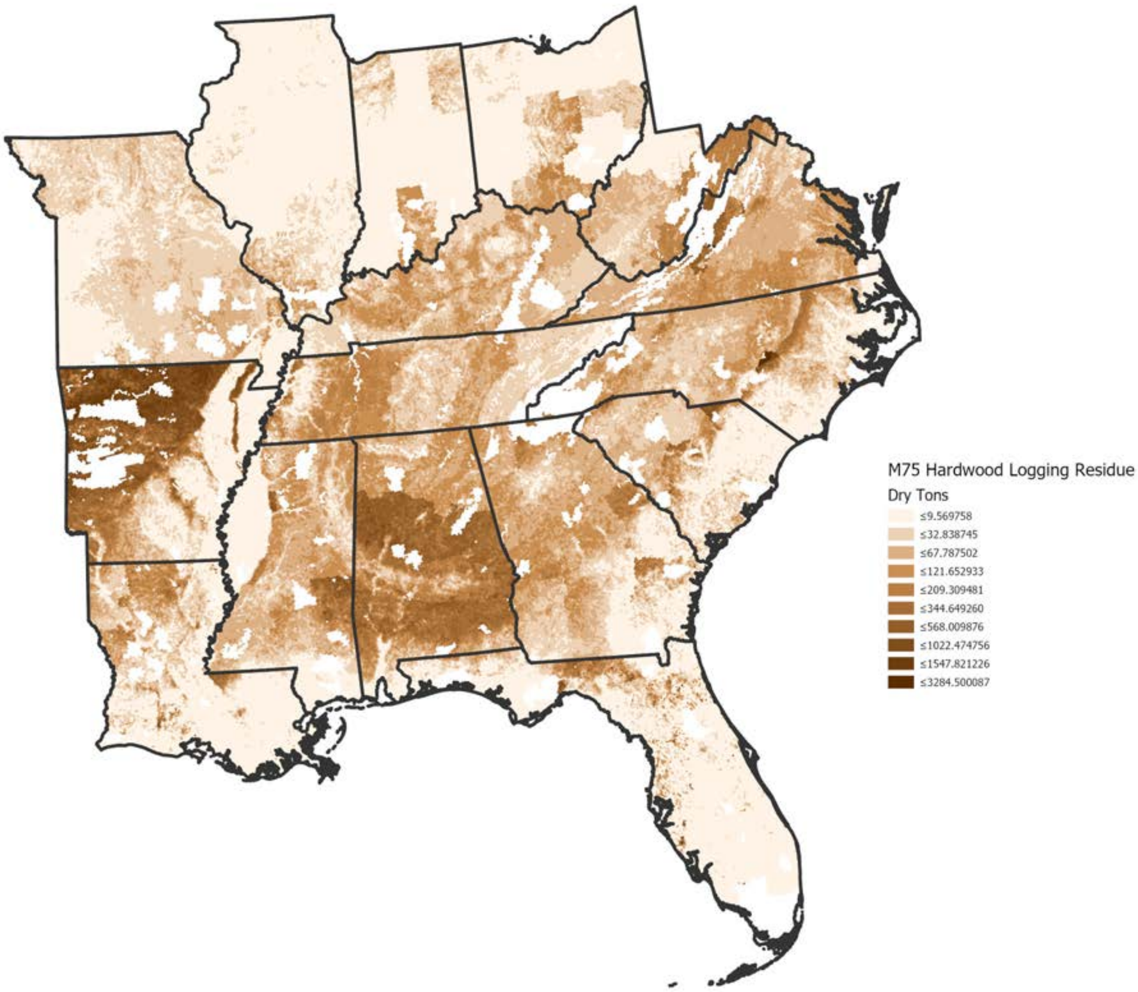
Table 2. Annual average hardwood and softwood timber available for energy feedstock, U.S.

	Hardwood		
	Upland and Lowland Hardwoods	Mixed Stands[a]	Total
	Dry tons		
Logging Residues	8,272,586	1,585,603	9,858,189
Whole Trees (pulp)	24,841,533	446,370	25,287,903
Whole Trees (Pre-pulp)	3,928,157	31,480	3,959,636
	37,042,275	2,063,453	39,105,729
	Softwoods		
	Natural and Planted Softwood	Mixed Stands	Total
Logging Residues	3,736,821	2,335,513	6,072,335
Whole Trees (pulp)	22,585,690	743,951	23,329,641
Whole Trees (Pre-pulp)	1,538,978	52,466	1,591,444
	27,861,490	3,131,930	30,993,420

[a] Stands identified as mixed are assumed to have 37.5% hardwood and the remainder softwood.



Panel 1. Hardwood forest residues, 50 million dry ton scenario with one mile from road limitation



Panel 2. Hardwood forest residues, 75 million dry ton scenario with three miles from road limitation

Figure 3. Hardwood logging residue potential in the Southeast under the 2016 Billion-Ton Report medium demand and sustainability assumptions relaxing the one mile to the road restriction.

Milestones

- Generated data incorporated into the ASCENT Project 001 database for hardwood and softwood forest residues in the Southeast for two different sustainability scenarios.
- Developed a pine pathway for the Southeast. Examined its potential using ASCENT cellulosic pathway.
- Delivered pennycress and crush facility spreadsheet to Penn State for use in risk-reward profit sharing modeling.
- Developed economic multipliers for Fischer-Tropsch Synthetic Paraffinic Kerosene (FT-SPK); Feedstock - Conversion temp. - 1200~1600 deg. C; Product - jet and naphtha; Microsoft Excel model of economic analysis; and Alcohol to Jet Synthetic Paraffinic Kerosene (ATJ-SPK); Feedstock - yeast biocatalyst converts purified sugar to ethanol, followed by oligomerization and hydrogenation; Product - jet fuel.

