Appendix

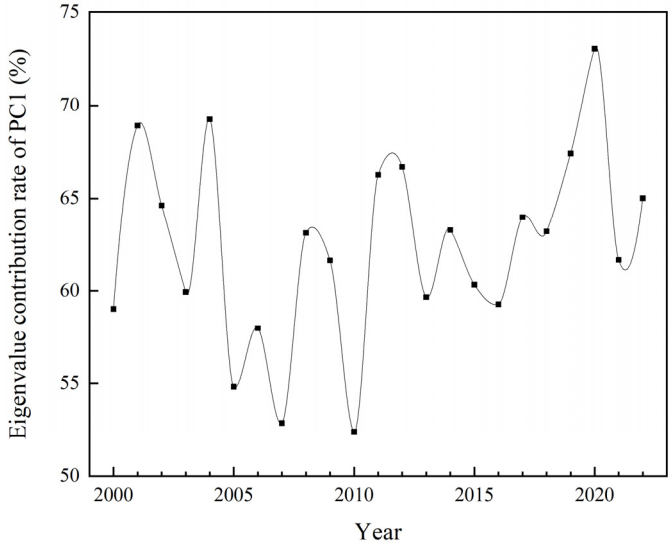

Figure S1. The result of eigenvalue contribution rate of PC1 (%)

Supplementary Figure 1 presented the outcomes of the Principal Component Analysis (PCA) of factors in constructing the Remote Sensing-based Ecological Index (RSEI) model for the Tibetan Plateau. The results indicated that the eigenvalue contribution rate of PC1 ranged from 53% to 75%, signifying that PC1 encompassed the majority of features of the four factors. This implies that PC1 effectively characterizes the ecological environment quality status in the region.

Table S1. Land use transition matrix during 2001-2020(km²)

Land Cover Category in 2001 (km²)	Land Cover Category in 2020 (km²)																
	Evergreen Needleleaf Forests	Evergreen Broadleaf Forests	Deciduous Needleleaf Forests	Deciduous Broadleaf Forests	Mixed Forests	Closed Shrublands	Open Shrublands	Woody Savannas	Savaunas	Grasslands	Permanent Wetlands	Croplands	Urhan and Built-up Lands	Permanent Snow and Ice	Barren	Water Bodies	Total
Evergreen Needleleaf Forests	30368	16		170	2487	1		3982	117	1082	175			2	3		38403
Evergreen Broadleaf Forests	31	2771		1	236			24	2	4				4			3073
Deciduous Needleleaf Forests										2							2
Deciduous Broadleaf Forests	447	48		4298	1488	2		978	252	410	1						7924
Mixed Forests	4791	163		437	38157	1		3677	103	1152	30			1			48512
Closed Shrublands					1	10		12	9	15							47
Open Shrublands							4849			1678	5			69	1061		7662
Woody Savannas	4604	115	2	513	5014	26		45733	2110	4683	69	17	5	69	31		62991
Savaunas	51	4		111	105	1		1147	3071	1691	16	14			6		6217
Grasslands	743	15	2	511	857	28	2593	10469	8550	1436544	578	920	16	905	35378	363	1498472
Permanent Wetlands	116				12			15	2	309	391	1		8	29	41	924
Croplands				29	6			94	125	2234	1	6084	13			1	8587
Urhan and Built-up Lands										10		1	867				878
Permanent Snow and Ice	4						3		1	570	44			28848	3746	10	33226
Barren	6						1101	14	30	67849	330		4	11263	1114481	4371	1199449
Water Bodies										143	36			344	1016	36156	37695
Total	41161	3132	4	6070	48363	69	8546	66145	14372	1518376	1676	7037	905	41513	1155751	40942	2954062

Table S2. Land use/cover data were extracted from MCD12Q1 dataset (2001-2020).

S	Name	Description
1	Evergreen Needleleaf Forests (ENF)	Dominated by evergreen conifer trees (canopy >2 m). Tree cover >60%.
2	Evergreen Broadleaf Forests (EBF)	Dominated by evergreen broadleaf and palmate trees (canopy >2 m). Tree cover >60%.
3	Deciduous Needleleaf Forests (DNF)	Dominated by deciduous needleleaf (larch) trees (canopy >2 m). Tree cover >60%.
4	Deciduous Broadleaf Forests (DBF)	Dominated by deciduous broadleaf trees (canopy >2 m). Tree cover >60%.
5	Mixed Forests (MF)	Dominated by neither deciduous nor evergreen (40-60% of each) tree type (canopy >2 m). Tree cover >60%.
6	Closed Shrublands (CSL)	Dominated by woody perennials (1-2m height) >60% cover.
7	Open Shrublands (OSL)	Dominated by woody perennials (1-2 m height) 10-60% cover.
8	Woody Savannas (WS)	Tree cover 30-60% (canopy >2 m).
9	Savannas (SAV)	Tree cover 10-30% (canopy >2 m).
10	Grasslands (GRA)	Dominated by herbaceous annuals (<2 m).
11	Permanent Wetlands (PW)	Permanently inundated lands with 30-60% water cover and >10% vegetated cover.
12	Croplands (CRO)	At least 60% of area is cultivated cropland.
13	Urban and Built-up Lands (UBL)	At least 30% impervious surface area including building materials, asphalt, and vehicles.
14	Cropland/Natural Vegetation Mosaics (CNVM)	Mosaics of small-scale cultivation 40-60% with natural tree, shrub, or herbaceous vegetation.
15	Permanent Snow and Ice (PSI)	At least 60% of area is covered by snow and ice for at least 10 months of the year.
16	Barren (BAR)	At least 60% of area is non-vegetated barren (sand, rock, soil) areas with less than 10% vegetation.
17	Water Bodies (WB)	At least 60% of area is covered by permanent water bodies.

