Supplementary Materials

Multidimensional Aspects of Sustainable Biofuel Feedstock Production

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Table S1. Calibration and validation performance evaluation of SWAT simulated data against USGS station 04155500 observations [37, 38, 39]

Metric	Optimal	Calibration (2003-2008)	Validation (2009-2014)	Overall (2003-2014)
NSE	1.0	0.69	0.75	0.72
KGE	1.0	0.84	0.86	0.86
KGE’	1.0	0.81	0.84	0.86
RSR	0.0	0.56	0.50	0.52
d	1.0	0.92	0.93	0.93
R^2	1.0	0.74	0.76	0.75
PBIAS (%)	0.0	4.56	-5.16	-0.48
RMSE (cms)	0.0	5.37	5.62	5.49

Table S2. Example life cycle analysis calculation of soybean crop

Soybeans		Quantity	Unit	Net carbon ($kgCO_2e/ha$)
SOM farm	% SOM	1.75	%	
	SOM per acre	78000	Kg/ha	
	SOM maintenance cost	2.3	%	
	SOM lost per year	1800	Kg/ha/yr	-3200
Biomass	Soybean yield	2.7	Tonne	
	Biofuel energy component	600	L/ha	
	Harvest efficiency	40	%	
	Shoot-to-root ratio	5.2		
	Total above-ground biomass	7300	Kg/ha	
	Above-ground residue	4400	Kg/ha	
	Belowground residue	1300	Kg/ha	
	Total residue	5700	Kg/ha	
	Residue contribution to SOM	1100	Kg/ha	2100
	No-till or perennial crop SOM credit	0.00	SOM increase	
	Seeds per acre	320,000	Seeds/ha	-21
Fertilizer	N (Urea)	0	Kg/ha	0
	P_2O_5	38	Kg/ha	-21
	K_2O	67	Kg/ha	-29
	Lime	0	Tonne/ha	0
Pesticides	Glyphosate Amine	0.9	Kg/ha	-41
Energy	Drying	0	%pts/tonne to dry	0
	Fuel, oil, lube	150	L/ha	-390
	Water	0	Hai	0
	Labor	2.5	Hr/ha	-11
Total	Carbon saving from displaced diesel			1600
	Carbon sequestered as SOM			2100
	Carbon from inputs			-500
	Net carbon sequestered and energy			3200

Table S3. Example economic analysis of soybean production USD per planted hectare in Northern Crescent U.S. [21]

Economic Elements	Year											
	2014	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**	**2006**	**2005**	**2004**	**2003**
Gross value soybeans	$1,222.65	$1,352.77	$1,563.88	$1,413.43	$1,155.96	$1,027.03	$950.46	$851.80	$622.64	$613.18	$527.44	$480.37
Operating costs												
Seed	$155.59	$153.98	$146.25	$147.26	$153.78	$143.11	$114.98	$103.12	$85.63	$78.27	$73.01	$67.83
Fertilizer	$122.19	$127.18	$129.68	$85.14	$64.27	$83.81	$89.17	$54.09	$48.46	$44.09	$35.27	$32.11
Chemicals	$55.65	$54.64	$52.61	$38.98	$39.79	$40.34	$36.56	$34.93	$34.38	$33.69	$41.32	$41.89
Custom services	$31.02	$30.16	$29.02	$23.81	$23.37	$23.09	$21.19	$21.19	$20.18	$24.23	$23.12	$23.14
Fuel, lube, and electricity	$42.81	$42.81	$43.25	$46.58	$36.53	$29.34	$44.26	$33.96	$30.75	$37.30	$26.50	$25.44
Repairs	$48.49	$47.57	$47.10	$29.79	$28.70	$28.16	$27.61	$26.73	$26.01	$31.67	$29.22	$27.52
Interest on operating capital	$0.15	$0.20	$0.30	$0.20	$0.35	$0.49	$7.48	$6.15	$5.83	$4.20	$1.80	$1.16
Allocated overhead												
Hired labor	$4.22	$4.15	$4.03	$3.24	$3.19	$3.16	$3.09	$2.99	$2.89	$8.15	$8.10	$8.05
Opportunity cost unpaid labor	$44.56	$43.74	$42.51	$46.09	$45.62	$45.13	$44.16	$42.73	$41.27	$54.96	$53.52	$53.75
Capital recovery machine and equip.	$181.42	$174.95	$170.08	$175.44	$165.37	$159.61	$150.27	$137.33	$130.86	$137.83	$127.11	$119.65
Opportunity cost of land	$311.15	$300.11	$275.82	$245.49	$224.45	$218.35	$188.58	$170.92	$175.35	$177.74	$176.28	$171.44
Taxes and insurance	$25.71	$25.22	$24.72	$30.95	$28.85	$33.17	$29.57	$26.63	$24.68	$19.14	$18.40	$18.35
General farm overhead	$56.37	$55.30	$54.76	$49.08	$47.33	$46.44	$45.55	$44.06	$42.88	$37.20	$35.35	$34.83
Net value of production	$143.33	$292.77	$543.75	$491.38	$294.37	$172.83	$147.98	$146.97	-$46.53	-$75.29	-$121.57	-$144.79
Yield (Tonne/ha)	296	282	302	309	322	282	249	289	309	289	255	202
Price ($/Tonne)	$30.60	$35.47	$38.27	$33.84	$26.52	$26.93	$28.29	$21.81	$14.91	$15.56	$15.20	$17.68