Major Accomplishments

A new logging residue spatial layer for hardwoods and softwoods was completed. This spatial layer contains forest residues from logging and thinning activities, along with sustainability criteria used in the 2016 Billion-Ton Report as well as relaxing the one mile to the road limitation to three miles.

Publications

None

Outreach Efforts

The University of Tennessee, Institute of Agriculture (UTIA) and the Commercial Aviation Alternative Fuels Initiative (CAAFI) are partnering to identify sites with optimal woody biomass and essential supply chain infrastructure because these factors present challenges for processors with limited resources to conduct site assessments with enough detail needed to attract investment capital. The initial attempt will highlight the availability of woody biomass in the region, and thereby extend its potential utilization.

Awards

None

Student Involvement

Alan Robertson graduated and was employed by Pilot. He worked on oilseeds and switchgrass quality.

Luis Vizcaya is working on a forest harvesting model and biorefinery siting given forest residue availability. Vizcaya was also included in the project to analyze the optimal harvest pattern of forestry residues that will be the derived supply for biorefineries.

Latif Patway is examining potential environmental benefits.

Plans for Next Period

- Complete blend study.
- Develop forest harvest model
- Complete several manuscripts.
- Continue work on forest sector.
- Develop a stochastic analysis focusing on pennycress, carinata, and camelina feasibility in the Southeast.
- Continue to work on Memphis International Airport region analysis using camelina and pennycress as feedstocks.
- Work on feedstock sustainability issues.
- Develop stakeholders for the Central Appalachia region.

Task 2 – Develop National Lipid Analysis

University of Tennessee

Objectives

The UT team will complete the national lipid supply availability analysis employing POLYSYS to develop information on the potential impacts and feasibility of using lipids to supply aviation fuel.

Research Approach

POLYSYS will be used to estimate and assess the supply and availability of lipid feedstock options at regional and national levels. This U.S. agricultural sector model forecasts changes in commodity prices and net farm income over time. Analysis requires consistency amongst the crops. Budgets have been reevaluated for pennycress, camelina, and carinata for consistent assumptions where possible. Yields have been compared to literature sources and cover crop estimates appear to be consistent. See yield maps (Figures 4–6) below.

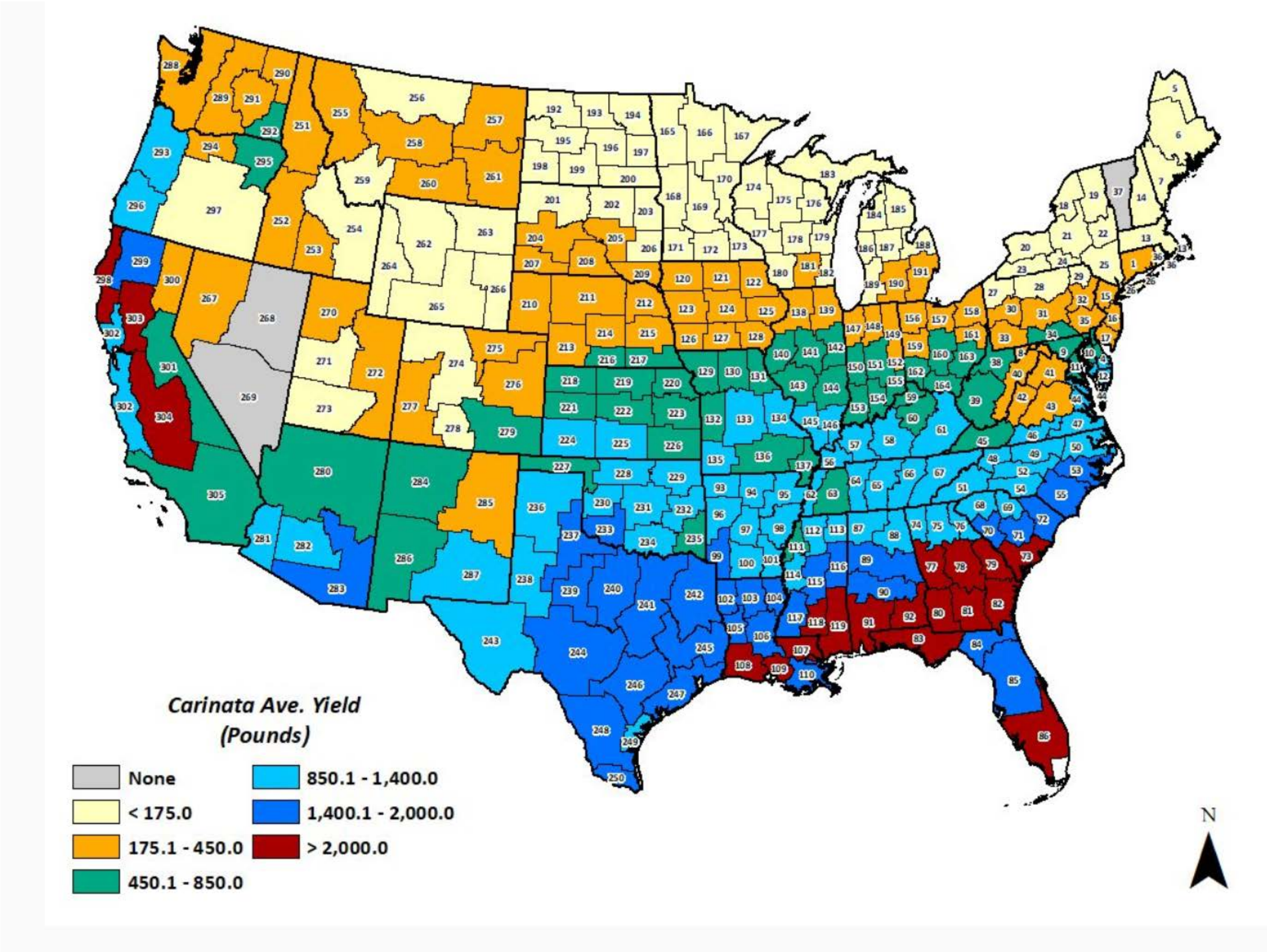


Figure 4. Yield map for carinata.

