Monitoring of Farmland Abandonment Based on Google Earth Engine and Interpretable Machine Learning

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Table S1. Remote sensing identification and classification of land use/land cover types in the study area

Feature Type	Feature abbreviation	Feature variable	Feature description
Spectral features	Blue	Blue Band	Derived from the blue band of Landsat imagery, corresponding to SR_B2 (for Landsat 8 and 9) or SR_B1 (for Landsat 5 and 7), and named as 'blue' after processing.
	Green	Green Band	Derived from the green band of Landsat imagery, corresponding to SR_B3, and named as 'green' after processing.
	Red	Red Band	Derived from the red band of Landsat imagery, corresponding to SR_B4, and named as 'red' after processing.
	Nir	Near Infrared Band	Derived from the near-infrared band of Landsat imagery, corresponding to SR_B5, and named as 'nir' after processing.
	Swir1	Shortwave Infrared Band 1	Derived from the shortwave infrared band 1 of Landsat imagery, corresponding to SR_B6 (for Landsat 8 and 9) or SR_B5 (for Landsat 5 and 7), and named as 'swir1' after processing.
	Swir2	Shortwave Infrared Band 2	Derived from the shortwave infrared band 2 of Landsat imagery, corresponding to SR_B7, and named as 'swir2' after processing.
Phenological features	MNDWI	Modified Normalized Difference Water Index	Calculated as (Green-Swir1)/(Green+Swir1), used for water body identification.
	NDBI	Normalized Difference Built-up Index	Calculated as (Swir1-Nir)/(Swir1+Nir), used for identifying built-up areas.
	NDVI	Normalized Difference Vegetation Index	Calculated as (Nir-Red)/(Nir+Red), used to assess vegetation cover.
	EVI	Enhanced Vegetation Index	Calculated as 2.5*(Nir-Red)/(Nir+6*Red*-7.5Blue+1), also used to assess vegetation conditions, more sensitive to high vegetation cover areas.
	NDMI	Normalized Difference Moisture Index	Calculated as (Nir- Swir2)/(Nir+ Swir2), used for monitoring vegetation water content.
	LSWI	Land Surface Water Index	Calculated as (Nir- Swir1)/(Nir+ Swir1), used for identifying water bodies and soil moisture.
Textural features	Contrast	Contrast	Calculated based on the Gray Level Co-occurrence Matrix (GLCM), formula: $\text{Contrast} = \sum_i \sum_j p(i,j) \cdot (i-j)^2$
	Correlation	Correlation	Calculated based on the GLCM, formula:

Feature Type	Feature abbreviation	Feature variable	Feature description
			$\text{Correlation} = \sum_i \sum_j \frac{(i-\text{Mean})\cdot(j-\text{Mean})\cdot p(i,j)^2}{\text{Variance}}$
	Energy	Energy (Homogeneity)	Calculated based on the GLCM, formula: $Energy = \sum_i \sum_j p(i,j) * \frac{1}{1+(i+j)^2}$
	Entropy	Entropy	Calculated based on the GLCM, formula: $Entropy = \sum_i \sum_j p(i,j) * Inp(i,j)$
Topographic features	DEM	Digital Elevation Model	Obtained from 'USGS/SRTMGL1_003' data via GEE, and calculated using terrain = ee.Algorithms.Terrain(dataset_srtm).
	Slope	Slope	Slope information derived from terrain, obtained by adding slope = terrain.select('slope') to the image.
	Aspect	Aspect	Aspect information derived from terrain, obtained by adding aspect = terrain.select('aspect') to the image.

