

Table.S1: The vegetation coverage and its change value and ranking of built-up areas in provincial capital cities from 1990 to 2020

City/year	1990	1995	2000	2005	2010	2015	2020	FVC change value (%)	GDP rank	Expansion speed rank	FVC rank
Shanghai	33.01	35.11	37.16	33.69	42.21	43.94	47.96	14.95	1	2	3
Beijing	37.62	36.44	34.92	38.64	40.87	51.24	50.30	12.68	2	1	1
Guangzhou	39.98	37.45	34.65	39.15	41.26	44.13	45.95	5.97	3	3	5
Chongqing	31.14	36.11	36.34	33.79	34.32	44.48	41.93	10.79	4	15	19
Chengdu	46.19	35.74	39.19	31.35	32.58	39.76	43.76	-2.43	5	8	12
Hangzhou	37.80	35.57	33.35	40.50	32.07	35.83	45.02	7.22	6	4	8
Wuhan	37.70	34.51	37.31	41.94	39.93	45.63	43.96	6.25	7	7	10
Nanjing	40.87	38.35	33.80	36.31	44.53	42.42	45.32	4.46	8	9	7
Tianjin	33.81	38.95	40.31	35.53	38.77	39.76	48.74	14.93	9	5	2
Changsha	37.99	37.97	37.37	40.04	34.57	40.16	40.25	2.27	10	16	21
Zhengzhou	37.97	45.02	36.00	37.71	35.10	42.54	43.68	5.70	11	6	13
Jinan	37.28	43.27	27.65	42.32	48.84	39.71	47.84	10.57	12	10	4
Hefei	44.28	44.73	43.07	44.41	33.13	42.66	45.77	1.48	13	14	6
Xi'an	25.19	34.92	40.45	31.83	33.30	38.44	38.36	13.17	14	11	25
Fuzhou	41.41	40.49	42.27	33.36	37.30	40.68	40.64	-0.77	15	19	20
Kunming	28.17	28.10	30.20	32.63	39.74	35.71	35.64	7.47	16	18	26
Changchun	17.71	32.23	31.55	35.42	33.54	37.66	38.61	20.89	17	17	23
Shenyang	29.41	30.31	30.46	35.91	37.87	39.64	43.58	14.17	18	12	14
Shijiazhuang	33.04	35.60	45.94	32.91	36.43	37.54	43.98	10.95	19	13	9
Nanchang	31.73	36.09	37.85	33.86	39.28	38.87	39.42	7.68	20	21	22
Harbin	35.47	33.97	40.57	35.75	35.82	37.22	43.78	8.31	21	20	11
Nanning	41.71	43.72	42.56	41.65	44.10	43.00	42.05	0.34	22	26	18
Guiyang	32.69	28.23	32.76	33.97	36.71	39.76	42.97	10.27	23	22	17
Taiyuan	37.20	35.43	28.54	34.28	34.70	41.50	43.52	6.32	24	23	15
Urumqi	30.15	24.60	28.48	28.56	22.77	32.10	32.10	1.95	25	24	30
Lanzhou	27.89	30.00	37.99	28.61	31.62	28.52	32.30	4.41	26	29	29
Hohhot	15.54	11.86	24.94	18.59	29.10	30.97	33.94	18.40	27	27	28
Yinchuan	25.18	29.11	28.11	26.62	35.02	34.00	34.84	9.67	28	25	27
Haikou	43.88	36.39	40.23	40.86	34.76	35.20	43.18	-0.71	29	28	16
Xining	27.83	26.41	31.95	33.79	37.49	35.84	38.43	10.61	30	30	24
Lhasa	21.49	21.14	28.59	28.89	29.34	23.21	30.59	9.10	31	31	31

Table.S2: The total area and vegetation coverage of built-up areas in provincial capital cities from 1990 to 2020