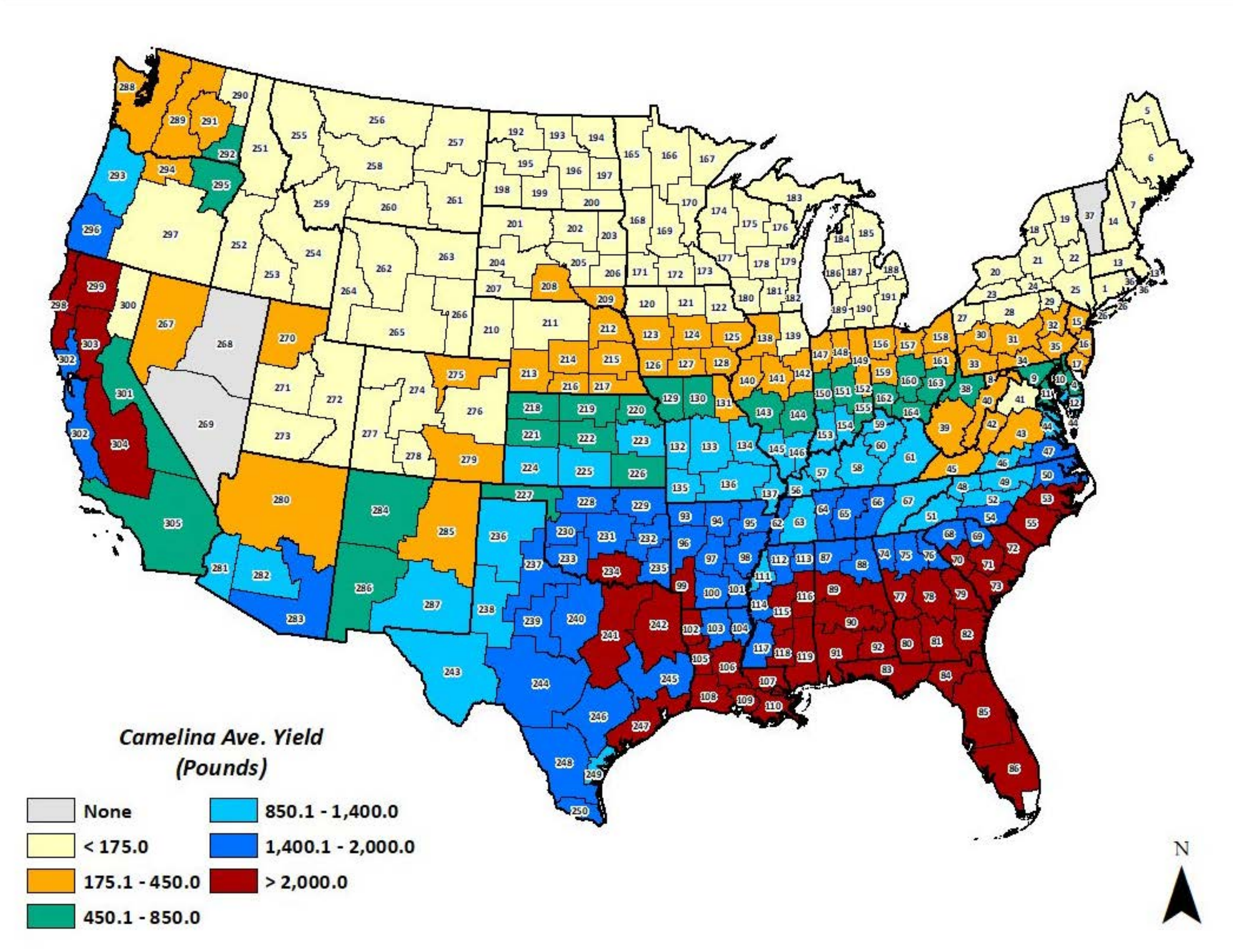


Figure 5. Yield map for camelina.