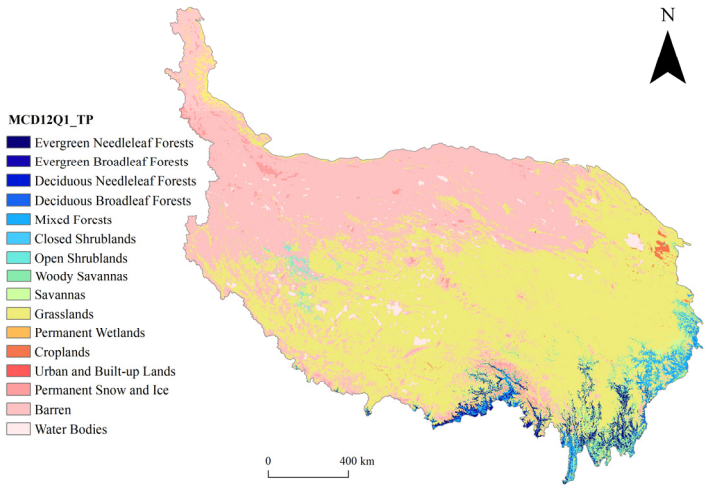

Figure S2. Spatial distribution of land use types on the TP in 2020

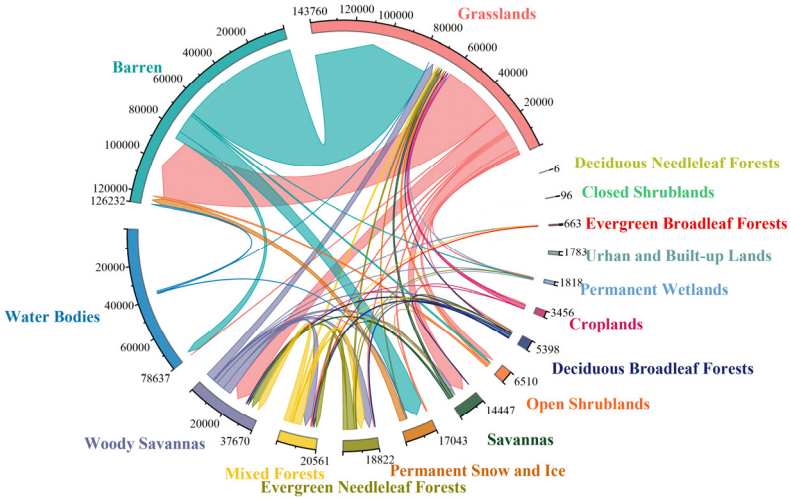

Figure S3. Land use transition matrix during 2001-2020 (km^2) in Tibetan Plateau

According to the 2020 data, Supplementary Figure S2 showed the spatial distribution of land use types in Tibetan Plateau. Tibetan Plateau's main LUCC types consisted of sixteen categories based on the IGBP global land cover classification system. These categories presented a spatial distribution feature from southeast to northwest of forests, grasslands, and bare land in sequence. The main land use type in Tibetan Plateau was grassland (GRA). Forests mainly comprised evergreen needleleaf forests (ENF) and mixed forests (MF) and mostly occupied the southern low altitude regions. Open shrublands (OSL) were distributed in the central and western regions of the study area, while barren land (BAR) was primarily distributed in northern Tibetan Plateau. Water bodies (WB) were scattered across the west part of the plateau, and croplands (CRO) and urban and built-up lands (UBL) were concentrated in the "One River and Two Streams" and Hehuang Valley.

Land use transition matrix is a useful tool to analyze the structure and changes of land use types over a certain period [1]. Therefore, the land use transition matrix was used to obtain the land use transition situation of Tibetan Plateau from 2001 to 2020, as shown in Supplementary Table. 1. In the matrix, orange color labeled as "stable" denotes an area that did not witness any significant land use changes. It was evident that GRA, BAR, Woody Savannas (WS), MF, WB, and ENF in Tibetan Plateau, mainly remained stable during 2001 to 2020. Supplementary Figure 3 was drawn to better illustrate the transitions of land use types that underwent changes. Combining Supplementary Table S2 and Supplementary Figure S3 can clearly reflect that 35,378 km^2 of GRA in Tibetan Plateau mainly transitioned

to BAR, and 10,469 km^2 transitioned to WS. Furthermore, 67,849 km^2 and 11,263 km^2 of BAR were respectively converted to GRA and Permanent Snow and Ice (PSI). The transition between other land use types was relatively small. These land use transitions provide excellent insights into the patterns and trends of land use evolution in Tibetan Plateau over the considered period.

References

1. Chen, A.; Yang, X.; Guo, J., et al. Dynamic of land use, landscape, and their impact on ecological quality in the northern sand-prevention belt of China. Journal of Environmental Management. **2022**, *317*. https://doi.org/10.1016/j.jenvman.2022.115351