Supplementary Information

Table S1. Life-cycle GHG emission factors associated with different inputs and processes

Input/Activity	GWP	References
Nitrogen ($kgCO_2e$ per kg of N)	6.89	(Liang et al., 2021)
Phosphorous ($kgCO_2e$ per kg of P_2O_5)	0.67	
Potassium ($kgCO_2e$ per kg of K)	0.65	
Lime ($kgCO_2e$ per kg of input)	0.015	
Herbicides ($kgCO_2e$ per kg of input)	16.35	
Machine ($kgCO_2e$ per kg of input)	1.58	(Argonne National Laboratory, 2020)
Diesel ($kgCO_2e$ per liter)	2.73	
Electricity ($kgCO_2e$ per kwh)	0.61	
Gasoline (gCO_2e per MJ)	94	
Feedstock transportation ($kgCO_2e$ per ton per km)	0.20	(Masum et al., 2020)
Rice cultivation (mg CH_4 /(m^2 * h))	9.28	(Liang et al., 2021)
Soil carbon loss-corn stover (kg CO2e/MT stover)	103	(Zhao et al., 2016)
Soil carbon loss-wheat straw (kg CO_2e/MT straw)	312	(Jin et al., 2020)
Soil carbon loss-rice straw (kg CO e/MT straw)	312	
Biomass preprocessing ($kgCO_2e$/MT biomass)	51.89	(Obnamia et al., 2019)
Biomass burning for electricity ($kgCO_2e$/MT biomass)	34.4	(WDNR, 2010)

Table S2. Domestic demand elasticities of crop commodities

Commodity	Elasticity
Corn	-0.40
Soybeans	-0.65
Wheat	-0.40
Cotton	-0.55
Peanuts	-0.70
Rice	-0.35
Rapeseed	-0.70

Notes: This table shows the commodities that can be used for domestic consumption. Data source: Huang et al. (2007).

Table S3: Cost parameters for straw-based biomass (source: Zhang et al. (2013))

Input/Activity		Corn stover	Rice straw	Wheat straw	Rapeseed straw
Extra fertilizer application ($/MT)	Nitrogen	2.22	4.43	3.08	1.70
	Phosphorous	0.32	0.57	0.74	0.16
	Potassium	1.59	2.42	2.89	0.34
Collection ($/MT)		10.99	10.99	10.99	10.99
Processing and storing ($/MT)		14	14	14	14
Transportation	Fixed cost ($/MT)	1.82	1.82	1.82	1.82
	Variable cost ($/MT/Km)	0.09	0.09	0.09	0.09

Table S4. Economic model validation for year 2020.

	Observed	Model	Difference (%)
Corn acreage (1000 ha)	516.124	489.931	-5.1%
Wheat acreage (1000 ha)	2311.42	2357.255	2.0%
Rice acreage (1000 ha)	2178.884	2155.573	-1.1%
Soybean acreage (1000 ha)	196.372	188.825	-3.8%
Rapeseed acreage (1000 ha)	171.413	172.582	0.7%
Corn Production (1000 MT)	3083.028	3119.996	1.2%
Wheat Production (1000 MT)	13338.69	13033.287	-2.3%
Rice production (1000 MT)	19657.043	20143.569	2.5%
Soybean production (1000 MT)	519.345	525.531	1.2%
Rapeseed production (1000 MT)	512.074	518.012	1.2%
Corn price ($/MT)	333.333	320.1	-4.0%
Wheat price ($/MT)	339.394	332.035	-2.2%
Rice price ($/MT)	356.678	367.728	3.1%
Soybean price ($/MT)	666.667	680.844	2.1%
Rapeseed price ($/MT)	636.364	632.208	-0.7%