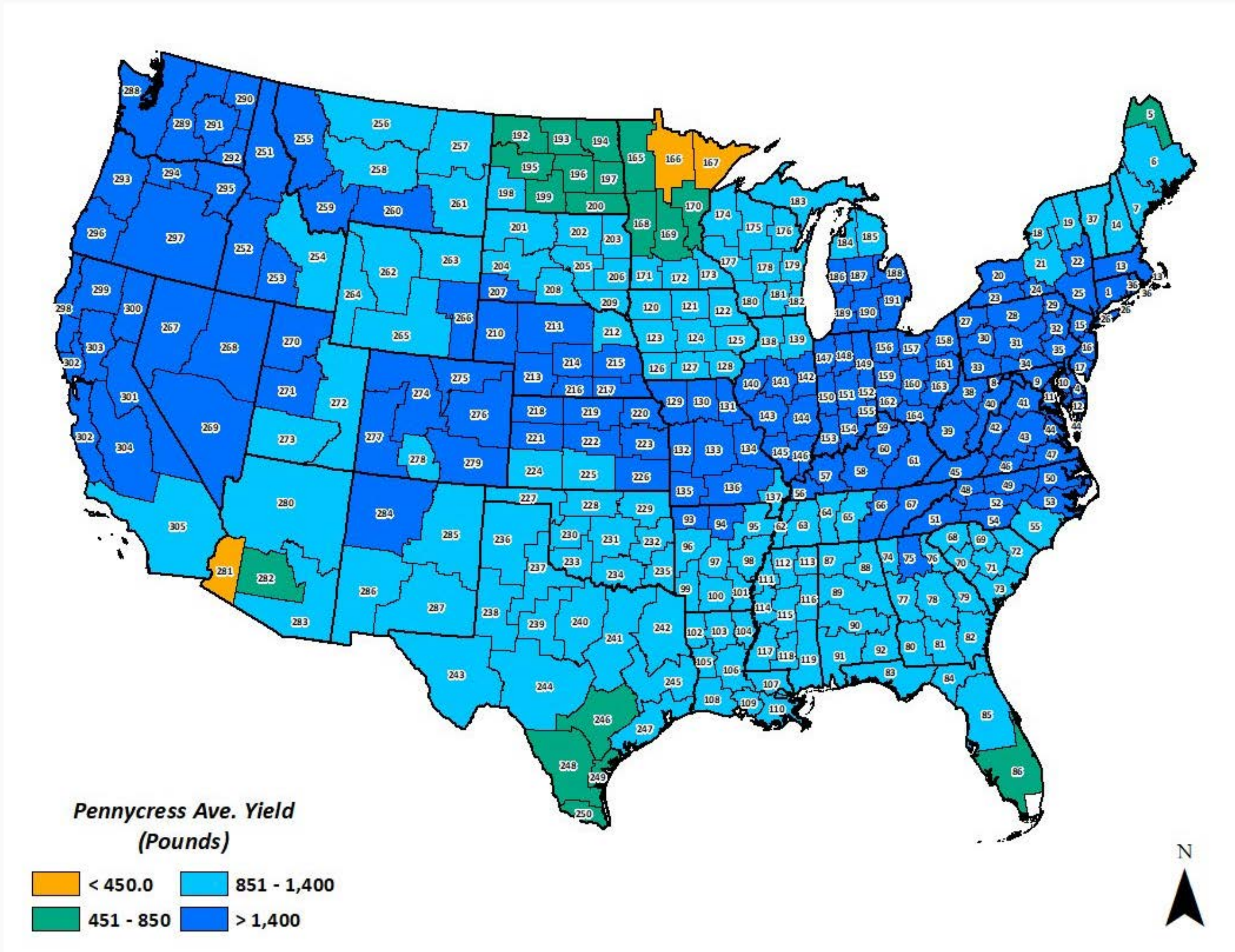


Figure 6. Yield map for pennycress.

Milestones

This Task is behind schedule because COVID-19 has limited access to POLYSYS. The situation will improve in the next quarter. The analysis will be completed and written up for the ASCENT-organized, special issue of *Frontiers in Energy Research*. featuring the work ASCENT Project 001 has completed up to this point. The issue will include articles that provide an introduction and overview, covering sustainability as a key value proposition for SAF, feedstocks and economic sustainability, techno-economic analysis of conversion pathways, supply chain development and de-risking, environmental performance including greenhouse gas life cycle analysis (LCA) and local air quality/ emissions benefits, recent advances in indirect land use change () modeling, ecosystem services provided by SAF pathways, SAF and social sustainability, and policy effects on deployment and sustainability performance, including future scenario analyses of the potential for deployment, targets and policies, and fuel testing/analysis and properties. The planned article, written about this project, will address both feedstock and economic sustainability of oilseed cover crops.

Major Accomplishments

- Crops are consistent and ready to be placed into POLYSYS. Last year the POLYSYS modeling was completed to accommodate additional cover crops.
- Completed the carinata spreadsheet, incorporating risk into the analysis. The spreadsheet is under review.

- Compared the assumptions between the three oilseed crops and attempted to develop spreadsheets that contain similar price data and other assumptions.

Publications

Choi, Yejun; Lambert, Dayton M.; Jensen, Kimberly L.; Clark, Christopher D.; English, Burton C.; Thomas, McKenzie. 2020. "Rank-Ordered Analysis of Consumer Preferences for the Attributes of a Value-Added Biofuel Co-Product" *Sustainability* 12, no. 6: 2363.

Trejo-Pech, C., J. A. Larson, B. C. English, and T. E. Yu. 2019. Cost and Profitability Analysis of a Prospective Pennycress to Sustainable Aviation Fuel Supply Chain in Southern USA. Energies, 12, no. 16: 3055.

A carinata article is in draft form.

Outreach Efforts

None

Awards

None

Student Involvement

Alan Robertson

Plans for Next Period

Complete national oilseed analysis.

Task 3 – Lay the Groundwork for Lipid and/or Biomass in TN and Southeastern U.S.

University of Tennessee

Objectives

The team at UT will facilitate regional deployment/production of renewable jet fuel by completing the groundwork phase of the regional oilseed feedstock to biofuel pathway and developing a proposal for regional deployment in the Southeastern U.S. and in Central Appalachia leading to the development of SAF regional deployment plans..

Research Approach

- Same as Task 1 but focused on small areas such as the Central Appalachia, Memphis, and Nashville regions.
- Softwood analysis is focused on the Southeast and findings are displayed in Task 1 above.
- Developed seed trial for oilseed cover crops using funding from UT seed money. The findings will be incorporated in this report for the first year under subproject 2.

Central Appalachia—first year of a multi-year project

This project was initiated about the time when COVID-19 hit. The project was rearranged to reflect laboratory closures and travel restrictions. The research approach was modified somewhat to reflect these changes. The hardwood forest residue layer was developed for BioFLAME and Freight and Fuel Transportation Optimization Tool (FTOT) (Figures 7 and 8).

