Supplementary Materials

Soybean Expansion in the MATOPIBA Region of Piauí, Brazil (1985–2024): Native-Vegetation Conversion, Overlap with Legally Protected Areas, and Implications for Sustainable Land Governance

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Table S1. Soybean and direct native-vegetation-to-soybean transition by municipality in Piauí's MATOPIBA. Soybean area refers to 2024; the direct transition is accumulated over 1985–2024 and counts each pixel once. The share is the proportion of the municipal territory inside the study region under soybean in 2024. The local indicator of spatial association (LISA) and its quadrant refer to that share, computed with a first-order contiguity weight matrix; HH denotes a municipality with a high share surrounded by municipalities with high shares. Municipalities are ordered by soybean area. Data: MapBiomas Collection 10; IBGE.

Municipality	Area in region (ha)	Soybean 2024 (ha)	Share of municipality (%)	Direct transition 1985–2024 (ha)	LISA	Quadrant
Baixa Grande do Ribeiro	784,179	226,198	28.85	56,738	3.72	HH
Uruçuí	844,840	203,482	24.09	59,230	1.63	HH
Bom Jesus	549,370	98,059	17.85	18,131	0.71	HH
Ribeiro Gonçalves	400,399	87,038	21.74	27,683	3.82	HH
Santa Filomena	531,569	75,192	14.15	20,652	1.84	HH
Currais	316,985	52,170	16.46	6,619	0.81	HH
Gilbués	351,012	49,695	14.16	13,325	0.58	HH
Sebastião Leal	316,232	40,326	12.75	16,398	0.18	HH
Monte Alegre do Piauí	242,742	25,963	10.70	8,248	0.15	HH
Palmeira do Piauí	203,256	21,827	10.74	1,921	0.38	HH
Corrente	306,112	17,052	5.57	5,051	0.06	LL
Barreiras do Piauí	217,757	9,775	4.49	2,146	-0.05	LH
Landri Sales	109,324	7,169	6.56	3,110	-0.00	HL
Antônio Almeida	64,752	5,821	8.99	2,701	0.18	HH
Redenção do Gurguéia	248,080	5,039	2.03	604	0.04	LL
Alvorada do Gurguéia	214,048	4,704	2.20	1,105	-0.05	LH
Parnaguá	344,273	3,332	0.97	702	0.41	LL
São Gonçalo do Gurguéia	139,083	3,078	2.21	1,296	0.02	LL
Cristalândia do Piauí	120,775	2,596	2.15	466	0.19	LL
Sebastião Barros	89,710	1,232	1.37	603	0.27	LL
Manoel Emídio	162,720	1,183	0.73	75	-0.02	LH
Bertolínia	122,129	890	0.73	329	0.16	LL
Curimatá	235,452	540	0.23	34	0.56	LL
Riacho Frio	222,972	506	0.23	169	0.12	LL
Santa Luz	119,024	230	0.19	76	-0.47	LH
Porto Alegre do Piauí	117,310	228	0.19	471	0.11	LL
Eliseu Martins	110,252	200	0.18	16	0.57	LL
Morro Cabeça no Tempo	221,673	84	0.04	1	0.13	LL
Avelino Lopes	122,534	73	0.06	0	0.62	LL
Cristino Castro	185,342	32	0.02	2	-0.10	LH
Marcos Parente	68,028	21	0.03	106	0.30	LL
Colônia do Gurguéia	43,139	15	0.04	0	0.53	LL
Júlio Borges	128,912	14	0.01	0	0.59	LL
Region total	**8,253,987**	**943,763**	**11.43**	**248,009**		

Global Moran's I of the municipal soybean share = 0.545 (expected value under spatial randomness -0.031; pseudo p = 0.0001, 9,999 permutations; mean number of neighbours 4.36). The six largest producers hold 78.6% of the regional soybean area and the Gini coefficient of the distribution across municipalities is 0.804.