Table S1. Data and sources

Categories	Name	Spatial resolution	Year	Sources
Land use	LULC	30 m	1980-2020	RESDC（https://www.resdc.cn/）
Terrain	DEM	30 m	-	GDC（https://www.gscloud.cn/）
Climate	Precipitation	-	2010-2020	CMDC（https://data.cma.cn/）
	Temperature	-	2010-2020	
Vegetation	Drought index	1000 m		TPDC（https://data.tpdc.ac.cn/）
	NDVI	30 m		RESDC（https://www.resdc.cn/）
Socio-economics	nighttime lights	500 m	2010,2015,2020	EOG（https://eogdata.mines.edu/products/vnl/）
	GDP	1000 m		RESDC（https://www.resdc.cn/）
	Population	100 m		World Pop（https://hub.worldpop.org）
	Distance to railway			
	Distance to primary road			
	Distance to secondary road	-	2020	NGCC（https://www.ngcc.cn/）
	Distance to township Road			
	Distance to residential areas			

Table S2. Classification indicators of land use degree

Classification	Content
1	Unused or difficult-to-use land
2	Forest land, grassland, or water areas
3	Cultivated land, orchards, artificial grasslands
4	Construction land, including urban areas, residential areas, industrial and mining land, transportation land.

Table S3. Details of Multiple Scenario Settings

Classification	Content
NIS	The Natural Increase Scenario (NIS) represents a baseline scenario in which the TRB evolves naturally according to current trends without significant external intervention; the future land use demand under the NIS scenario is based on the Markov chain of the land use maps from 2010-2020[58].
FSS	The Food Security Scenario (FSS) represents a situation where the TRB considers the importance of food security and emphasizes enhancing agricultural production capacity; specifically, it is set so that the total possibility of cultivated land converting to forest, grassland, built-up land, and unused land decreases by 5%, while the possibility of other lands, except cultivated land, being converted to cultivated land increases by 10% [59].
EDS	The Economic Development Scenario (EDS) represents a situation where the TRB focuses on economic growth and urbanization speed; specifically, it is set that the possibility of land other than built-up land being converted to built-up land increases by 20%, and the possibility of built-up land being converted to other land use types, except for cultivated land, decreases by 30% [60].
WPS	The Water Resources Protection Scenario (WPS) represents a situation where the TRB maintains water resources and aquatic ecological balance; the specific setting is that the possibility of water bodies transforming into other types of land use is set to 0%, and the possibility of other land use types being converted to cultivated land decreases by 30% [61].
EPS	The Ecological Protection Scenario (EPS) represents a situation where the TRB expands the scope of ecological protection and reduces human interference; specifically, it is set that: the possibility of other lands being converted to built-up land decreases by 30%, and the possibility of built-up land flowing to other lands, except for cultivated land, increases by 20% [60].

BES	The Balanced Economy and Ecology Scenario (BES) represents the development of TRB where economic growth is pursued while also preserving the ecosystem.; specifically, it is set that the possibility of water bodies and grassland being transferred to built-up land decreases by 20%. The possibility of cultivated land and forest land being converted to built-up land decreases by 10%; the possibility of construction land becoming forest land decreases by 20%, and the possibility of becoming water, unused land, and grassland decreases by 10% [60].

Table S4. Single and comprehensive land use values for various land categories between 2020 and 2060

Scenario	Indicator	Land category	2020-2030	2030-2040	2040-2050	2050-2060	2020-2060
NIS	SLUDD	Cultivated land	1.52	1.09	0.80	0.28	4.19
		Forest land	0.02	0.01	-0.57	-0.19	-0.72
		Grassland	-1.79	-1.77	-1.71	-0.84	-4.87
		Water bodies	0.16	0.18	0.06	1.97	2.45
		Built-up land	2.88	1.84	1.45	1.06	9.32
		Unused land	-0.08	-0.08	-0.08	-0.08	-0.31
	CLUDD		0.55	0.45	0.37	0.17	1.54
FSS	SLUDD	Cultivated land	1.69	1.04	0.77	0.60	4.74
		Forest land	0.00	0.01	0.02	0.01	0.03
		Grassland	-1.96	-1.77	-1.74	-1.62	-5.42
		Water bodies	0.16	0.19	0.04	-0.37	0.01
		Built-up land	2.74	1.92	1.39	0.43	8.04
		Unused land	-0.08	-0.08	-0.08	-0.08	-0.32
	CLUDD		0.60	0.44	0.36	0.29	1.69
EDS	SLUDD	Cultivated land	1.51	1.09	0.80	0.37	4.29
		Forest land	0.01	0.01	0.02	0.00	0.03
		Grassland	-1.81	-1.77	-1.74	-1.03	-5.01
		Water bodies	0.15	0.20	0.03	-0.36	0.01
		Built-up land	3.56	1.71	1.37	1.01	9.87
		Unused land	-0.08	-0.08	-0.08	-0.08	-0.31
	CLUDD		0.55	0.45	0.37	0.20	1.56
WPS	SLUDD	Cultivated land	1.04	1.21	0.88	0.25	3.80
		Forest land	-0.09	-0.21	-0.21	-0.09	-0.59
		Grassland	-1.27	-1.76	-1.72	-0.65	-4.43
		Water bodies	0.26	0.05	-0.24	0.12	0.17