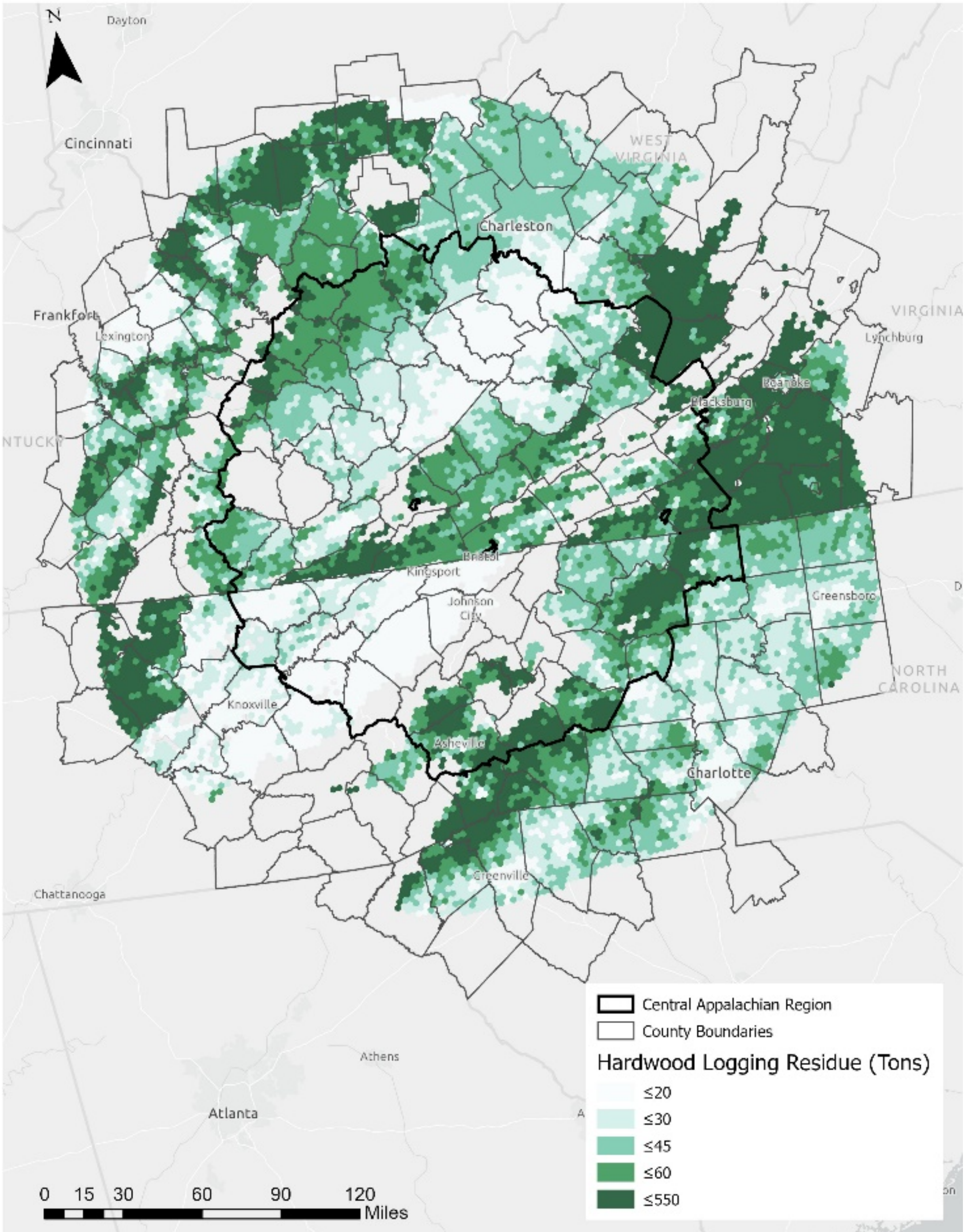


Figure 7. Estimated privately owned hardwood forest residues

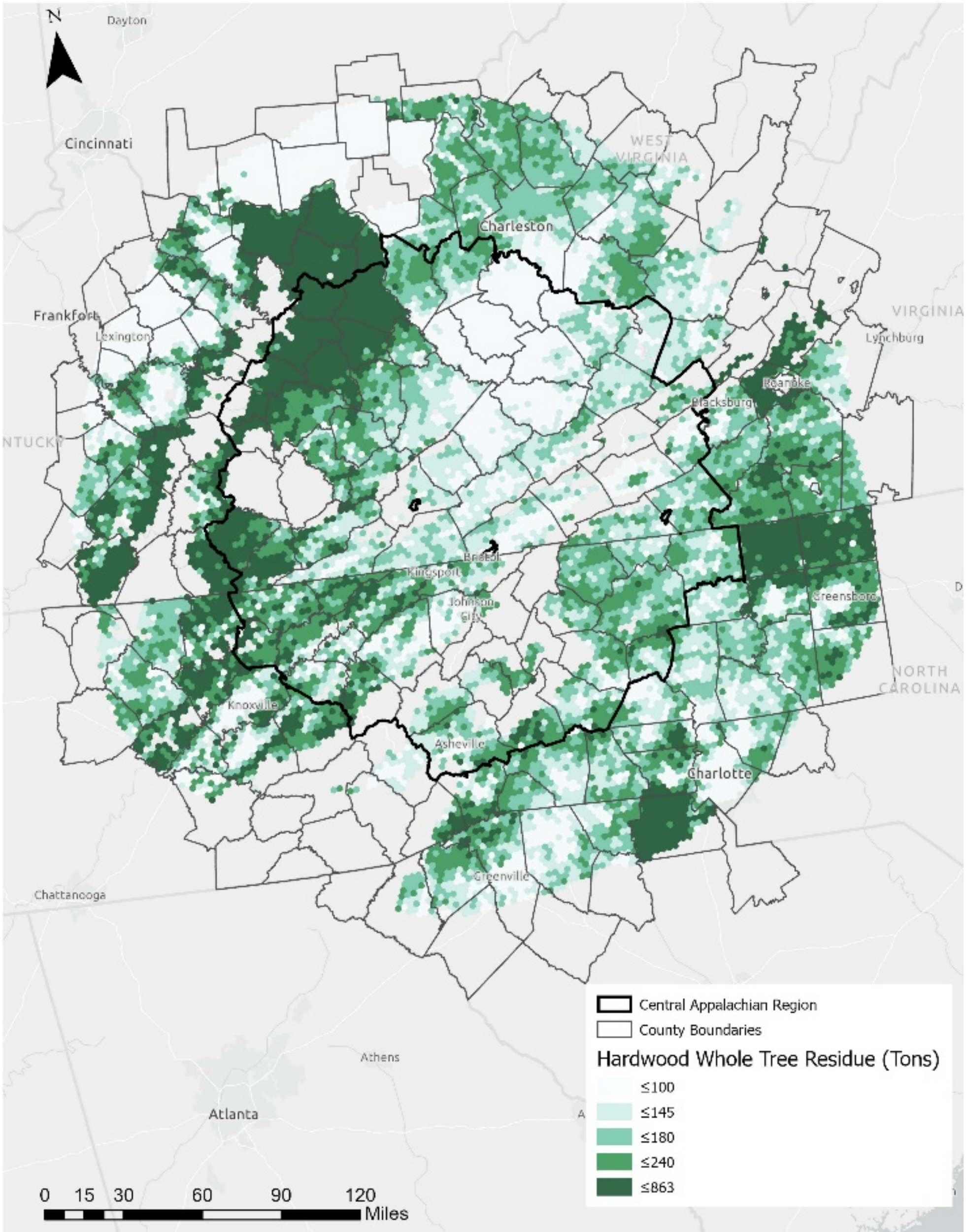


Figure 8. Estimated whole tree, privately owned forest residue from thinning and pulpwood material.

In addition, the potential locations of a biorefinery were developed and located within the region (Figure 9). Existing sawmills were identified in the region. Contract was established with the Center for Natural Capital, and the development of stakeholder advisory board and stakeholder group has been initiated. The initial brainstorming meeting is scheduled for mid-November.

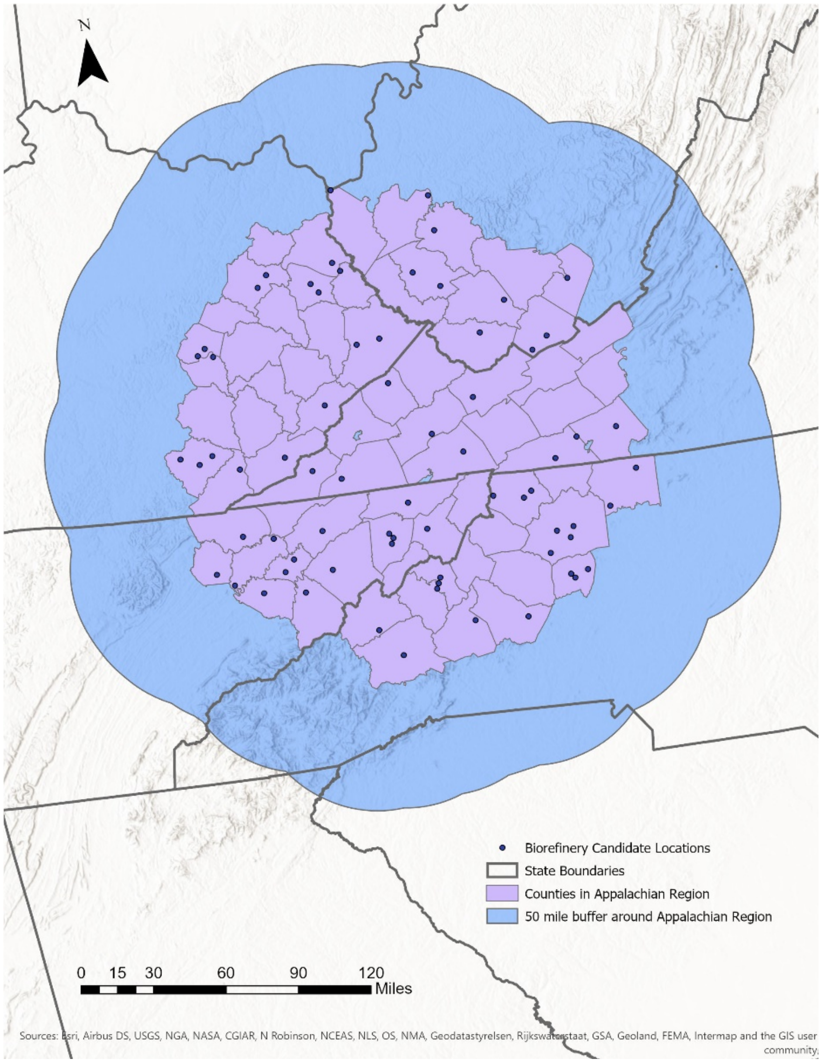


Figure 9. Industrial park within the Central Appalachian study region or in West Virginia at towns of a pre-specified size.

Survey of producers
A total of 206 farmers in AL, AR, IL, KY, MO, MS, and TN responded to a survey conducted using Qualtrics and the Farm Journal contact online service.

Survey of consumers
A survey of consumers and their use of biochar as a soil amendment was conducted. The pre-test and survey were administered online through Qualtrics, an online hosting service. A total of 771 Tennesseans responded.

Milestones
The Nashville modeling work using cover crop oilseeds is completed. The next step will be to develop a regional deployment plan once risk and uncertainty are evaluated.

The Memphis modeling work is completed, but analysis has not begun. Analysis will be initiated during the second quarter of 2021.

Major Accomplishments

Survey of producers results

Of the survey respondents, 55% stated they would plant a cover crop (pennycress),38% said no but they supported SAF, and 7% said no and they do not support SAF. Of the 55% of respondents who answered yes to growing pennycress, 50% of them would need to earn at least $0.10 per pound. The farmers' concerns about growing an oilseed crop as a cover were ranked in order of concern on a 1 to 5 scale, with 5 being extremely concerned. The results are shown in Figure 10.