City/year	1990		1995		2000		2005		2010		2015		2020	
	Area:km2	VCR	Area:km2	VCR	Area:km2	VCR	Area:km2	VCR	Area:km2	VCR	Area:km2	VCR	Area:km2	VCR
Shanghai	394.71	0.31	544.42	0.32	763.70	0.37	1478.30	0.30	2339.95	0.41	2893.43	0.50	3970.61	0.57
Beijing	744.13	0.38	850.13	0.37	1008.45	0.34	1884.49	0.41	2821.61	0.45	3237.89	0.58	4491.65	0.60
Guangzhou	176.45	0.42	326.28	0.38	662.92	0.36	1100.46	0.41	1733.52	0.46	1874.89	0.48	2516.18	0.51
Chongqing	110.94	0.31	137.96	0.36	171.93	0.36	256.17	0.34	428.93	0.34	474.81	0.44	829.84	0.42
Chengdu	164.64	0.50	255.02	0.36	379.47	0.42	597.11	0.28	990.52	0.30	1080.70	0.42	1479.05	0.47
Hangzhou	87.88	0.39	112.62	0.37	198.80	0.32	486.20	0.42	868.89	0.30	1212.31	0.36	1852.17	0.51
Wuhan	211.39	0.39	237.14	0.34	302.31	0.39	435.69	0.48	671.71	0.44	897.63	0.58	1556.65	0.51
Nanjing	190.98	0.46	277.53	0.41	338.62	0.33	586.07	0.37	875.33	0.49	1015.72	0.47	1257.78	0.52
Tianjin	313.77	0.31	380.98	0.40	462.16	0.41	827.44	0.34	1479.35	0.41	1634.76	0.50	2009.37	0.56
Changsha	56.05	0.41	75.04	0.40	106.16	0.40	227.42	0.44	358.08	0.34	444.01	0.43	727.49	0.45
Zhengzhou	185.20	0.40	237.29	0.53	296.31	0.40	491.78	0.41	672.06	0.35	935.58	0.47	1857.52	0.51
Jinan	220.40	0.40	295.48	0.49	370.18	0.20	549.95	0.47	811.24	0.62	947.19	0.43	1263.99	0.54
Hefei	191.95	0.65	250.00	0.60	329.36	0.56	388.72	0.49	546.79	0.33	623.46	0.49	919.72	0.54
Xi'an	138.44	0.17	381.45	0.35	446.33	0.46	543.22	0.30	744.50	0.31	728.01	0.40	1058.79	0.37
Fuzhou	82.02	0.43	117.76	0.42	158.71	0.45	190.34	0.32	280.40	0.38	541.64	0.44	667.97	0.44
Kunming	69.39	0.26	116.85	0.24	191.02	0.28	306.78	0.31	405.49	0.41	539.00	0.36	712.38	0.36
Changchun	114.57	0.03	148.01	0.30	183.83	0.29	247.96	0.35	374.01	0.32	431.85	0.40	765.82	0.42
Shenyang	182.68	0.25	216.87	0.27	246.55	0.28	350.29	0.35	520.50	0.39	653.01	0.43	1007.77	0.49
Shijiazhuang	101.01	0.32	150.33	0.36	256.69	0.38	319.59	0.30	446.79	0.36	565.20	0.37	858.96	0.49
Nanchang	51.10	0.30	95.77	0.38	110.97	0.41	180.92	0.34	294.13	0.42	371.76	0.41	547.81	0.42
Harbin	164.66	0.36	177.92	0.34	206.25	0.42	270.65	0.36	378.74	0.37	443.30	0.39	741.33	0.53
Nanning	139.28	0.53	157.91	0.48	191.60	0.48	229.62	0.45	409.91	0.48	443.99	0.45	519.39	0.45
Guiyang	11.24	0.24	52.09	0.24	67.46	0.29	90.26	0.32	176.33	0.38	265.78	0.40	490.49	0.46
Taiyuan	208.87	0.39	302.57	0.36	345.85	0.17	392.51	0.32	473.38	0.36	624.08	0.47	640.39	0.49
Urumqi	510.09	0.17	534.89	0.18	551.05	0.19	573.77	0.22	626.41	0.16	741.53	0.27	908.83	0.30
Lanzhou	148.60	0.20	179.21	0.25	218.74	0.39	240.98	0.23	258.46	0.27	272.26	0.23	330.47	0.30
Hohhot	52.03	0.01	61.42	0.00	79.17	0.19	146.42	0.05	195.60	0.23	236.43	0.27	401.46	0.32
Yinchuan	45.37	0.20	53.40	0.25	80.60	0.25	157.25	0.21	222.10	0.35	269.21	0.33	437.82	0.34
Haikou	47.50	0.50	64.43	0.37	72.52	0.45	78.36	0.45	92.48	0.35	92.48	0.35	281.51	0.49
Xining	65.22	0.23	74.04	0.22	84.68	0.31	93.47	0.33	117.08	0.40	134.64	0.38	178.70	0.42
Lhasa	34.07	0.21	37.61	0.21	43.42	0.29	50.51	0.29	70.00	0.29	79.94	0.23	108.28	0.31

Table.S3: Expansion rate and vegetation growth rate of built-up areas in provincial capital cities from 1990 to 2020