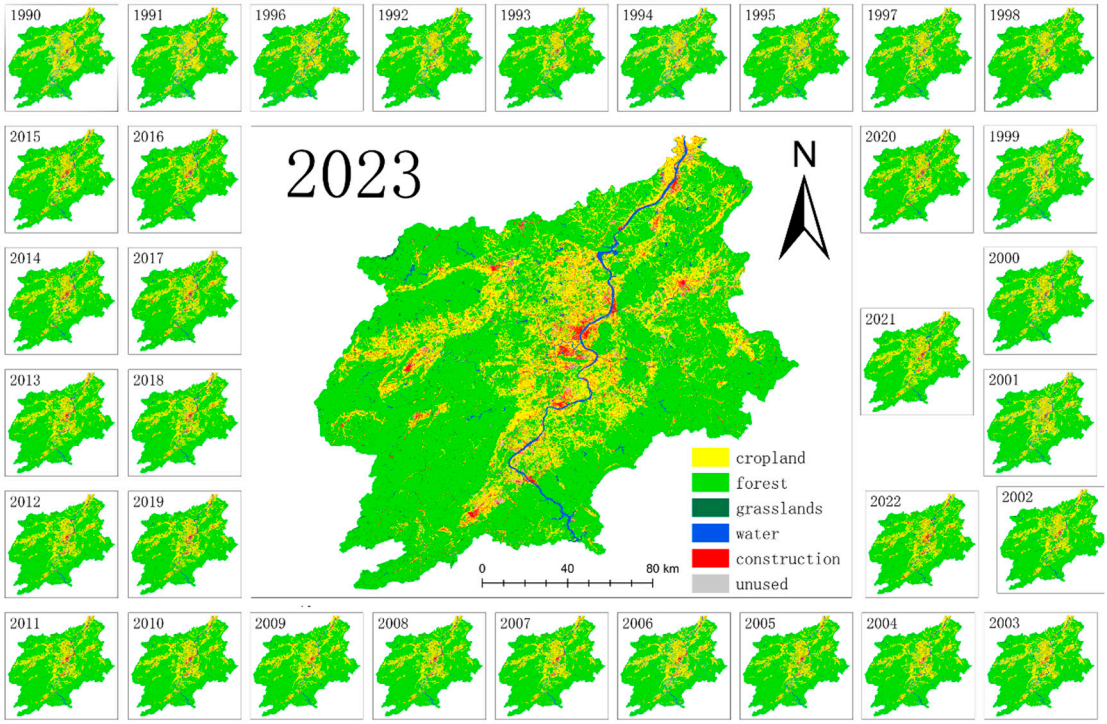


Figure S1. Land-cover maps for 1990-2023 in the study area

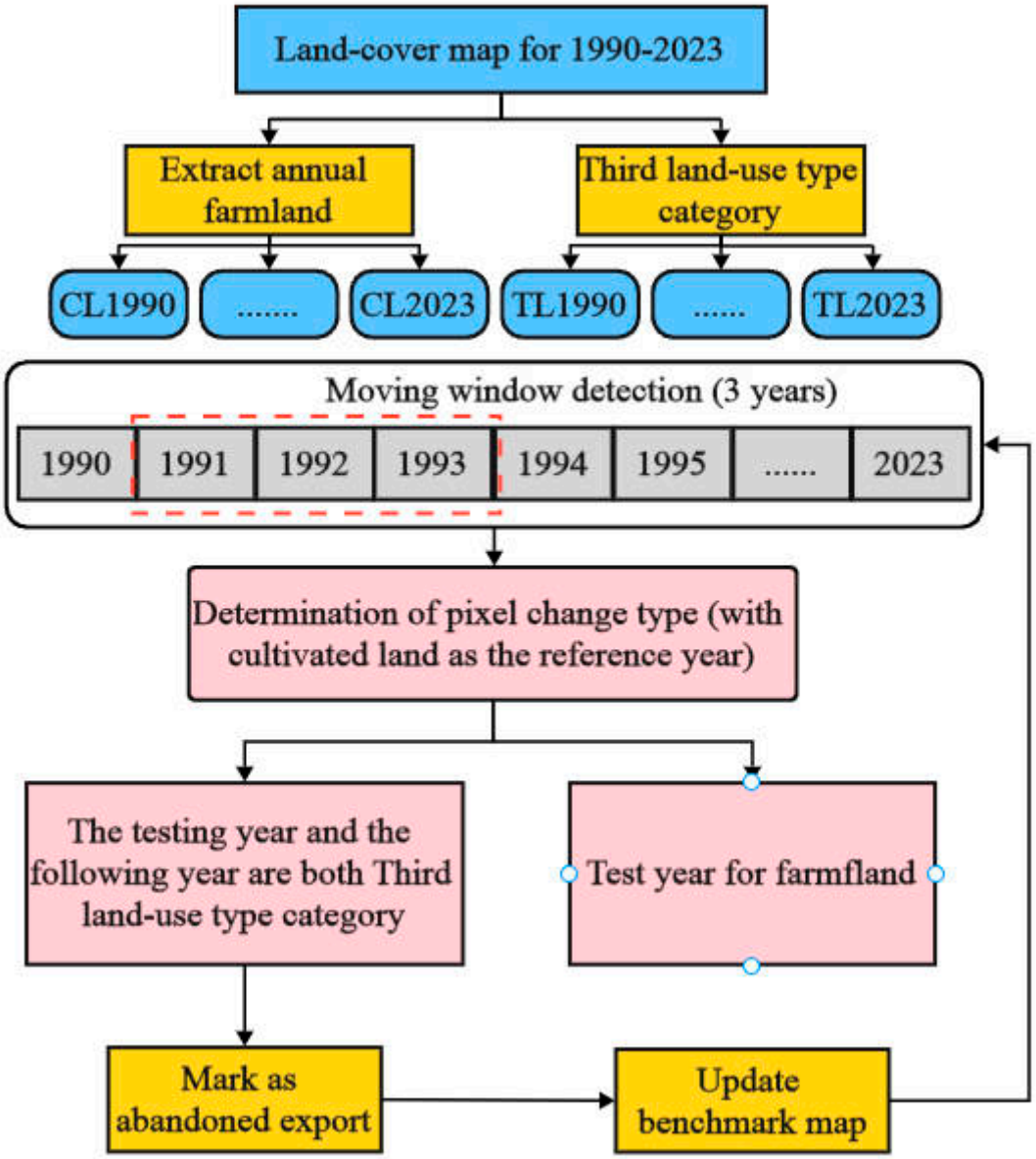


Figure S2. The process of determining abandoned farmland

Table S2. Abandoned farmland in the study area from 1990 to 2022 (unit: ha)

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Abandoned area	9371	13165	20890	13393	13809	3119	4889
Farmland area	509234	517058	488699	481579	454554	504870	483774
Abandonment rate	1.84%	2.55%	4.27%	2.78%	3.04%	0.62%	1.01%
Year	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Abandoned area	8648	1981	7057	4082	4917	2311	6132
Farmland area	481840	515682	489648	491548	485278	510916	490677
Abandonment rate	1.79%	0.38%	1.44%	0.83%	1.01%	0.45%	1.25%
Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Abandoned area	15352	6516	4247	1343	2475	3420	2714
Farmland area	466851	468868	463707	516687	499102	530998	545837
Abandonment rate	3.29%	1.39%	0.92%	0.26%	0.50%	0.64%	0.50%
Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**

Abandoned area	4809	3620	7059	8015	3279	8527	3538
Farmland area	540677	555300	576771	547230	582089	542844	577298
Abandonment rate	0.89%	0.65%	1.22%	1.46%	0.56%	1.57%	0.61%
Year	**2018**	**2019**	**2020**	**2021**	**2022**		
Abandoned area	5489	9109	5861	1381	5050		
Farmland area	577870	551846	553646	626827	567873		
Abandonment rate	0.95%	1.65%	1.06%	0.22%	0.89%		

Table S3. Abandoned land rates in various districts and counties of the study area from 1990 to 2022

(unit: %)