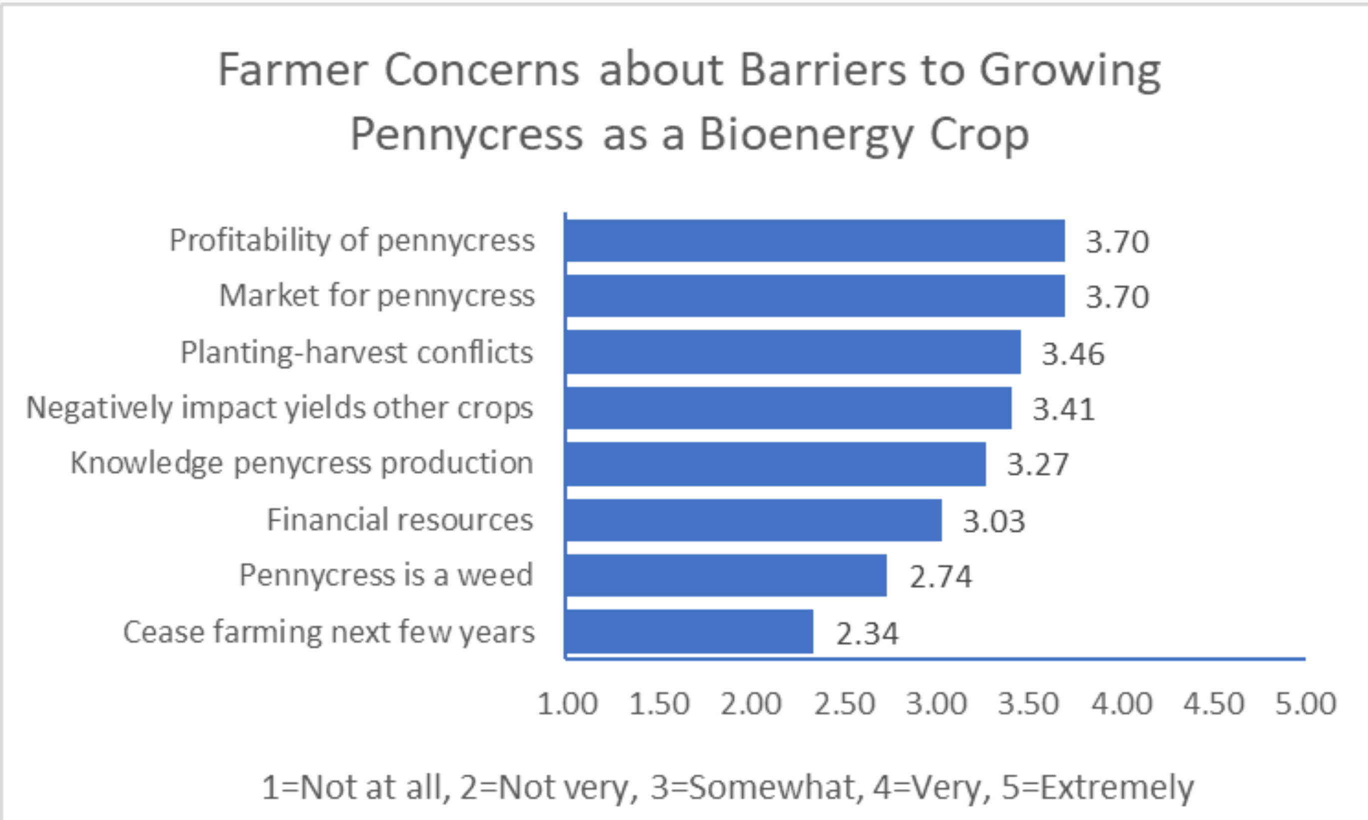


Figure 10. Farmer concerns about barriers to growing pennycress as a bioenergy crop.

Survey of consumers

The participants of the consumer biochar survey were asked to choose between two potting mix products: a conventional eight-quart bag of potting mix priced at $4.99, and an eight-quart potting mix bag with 25% biochar priced at either $4.99, $6.49, $7.99, $9.49, or $10.99. The estimate of willingness to pay (WTP) for a 25% biochar potting mix was $8.52, a significant premium over the potting mix with no biochar at $4.99. Overall, 54.42% of the respondents were willing to pay the price offered for the 25% biochar potting mix. Other factors and influences on WTP included greater percent of income spent on gardening supplies, greater potting mix purchases, likely purchase at garden centers, importance of product being a biofuel co-product, and greater concerns about climate change.

Task 4 – Biorefinery Infrastructure and Siting (Supporting Role)

University of Tennessee

Objective

Provide feedstock support to other members of ASCENT as requested.

Research Approach

The research approach to Task 4 is to provide necessary input through research efforts using feedstock tools developed prior to or as a part of this project. The approach will differ as questions surface from other universities. This year, we provided input to Penn State on the cost of feedstock production, and to FTOT asking for information on feedstock availability in the Central Appalachian region. Discussions were also held about the potential of assisting Scott Q. Turn at the University of Hawaii with an economic analysis of Hawaii feedstock and conversion efforts.

Milestone(s)

1. Delivered potential hardwood feedstock layer to FTOT.
2. Delivered crushing facility and pennycress budget information to Penn State for risk analysis project

Major Accomplishments

See Tasks 1 and 3 above.

Publications

Sharma, B. P., T. E. Yu, B. C. English, C. Boyer, and J. A. Larson. 2019. Stochastic Optimization of Cellulosic Biofuel Supply Chain under Feedstock Yield Uncertainty. *Energy Procedia*, 158: 1009-1014.

Trejo-Pech, C., J. A. Larson, B. C. English, and T. E. Yu. 2019. Cost and Profitability Analysis of a Prospective Pennycress to Sustainable Aviation Fuel Supply Chain in Southern USA. Energies, 12, no. 16: 3055.

Choi, Y., D. Lambert, K. L. Jensen, C. D. Clark, B. C. English, and M. Thomas, 2020. Rank-Ordered Analysis of Consumer Preferences for the Attributes of a Value-Added Biofuel Co-Product, *Sustainability*, 12, 2363.

Gill, MacKenzie, K. L. Jensen, D. M. Lambert, S. Upendram, B. C. English, N. Labbé, S. Jackson, and R. J. Menard, 2020. Consumer Preferences for Eco-Friendly Attributes in Disposable Dinnerware, Resources, Conservation and Recycling, Volume 161, October 2020, 104965.

