

Supplementary data

Spatial Green Space Assessment in Suburbia: Implications for Urban Development

Table S1. Error matrix of LULC of Nonthaburi in 2020

	LCLU Type	Reference Data														Total classified points
		AAQC	AAQP	AHOR	AOPE	APAD	MBAR	MMSW	MRNS	UGLF	UMUB	UPRK	URRW	WATR		
Classified Data	AAQC	10	0	0	1	0	0	0	0	0	0	0	0	0	11	
	AAQP	0	16	0	0	1	0	0	0	0	0	0	0	0	17	
	AHOR	0	1	32	1	2	1	4	2	0	0	0	0	0	43	
	AOPE	0	0	0	64	0	0	2	9	0	1	0	0	0	76	
	APAD	2	1	3	5	171	2	7	4	0	1	0	0	0	196	
	MBAR	0	0	1	0	0	16	0	3	0	3	0	0	0	23	
	MMSW	1	0	1	1	2	0	59	4	0	0	0	0	0	68	
	MRNS	0	0	0	1	0	2	5	61	0	1	0	0	0	70	
	UGLF	0	0	0	0	0	1	0	1	5	0	0	0	0	7	
	UMUB	0	0	2	4	1	5	7	16	0	183	0	0	0	218	
	UPRK	0	0	0	0	0	0	0	0	0	0	5	0	0	5	
	URRW	0	0	0	0	0	0	0	1	0	0	0	25	0	26	
	WATR	0	0	1	0	0	0	0	0	0	0	0	0	30	31	
	Total reference points	13	18	40	77	177	27	84	101	5	189	5	25	30	791	

Overall accuracy=85.59%, Kappa coefficient=0.83

Where; AAQC=Aquaculture, AAQP=Aquatic plant, AHOR=Field crop and horticulture, AOPE=Perennial and orchard, APAD=Paddy field, MBAR=Bare land, MMSW=Marsh and swamp, MRNS=Rangeland and scrub, UGLF=Golf course, UMUB=Urban and built-up, UPRK=Recreation area, URRW=Road, and WATR=Water body

Table S2. Error matrix of green space extraction by using THEOS multi-indices model

Classified Data	LCLU Type		Reference Data	
			Green area	Non-green area
			Total	
	Green area		897	87
	Non-green area		3	833
	Total		900	920
				1820

Overall accuracy=95.05%, Kappa coefficient=0.90

Table S3. Green space type, UGSI, and PCGS in each district of Nonthaburi, 2020

a) Green Space Area (km ²)							
District	Community economic	Fallow	Functional utility	Median strip	Natural	Public service	Grand total
Bang Bua Thong	37.50	3.68	30.17	0.19	12.25	0.03	83.83
Bang Krui	13.51	0.83	14.45	0.10	3.46	0.04	32.40
Bang Yai	48.16	0.91	17.51	0.07	9.14	0.08	75.88
Muang Nontaburi	9.33	1.22	17.73	0.11	4.07	0.42	32.87
Pak Kret	19.10	3.23	20.40	0.13	10.61	0.28	53.76
Sai Noi	139.81	7.20	23.84	0.19	15.48	0.05	186.54
Province summary	267.41	17.07	124.10	0.79	55.01	0.90	465.29
b) Urban Green Space Index (UGSI) (%)							
Bang Bua Thong	31.74	3.12	25.53	0.16	10.37	0.03	70.95
Bang Krui	24.99	1.54	26.74	0.19	6.41	0.07	59.94
Bang Yai	51.11	0.97	18.59	0.07	9.70	0.09	80.52
Muang Nontaburi	12.65	1.65	24.05	0.15	5.51	0.57	44.58
Pak Kret	20.08	3.40	21.44	0.14	11.16	0.30	56.51
Sai Noi	69.38	3.57	11.83	0.09	7.68	0.02	92.58
Province summary	41.99	2.68	19.49	0.12	8.64	0.14	73.06
c) Per Capita Green Space (PCGS) (m ² /capita)							
Bang Bua Thong	133.10	13.07	107.08	0.69	43.48	0.12	297.53
Bang Krui	95.70	5.91	102.40	0.72	24.53	0.28	229.54
Bang Yai	307.05	5.80	111.66	0.42	58.28	0.53	483.74
Muang Nontaburi	25.40	3.32	48.29	0.31	11.07	1.14	89.53
Pak Kret	76.58	12.96	81.77	0.54	42.56	1.14	215.54
Sai Noi	2,025.96	104.27	345.40	2.69	224.27	0.65	2,703.24
Province summary	211.32	13.49	98.07	0.63	43.47	0.71	367.71