Year	JZ	QY	JA	JS	XJ	XG	YF	TH	SC	WA	AF	YX	JGS
1991	1.62	3.84	1.81	2.81	4.33	2.45	3.10	2.80	2.10	2.87	1.56	1.81	2.41
1992	3.35	5.13	3.86	3.70	8.49	3.91	3.83	3.97	3.96	3.69	3.92	4.44	6.86
1993	2.12	2.86	1.93	3.10	3.57	2.11	3.16	2.83	3.22	4.87	1.78	2.91	4.48
1994	2.11	3.79	1.84	3.24	3.47	2.06	4.41	2.68	4.54	3.00	2.10	4.05	10.38
1995	0.32	0.50	0.56	0.69	0.99	0.51	0.72	0.31	0.55	0.33	0.80	0.95	1.21
1996	0.40	0.71	0.98	1.03	1.22	0.74	1.18	0.61	0.60	0.75	1.56	1.76	1.67
1997	0.57	1.06	1.75	1.45	1.27	1.54	2.04	1.03	1.65	2.08	2.66	3.98	3.55
1998	0.11	0.31	0.32	0.27	0.17	0.26	0.43	0.20	0.98	0.93	0.46	0.64	0.65
1999	0.59	1.01	1.37	1.38	0.76	1.02	1.81	1.05	2.55	2.63	1.56	2.06	2.80
2000	0.54	0.65	0.80	0.89	0.91	0.66	1.37	0.55	0.83	0.83	0.90	0.82	1.84
2001	0.16	1.19	0.57	0.96	1.56	1.20	1.70	0.48	2.06	1.44	0.90	1.02	1.58
2002	0.10	0.31	0.26	0.41	0.59	0.62	0.79	0.20	0.84	0.56	0.43	0.63	0.66
2003	0.43	1.12	1.22	0.92	1.91	0.89	1.55	0.77	1.90	1.72	1.55	1.85	1.06
2004	1.69	2.32	2.95	3.16	3.88	2.44	3.53	2.74	4.61	9.31	2.69	3.06	3.23
2005	1.05	1.58	1.27	1.26	1.41	1.82	1.67	1.42	1.38	3.00	0.78	0.76	1.83
2006	0.44	0.74	0.91	0.80	1.94	0.83	0.86	0.87	1.00	1.98	0.74	0.50	0.57
2007	0.15	0.23	0.24	0.24	0.55	0.25	0.30	0.26	0.27	0.47	0.16	0.12	0.20
2008	0.45	0.43	0.58	0.46	0.99	0.60	0.52	0.43	0.50	0.73	0.29	0.20	0.41
2009	0.66	0.82	0.57	0.62	0.94	0.81	0.67	0.67	0.80	0.94	0.36	0.32	0.80
2010	0.47	0.48	0.51	0.52	0.73	0.45	0.49	0.48	0.64	0.79	0.37	0.29	0.51
2011	0.75	0.69	1.20	0.76	1.57	0.75	0.76	0.66	1.05	0.96	0.99	0.68	0.94
2012	0.30	0.62	0.84	0.51	0.67	0.37	0.60	0.39	0.98	0.59	0.86	1.00	0.98
2013	1.03	1.12	1.24	1.24	1.61	1.11	1.21	0.67	2.68	1.31	1.08	1.18	2.42
2014	1.45	1.53	1.83	1.36	2.24	1.27	1.27	1.06	1.35	1.54	1.49	1.51	1.61
2015	0.44	0.41	0.65	0.43	0.72	0.35	0.58	0.39	0.77	0.56	0.70	0.78	0.71
2016	0.87	1.10	1.44	1.49	1.72	1.02	2.02	1.07	2.16	1.88	1.99	1.86	2.25
2017	0.23	0.46	0.41	0.51	0.43	0.35	0.65	0.30	1.22	1.01	0.86	1.02	1.12
2018	0.42	0.84	0.64	0.85	0.77	0.51	1.07	0.53	2.19	1.79	1.10	1.14	1.62
2019	0.60	1.18	1.28	1.64	1.57	1.03	2.19	0.91	3.38	2.44	1.91	1.92	3.02
2020	0.42	0.97	0.79	1.36	1.31	0.64	1.33	0.69	1.51	1.46	1.16	1.03	1.48
2021	0.08	0.20	0.13	0.29	0.21	0.14	0.38	0.14	0.25	0.17	0.28	0.26	0.23
2022	0.19	0.72	0.50	0.77	0.87	0.52	0.98	0.47	1.93	1.13	1.29	1.43	1.61

Tip：Jizhou District (JZ), Qingyuan District (QY), Ji'an County (JA), Jishui County (JS), Xiajiang County (XJ), Xingan

County (XG), Yongfeng County (YG), Taihe County (TH), Suichuan County (SC), Wan'an County (WA), Anfu County (AF), Yongxin County (YX), and Jinggangshan City (JGS).

Table S4. Interaction matrix of main driving factors of SHAP from 1992 to 2022

Year	PCY&PD	PCY&SOC	PCY&DEM	PD&SOC	SOC&DEM	PD&DEM
1992	0.012	0.002	0.014	0.001	0.004	0.005
2002	0.013	0.018	0.017	0.005	0.009	0.003
2012	0.013	0.027	0.016	0.008	0.007	0.007
2022	0.026	0.027	0.013	0.015	0.006	0.006

Tip: PCY: potential crop yield; PD: population density; DEM: digital elevation model; SOC: soil organic carbon.