		Built-up land	3.15	1.87	1.37	1.05	9.62
		Unused land	-0.06	-0.08	-0.08	-0.08	-0.29
	CLUDD		0.39	0.48	0.39	0.14	1.40
		Cultivated land	1.54	1.08	0.80	0.38	4.35
		Forest land	0.03	-0.38	-0.23	-0.42	-0.96
		Grassland	-1.76	-1.75	-1.73	-1.03	-4.96
EPS	**SLUDD**	Water bodies	0.16	0.16	0.06	0.02	0.41
		Built-up land	1.88	2.13	1.52	1.15	8.51
		Unused land	-0.08	-0.08	-0.08	-0.08	-0.31
	CLUDD		0.54	0.45	0.37	0.20	1.56
		Cultivated land	1.53	1.08	0.80	0.36	4.31
		Forest land	0.02	0.01	-0.58	-0.16	-0.70
		Grassland	-1.77	-1.77	-1.71	-0.99	-4.94
BES	**SLUDD**	Water bodies	0.15	0.19	0.04	-0.36	0.01
		Built-up land	2.32	1.98	1.53	1.12	8.93
		Unused land	-0.08	-0.08	-0.08	-0.08	-0.31
	CLUDD		0.54	0.45	0.37	0.19	1.56

Table S5. Comprehensive Index of Land Use Degree for Multiple Scenarios from 2030 to 2060

Simulated year	NIS	FSS	EDS	WPS	EPS	BES
2030	2.08	2.09	2.08	2.06	2.08	2.08
2040	2.13	2.14	2.13	2.12	2.13	2.13
2050	2.17	2.18	2.18	2.16	2.17	2.17
2060	2.20	2.21	2.20	2.18	2.20	2.20

Figure S1. Standard deviation ellipses and centroid migration of various classes in the TRB from 1980 to 2020