Yu, T. E., B. C. English, J. Zhong, J. A. Larson, J. S. Fu, L. H. Lambert, and B. S. Wilson, 2020. High-resolution Multi-objective Optimization of Sustainable Supply Chains for a Large Scale Lignocellulosic Biofuel Industry, Pursuing Sustainability: OR/MS Applications in Sustainable Design, Manufacturing, Logistics, & Resources, C. Chen, V. Jayaraman, and Y. Chen, ed., Springer International Series in Operations Research and Management Science.

Lewis, K.C., E. K. News, S. Peterson, M. N. Pearlson, E. A. Lawless, K. Brandt, D. Camenzind, M. P. Wolcott, B. C. English, G. S. Latta, A. Malwitz, J. I. Hileman, N. L. Brown, and Z. Haq., 2019. U.S. Alternative Jet Fuel Deployment Scenario Analyses Identifying Key Drivers and Geospatial Patterns for the First Billion Gallons, BioFPR, Society of Chemical Industry and John Wiley & Sons, Ltd, December,13, pp 471–485.

Markel, E, B. C. English, C. M. Hellwinckel, and R. J. Menard., 2019. Potential for Pennycress to Support a Renewable Jet Fuel Industry, Ecology, Pollution and Environmental Science, *SciEnvironm* 1:121.

Choi, Y., D.M. Lambert, K.L. Jensen, C.D. Clark, B.C. English, and M. Thomas. 2020. "Rank-Ordered Analysis of Consumer Preferences for the Attributes of a Value-Added Biofuel Co-Product. *Sustainability*, 12, 2363; doi:10.3390/su12062363.

Thomas, M., K.L. Jensen. C. Clark., B. English, D. Lambert, and F. Walker. 2019. "Tennessee Home Gardener Preferences for Environmental Attributes in Gardening Supplies: A Multiple Indicators Multiple Causation Analysis." *2019 SNA Research Conference* 63: 87-93 (refereed proceedings).

Sharma, B.P, T. E. Yu, B. C. English, C. Boyer, and J. A. Larson, Impact of Government Subsidies on a Cellulosic Biofuel Sector with Diverse Risk Preferences toward Feedstock Uncertainty, *Energy Policy*, in press.

Thomas, M.*, K.L. Jensen, M. Velandia, C. Clark, B. English, D. Lambert, and F.Walker. 2020. "Outdoor Home Gardener Preferences for Environmental Attributes in Gardening Supplies and Use of Ecofriendly Gardening Practices." *HortTech.* Accepted, in press.

Thomas, M.*, K. L. Jensen, C. D. Clark, D. M. Lambert, B. C. English, and F. R. Walker. 2020. "Consumer Preferences for Potting Mix with Biochar." *Journal of Cleaner Production,* in review.

Gill, Mackenzie (August 2020). Consumer Preferences for Environmentally Friendly Disposable Dinnerware Alternatives, University of Tennessee M.S. Thesis.

Patwary, A. Latif (May 2020). "Efficiency Studies of the U.S. Transportation Sector", University of Tennessee M.S. Thesis.

Robertson, A. (May 2020). "Biomass Potential in Sustainable Aviation Fuel Development: Switchgrass Production Optimization and Carinata Oilseed Enterprise Viability Analysis", University of Tennessee M.S. Thesis.

Thomas, M. (May 2019). "An Analysis of Consumer Preferences for Gardening Products with Environmentally Friendly Attributes." University of Tennessee M.S. Thesis.

Outreach Efforts

Trejo-Pech, C., J. A. Larson, B. C. English, and T. E. Yu., 2019. Return and Risk Profile of a Potential Pennycress Processing Facility for the Aviation Industry, Southern Agricultural Economics Association Annual Meeting. Birmingham, AL, February 2-5.

Larson, J. A., C. Trejo-Pech, B. C. English, and T. E. Yu. 2019. Farm-level Risk Management Potential of Pennycress as a Bioenergy Cover Crop in a Corn-Soybean Rotation. Southern Agricultural Economics Association Annual Meeting. Birmingham, AL, February 2-5.

Thomas, L., K.L. Jensen, C. Clark, D. Lambert, B. English, and F. Walker. 2019. Consumers' Willingness to Pay for Potting Mix with Biochar. Selected Paper. Southern Agricultural Association Meetings, Birmingham, AL. February 2 – 5.
Choi, Y., D. Lambert, K.L. Jensen, C. Clark, B. English, and M. Thomas. 2019. "Estimating Consumer Preferences for Biochar Using Best and Worst Scaling." Selected Paper. 2019 Western Agricultural Association Meetings, Coeur D'Alene, ID. June 30-July 2.

Thomas, M., K.L. Jensen. C. Clark., B. English, D. Lambert, and F. Walker. 2019. "Tennessee Home Gardener Preferences for Environmental Attributes in Gardening Supplies: A Multiple Indicators Multiple Causation Analysis." Presentation at 2019 SNA Research Conference, Baltimore, MD, Jan. 7-8.

Awards

None

Student Involvement

McKenzie Thomas – Masters Graduate Student – Survey work
Luis Vizcaya – Masters Graduate Student – Modelling forest residues
Patwary, A. Latif – Masters Graduate Student – Sustainability and GHG emissions
Mackenzie Gill – Masters Graduate Student – Survey work
Ty Wolaver – Masters Graduate Student – Co-product evaluation

Plans for Next Period (Year)

- Complete oilseed national analysis
- Complete farm survey analysis
- Continue to react to ASCENT Project 001 needs
- Complete Nashville deployment plan
- Respond to UT-CAAFI analysis needs
- Complete website to place simulation analysis
- Complete FTOT-BioFLAME comparison findings.
- Continue to add social capital into supply chain framework.
- Enhance economic indicator analysis.