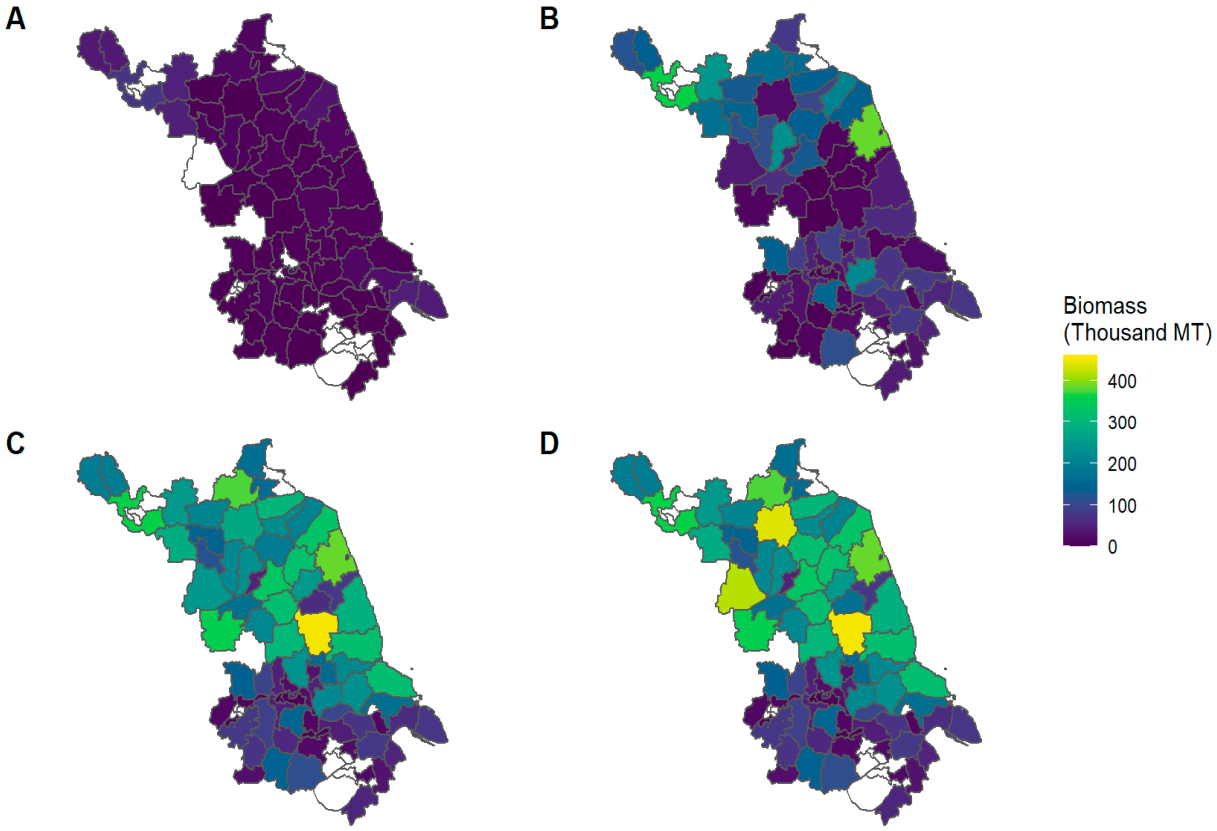

Figure S1. Spatial distribution of feedstock production for alternative levels of biomass price with 20% co-firing rate. (A) $50/MT; (B) $60/MT; (C) $70/MT; (D) $80/MT.

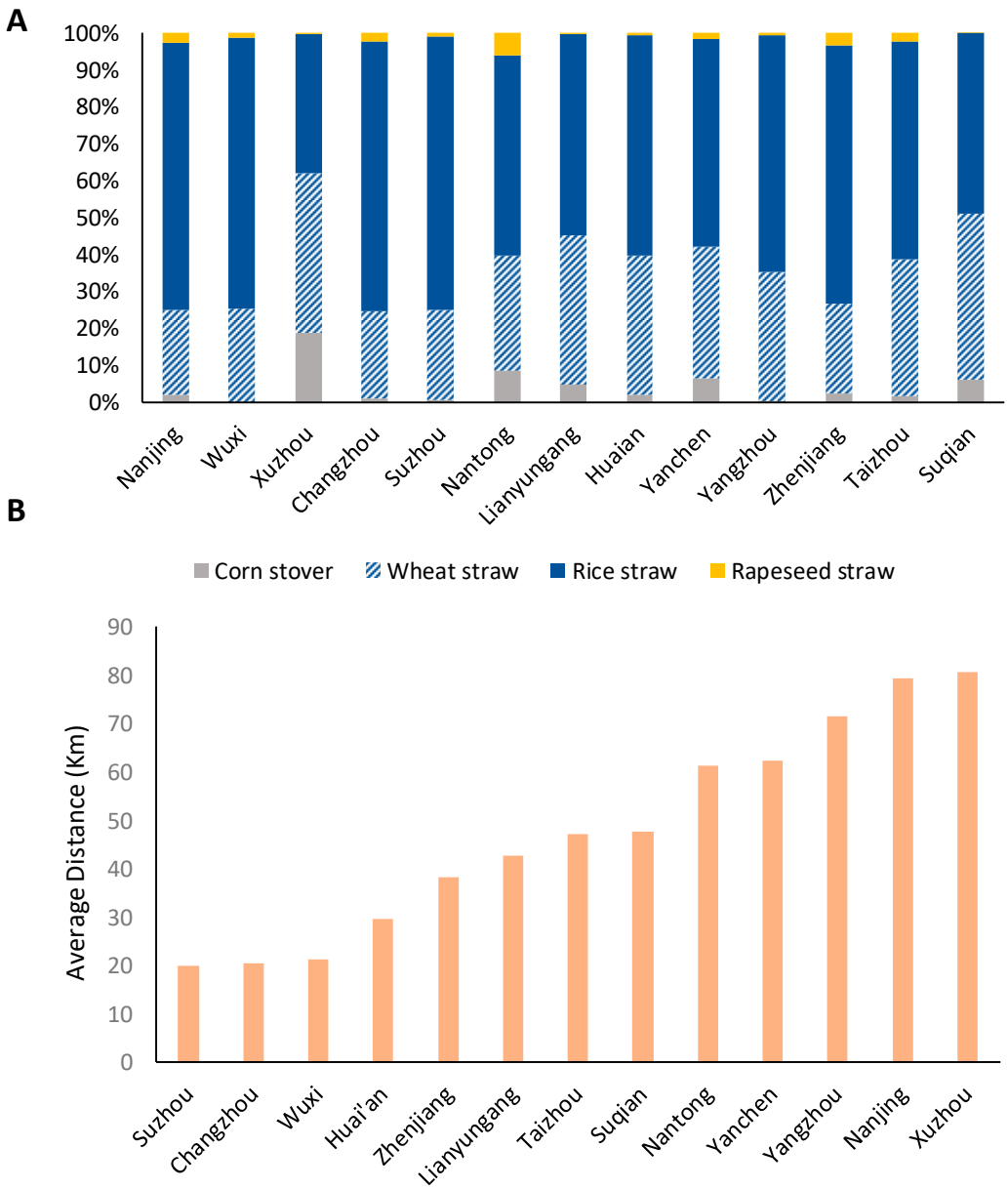

Figure S2. Biomass supply mix and average biomass hauling distances by co-firing facilities located in 13 cities at $80/MT biomass price and 20% co-firing level.