Table S4. Economic analysis bioenergy crop production over 12-year period in USD per hectare

Year	Corn	Corn-stover	Sorghum	Soybean	Corn-soybean	Corn-soybean-canola	Corn-stover-soybean	Miscanthus	Switchgrass	Sorghum-soybean
2003	-$161.53	-$144.37	-$118.51	-$144.79	-$161.53	-$161.53	-$144.37	-$3,691.95	-$1,212.69	-$118.51
2004	-$169.39	-$152.23	-$189.75	-$121.57	-$121.57	-$121.57	-$121.57	-$912.45	-$762.35	-$121.57
2005	-$343.05	-$325.89	-$249.64	-$343.05	-$343.05	-$1,150.94	-$325.89	-$126.72	-$779.00	-$249.64
2006	-$386.80	-$369.64	-$207.80	-$46.53	-$46.53	-$386.80	-$46.53	-$126.72	-$779.00	-$46.53
2007	-$269.40	-$252.24	-$17.96	$146.97	-$269.40	$146.97	-$252.24	-$126.72	-$779.00	-$17.96
2008	$147.98	$147.98	$147.98	-$182.68	$147.98	-$654.47	$147.98	-$126.72	-$779.00	$147.98
2009	-$316.43	-$299.27	-$174.73	$172.83	-$316.43	-$316.43	-$299.27	-$126.72	-$779.00	-$174.73
2010	$436.37	$453.54	-$35.96	$294.37	$294.37	$294.37	$294.37	-$126.72	-$852.00	$294.37
2011	$711.73	$728.90	$234.85	$711.73	$711.73	-$651.32	$728.90	-$126.72	-$852.00	$234.85
2012	$658.28	$669.94	-$187.60	$543.75	$543.75	$658.28	$543.75	-$126.72	-$852.00	$543.75
2013	$105.10	$122.27	-$46.09	$292.77	$105.10	$292.77	$122.27	-$126.72	-$924.29	-$46.09
2014	$143.33	$143.33	$143.33	-$193.43	$143.33	-$474.65	$143.33	-$126.72	-$924.29	$143.33
Total	$556.19	$722.33	-$701.88	$1,130.35	$687.74	-$2,525.33	$790.72	-$5,871.65	-$10,274.62	$589.24
Average	$46.35	$60.19	-$58.49	$94.20	$57.31	-$210.44	$65.89	-$489.30	-$856.22	$49.10