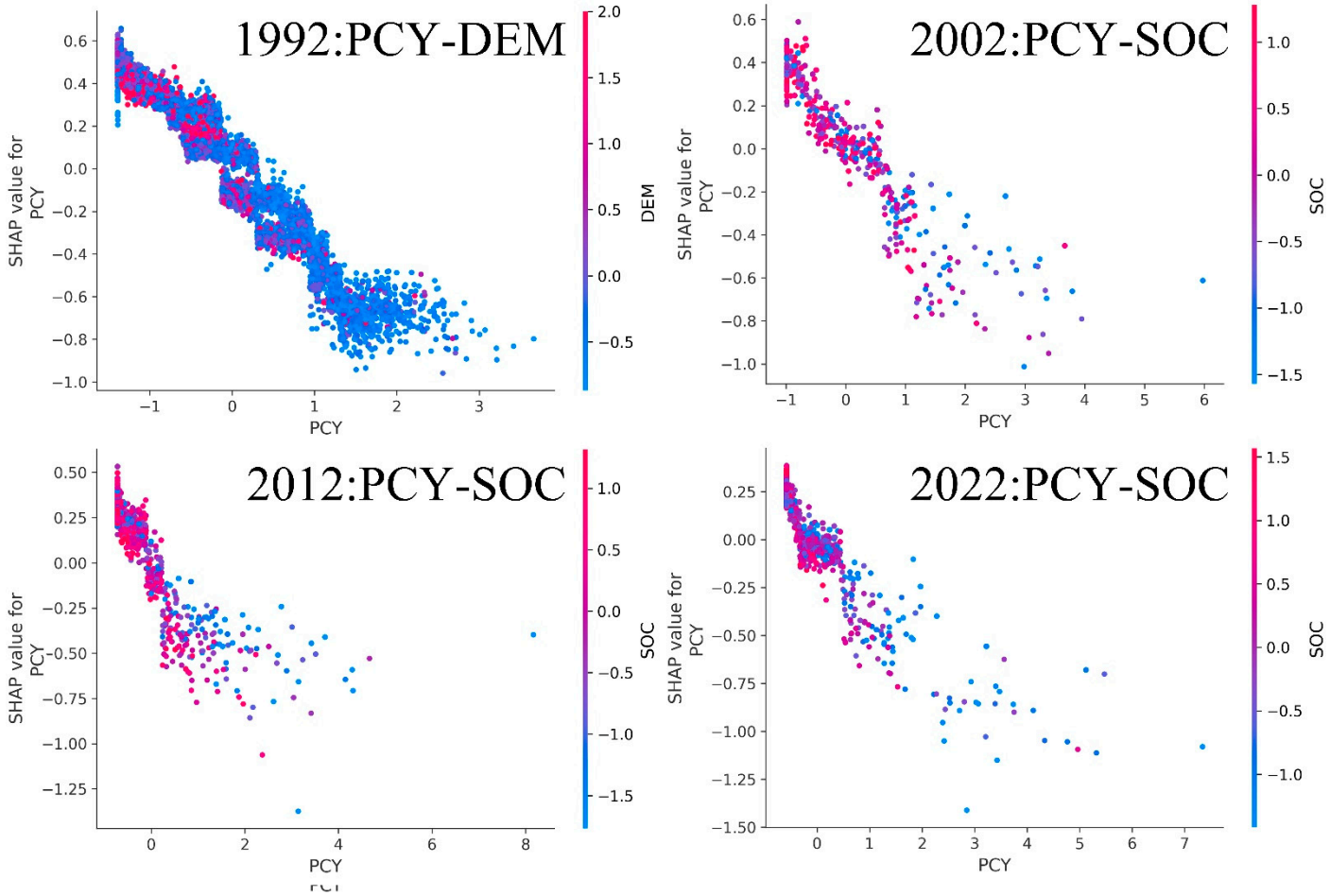


Figure S3. The dependency graph of the strongest interaction feature pairs. PCY: potential crop yield; DEM: digital elevation model; SOC: soil organic carbon.