Table S4. Urban green space area in each municipal of Nonthaburi, 2020

Municipal	Urban Green Space Area (km ²)						
	Community economic	Fallow	Functional utility	Median strip	Natural	Public service	Grand total
Nonthaburi	1.571	0.780	9.943	0.039	2.000	0.235	14.567
Pakkret	1.414	1.720	11.276	0.087	4.223	0.208	18.928
Bang Bua Thong	1.769	0.737	3.671	0.001	1.528	0.005	7.711
Bang Krang	2.651	0.122	1.707	0.038	0.276	0.000	4.793
Bang Sri Muang	1.210	0.028	1.656	0.001	0.400	0.148	3.443
Bangkruai	1.623	0.086	2.717		0.440		4.867
Bangkurud	8.202	0.255	4.647		1.443	0.008	14.555
Bangmaenang	7.815	0.088	3.984	0.006	1.532	0.005	13.430
Bangrakpattana	2.475	0.242	3.570		0.921		7.209
Mai Bang Bua Thong	10.051	1.374	6.039	0.019	3.180	0.013	20.676
Pimolrach	4.272	0.096	4.159		0.908	0.007	9.443
Saima	1.957	0.125	1.933		0.842		4.857
Ban Bang Muang	4.023	0.023	2.917	0.015	2.266		9.244
Bang Lane	2.159	0.017	1.570		0.242	0.026	4.014
Bang Muang	0.484		0.373		0.223	0.009	1.089
Bang Yai	3.367	0.158	1.839		0.725	0.017	6.106
Bangplub	2.409	0.260	1.693	0.004	0.682	0.076	5.125
Bangsithong	0.804	0.028	0.913	0.005	0.045		1.795
Plai Bang	2.208	0.325	4.667	0.055	0.738	0.040	8.033
Sainoi	1.226	0.190	0.571		0.131	0.035	2.152
Salaklang	6.743	0.273	3.055		1.820		11.891
Sao Thong Hin	2.706	0.127	2.548	0.045	0.911	0.021	6.357
Summary	71.136	7.054	75.449	0.317	25.477	0.853	180.285

Table S5. Urban Green Space Index (UGSI) in each municipal of Nonthaburi, 2020

Municipal	Urban Green Space Index (UGSI) (%)						
	Community economic	Fallow	Functional utility	Median strip	Natural	Public service	Grand total
Nonthaburi	3.798	1.885	24.042	0.094	4.836	0.568	35.223
Pakkret	3.079	3.746	24.556	0.189	9.197	0.453	41.219
Bang Bua Thong	12.621	5.259	26.197	0.009	10.904	0.033	55.023
Bang Krang	33.561	1.540	21.612	0.484	3.491	0.002	60.691
Bang Sri Muang	18.184	0.428	24.885	0.023	6.011	2.230	51.760
Bangkruai	15.476	0.821	25.904		4.195		46.396
Bangkurud	47.907	1.490	27.140		8.428	0.049	85.014
Bangmaenang	42.876	0.482	21.858	0.035	8.406	0.025	73.683
Bangrakpattana	20.173	1.974	29.101		7.509		58.757
Mai Bang Bua Thong	39.578	5.412	23.783	0.074	12.521	0.052	81.420
Pimolrach	30.367	0.685	29.568		6.455	0.050	67.125
Saima	22.993	1.468	22.707		9.893		57.061
Ban Bang Muang	32.829	0.185	23.808	0.126	18.492		75.441
Bang Lane	34.778	0.267	25.295		3.901	0.420	64.661
Bang Muang	30.952		23.839		14.293	0.593	69.676
Bang Yai	45.393	2.132	24.795		9.778	0.235	82.333
Bangplub	29.334	3.171	20.621	0.049	8.311	0.924	62.409
Bangsithong	25.117	0.881	28.509	0.167	1.405		56.078
Plai Bang	14.469	2.128	30.578	0.362	4.833	0.260	52.630
Sainoi	46.598	7.239	21.706		4.968	1.314	81.823
Salaklang	46.454	1.878	21.045		12.538		81.915
Sao Thong Hin	25.062	1.173	23.603	0.415	8.437	0.199	58.888
All municipal	23.401	2.321	24.820	0.104	8.381	0.281	59.308