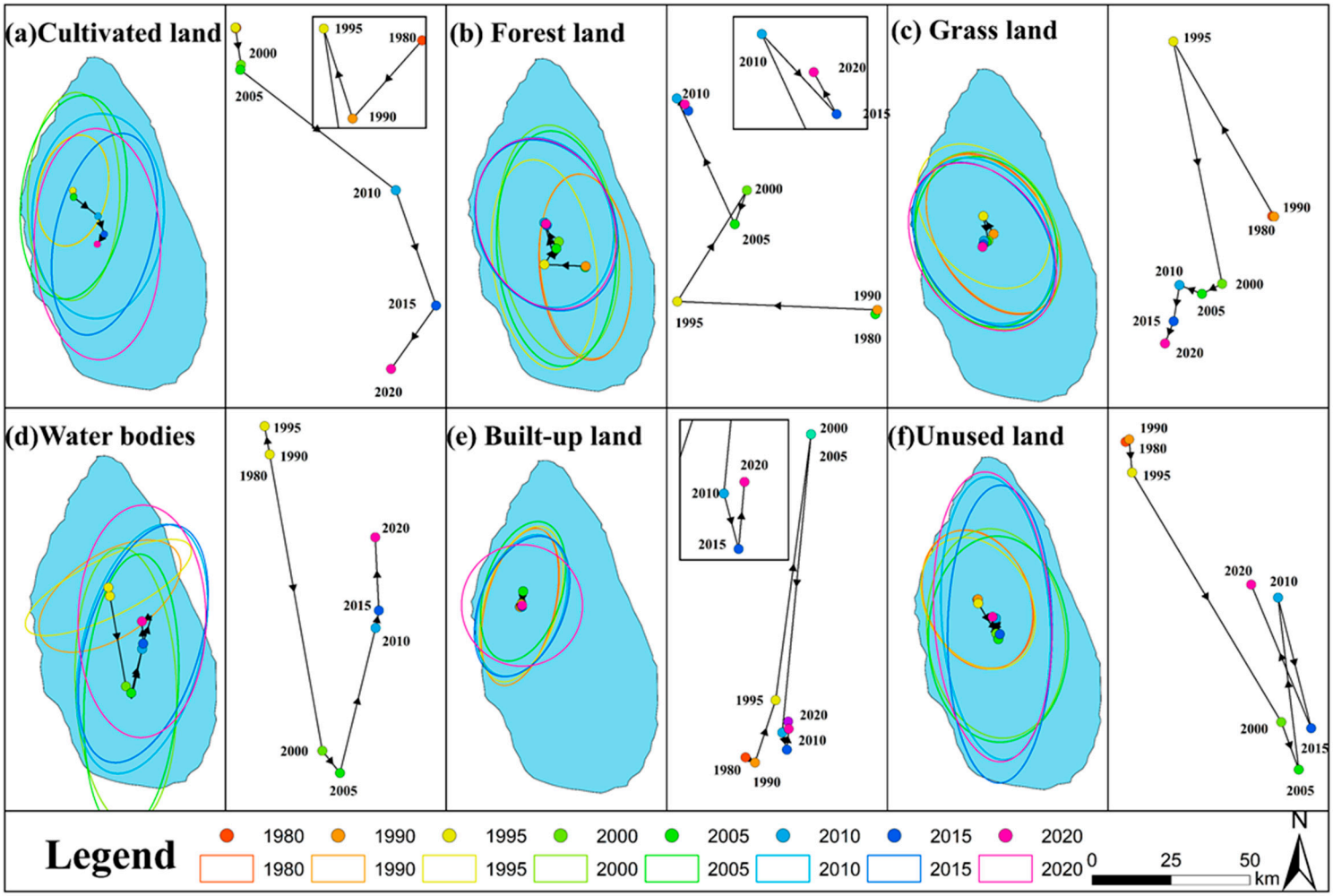


Figure S2. Standard deviation ellipse parameters and centroid motion in various regions of the TRB from 1980 to 2020

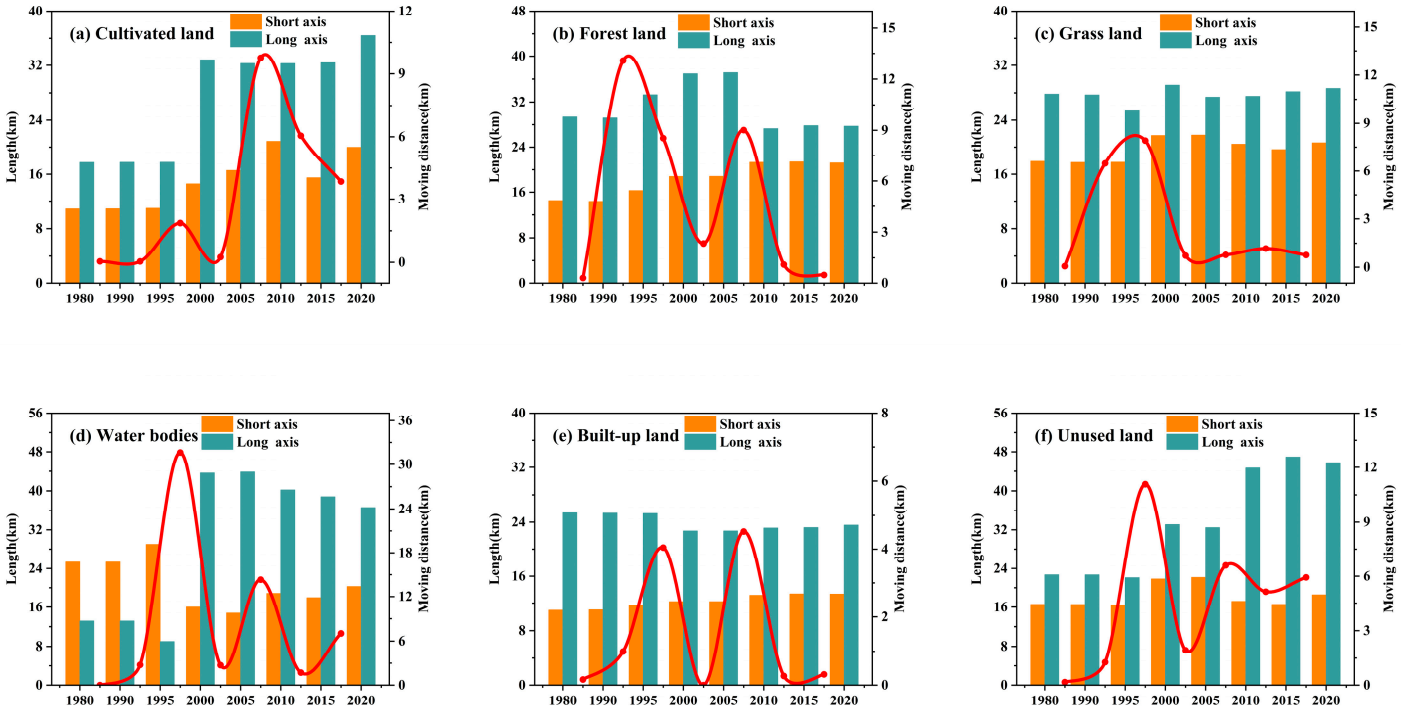


Figure S3. Changes in standard deviation ellipses and centroid migration of various land classes in the TRB under NIS/FSS/EDS/WPS/EPS/BES scenarios from 2020 to 2060.