City/year	1990-1995		1995-2000		2000-2005		2005-2010		2010-2015		2015-2020	
	Expansion speed	Growth rate	Expansion speed	Growth rate	Expansion speed	Growth rate	Expansion speed	Growth rate	Expansion speed	Growth rate	Expansion speed	Growth rate
Shanghai	29.94	0.01	43.86	0.05	142.92	-0.06	172.33	0.11	110.70	0.09	215.44	0.07
Beijing	21.20	-0.01	31.66	-0.03	175.21	0.07	187.42	0.03	83.26	0.13	250.75	0.02
Guangzhou	29.97	-0.05	67.33	-0.02	87.51	0.05	126.61	0.05	28.27	0.02	128.26	0.03
Chongqing	5.40	0.05	6.79	0.00	16.85	-0.03	34.55	0.01	9.18	0.10	71.01	-0.03
Chengdu	18.08	-0.14	24.89	0.06	43.53	-0.14	78.68	0.02	18.04	0.12	79.67	0.05
Hangzhou	4.95	-0.02	17.24	-0.05	57.48	0.10	76.54	-0.12	68.69	0.07	127.97	0.15
Wuhan	5.15	-0.05	13.03	0.05	26.68	0.09	47.20	-0.04	45.18	0.14	131.80	-0.07
Nanjing	17.31	-0.05	12.22	-0.08	49.49	0.04	57.85	0.12	28.08	-0.02	48.41	0.05
Tianjin	13.44	0.09	16.24	0.01	73.06	-0.07	130.38	0.06	31.08	0.10	74.92	0.06
Changsha	3.80	-0.01	6.22	0.00	24.25	0.04	26.13	-0.10	17.18	0.10	56.70	0.02
Zhengzhou	10.42	0.14	11.80	-0.14	39.09	0.01	36.06	-0.06	52.70	0.13	184.39	0.04
Jinan	15.02	0.08	14.94	-0.29	35.95	0.28	52.26	0.15	27.19	-0.18	63.36	0.11
Hefei	11.61	-0.05	15.87	-0.04	11.87	-0.07	31.61	-0.17	15.33	0.17	59.25	0.04
Xi'an	48.60	0.18	12.98	0.11	19.38	-0.16	40.26	0.01	-3.30	0.09	66.16	-0.03
Fuzhou	7.15	0.00	8.19	0.03	6.33	-0.14	18.01	0.06	52.25	0.06	25.27	0.00
Kunming	9.49	-0.01	14.83	0.03	23.15	0.03	19.74	0.10	26.70	-0.05	34.68	-0.01
Changchun	6.69	0.26	7.16	-0.01	12.83	0.06	25.21	-0.03	11.57	0.08	66.79	0.02
Shenyang	6.84	0.02	5.94	0.00	20.75	0.07	34.04	0.04	26.50	0.05	70.95	0.06
Shijiazhuang	9.86	0.04	21.27	0.02	12.58	-0.08	25.44	0.06	23.68	0.02	58.75	0.11
Nanchang	8.93	0.08	3.04	0.02	13.99	-0.07	22.64	0.08	15.53	-0.01	35.21	0.01
Harbin	2.65	-0.02	5.66	0.08	12.88	-0.06	21.62	0.01	12.91	0.03	59.61	0.14
Nanning	3.73	-0.04	6.74	0.00	7.60	-0.03	36.06	0.03	6.82	-0.02	15.08	-0.01
Guiyang	8.17	0.00	3.08	0.05	4.56	0.04	17.21	0.06	17.89	0.02	44.94	0.07
Taiyuan	18.74	-0.03	8.66	-0.19	9.33	0.15	16.18	0.04	30.14	0.12	3.26	0.02
Urumqi	4.96	0.01	3.23	0.02	4.54	0.03	10.53	-0.07	23.02	0.12	33.46	0.02
Lanzhou	6.12	0.05	7.91	0.13	4.45	-0.15	3.50	0.03	2.76	-0.03	11.64	0.07
Hohhot	1.88	-0.01	3.55	0.19	13.45	-0.14	9.84	0.18	8.17	0.04	33.01	0.06
Yinchuan	1.61	0.06	5.44	0.00	15.33	-0.04	12.97	0.14	9.42	-0.02	33.72	0.01
Haikou	3.39	-0.13	1.62	0.08	1.17	0.00	2.82	-0.10	3.55	-0.02	37.81	0.14
Xining	1.76	-0.01	2.13	0.09	1.76	0.02	4.72	0.07	3.51	-0.02	8.81	0.04
Lhasa	0.71	0.00	1.16	0.07	1.42	0.00	3.89	0.00	1.99	-0.06	5.67	0.07

Note: The city ranking refers to the GDP ranking of provincial capital cities in 2020, and the data comes from the statistical yearbooks and bulletins of various regions. The expansion rate is the average annual growth rate of the built-up area of a city, which represents the rate of change of the built-up area of a city in a unit time. In the table, the GDP and expansion rate are sorted from high to low, and the actual data value is replaced by rank. In this study, when $0 \leq FVC \leq 0.4$, the pixel is deemed to have no vegetation coverage, when $0.4 < FVC \leq 1.0$, the pixel is deemed to have vegetation coverage, and the vegetation coverage rate (VCR) is that the built-up area has vegetation coverage The ratio of the area of the area to the total area of the built-up area.