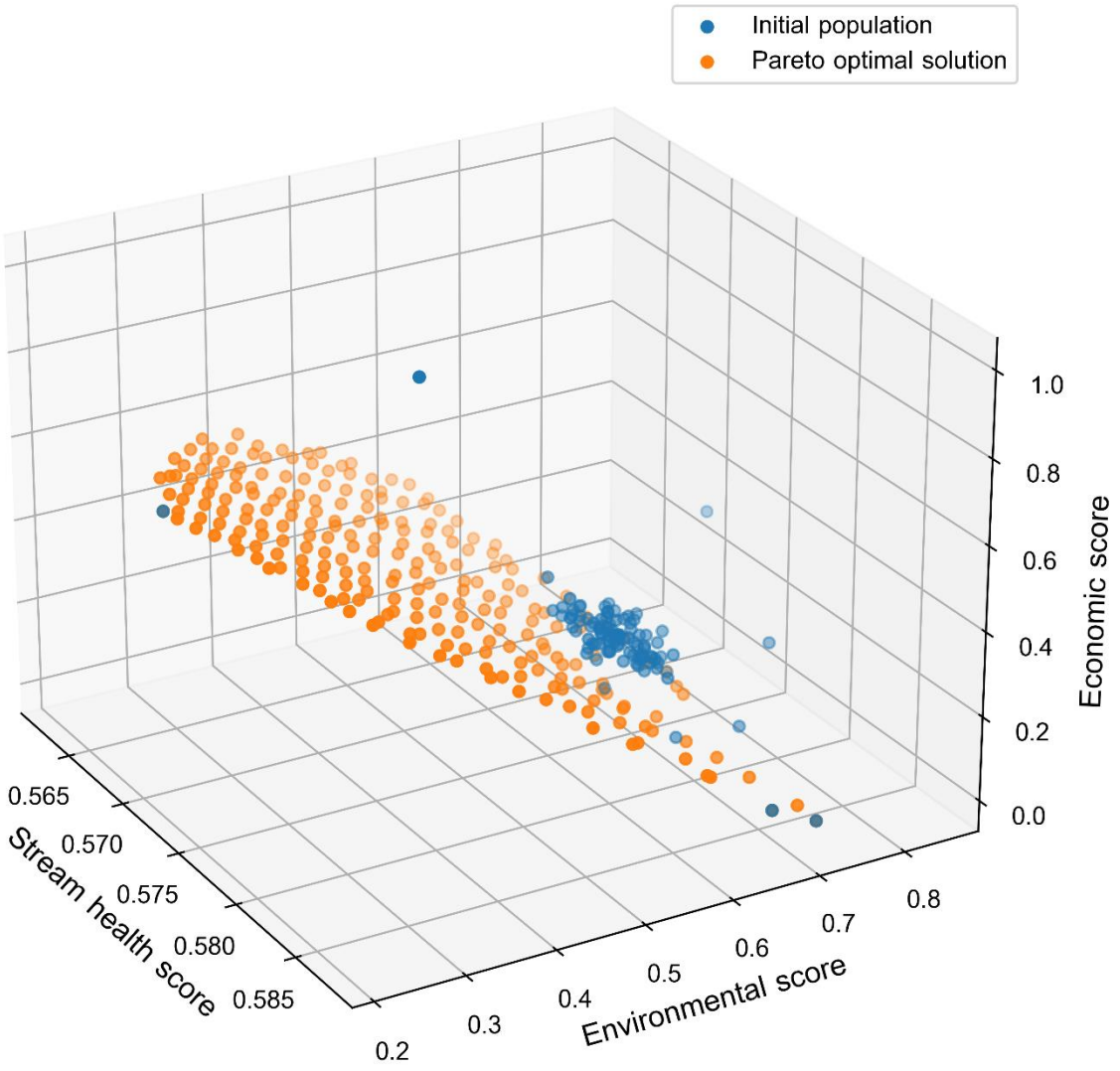

Figure S1. Initial population and Pareto optimal solutions front