Table S6. Per Capita Green Space (PCGS) in each municipal of Nonthaburi, 2020

Municipal	Per Capita Green Space (PCGS) (m ² /capita)						
	Community economic	Fallow	Functional utility	Median strip	Natural	Public service	Grand total
Nonthaburi	6.17	3.07	39.09	0.15	7.86	0.92	57.27
Pakkret	7.43	9.04	59.26	0.46	22.19	1.09	99.48
Bang Bua Thong	34.40	14.33	71.40	0.02	29.72	0.09	149.95
Bang Krang	115.20	5.29	74.18	1.66	11.98	0.01	208.32
Bang Sri Muang	36.79	0.87	50.35	0.05	12.16	4.51	104.73
Bangkruai	36.78	1.95	61.57		9.97		110.27
Bangkurud	204.69	6.37	115.96		36.01	0.21	363.24
Bangmaenang	168.20	1.89	85.75	0.14	32.98	0.10	289.05
Bangrakpattana	54.21	5.30	78.20		20.18		157.90
Mai Bang Bua Thong	184.23	25.19	110.71	0.34	58.29	0.24	379.00
Pimolrach	91.27	2.06	88.87		19.40	0.15	201.75
Saima	83.94	5.36	82.89		36.12		208.31
Ban Bang Muang	229.52	1.29	166.45	0.88	129.28		527.42
Bang Lane	134.53	1.03	97.85		15.09	1.63	250.12
Bang Muang	79.95		61.57		36.92	1.53	179.97
Bang Yai	289.72	13.61	158.25		62.41	1.50	525.48
Bangplub	224.60	24.28	157.89	0.37	63.63	7.08	477.86
Bangsithong	71.77	2.52	81.46	0.48	4.01		160.25
Plai Bang	48.46	7.13	102.42	1.21	16.19	0.87	176.28
Sainoi	481.18	74.75	224.14		51.30	13.56	844.92
Salaklang	362.89	14.67	164.40		97.95		639.91
Sao Thong Hin	68.82	3.22	64.81	1.14	23.17	0.55	161.71
All municipal	68.92	6.83	73.10	0.31	24.68	0.83	174.67

Table S7. List of public service green space and 500-meter accessibility area in Nonthaburi

No.	List	Municipal	Sub-district	District	Area (m ²)	Cluster within 500 meters	Total area of cluster (m ²)	Population number	Service area/ Population (m ² /capita)
1	Pitak Nonthaket Stadium	Sainoi sub-district	Sainoi	Sainoi	25,090.17	Group 1	34,547.31	3,992	8.65
2	Sainoi sub-district municipality park	Sainoi sub-district	Sainoi	Sainoi	9,457.14				
3	Limkul park	-	Nong Phrao Ngai	Sainoi	10,643.73	-	-	400	26.61
4	Mai Bang Bua Thong town municipality yard	Mai Bang Bua Thong town	Bang Bua Thong	Bang Bua Thong	13,085.25	-	-	2,020	6.48
5	Tesco Lotus Bangkruai-Sainoi community sport field	Bang Bua Thong town	Bang Bua Thong	Bang Bua Thong	4,631.14	-	-	2,118	<u>2.19</u>
6	Bua Thong 4 Village sport field	Pimolrach town	Pimolrach	Bang Bua Thong	8,774.48	Group 2	15,451.14	3,280	<u>4.71</u>
7	Prueksa 3 sport field	Bangkurud town	Bangkurud	Bang Bua Thong	6,676.66				
8	Baan Mai sub-district administrative organization stadium	-	Baan Mai	Bang Yai	10,051.13	-	-	1,332	7.55
9	Bangmaenang town municipality park	Bangmaenang town	Bangmaenang	Bang Yai	4,565.47	-	-	1,458	<u>3.13</u>
10	Somdet Phra Chao Taksin Maharat park	Sao Thong Hin sub-district	Sao Thong Hin	Bang Yai	8,157.96	Group 3	21,439.73	4,645	<u>4.62</u>
11	Bang Yai City park	Sao Thong Hin sub-district	Sao Thong Hin	Bang Yai	13,281.77				
12	Commemorating His Majesty the King's 80 th Birthday Anniversary park	Bang Muang sub-district	Sao Thong Hin	Bang Yai	9,264.64	-	-	2,302	<u>4.02</u>
13	Nonthaburi stadium	Bang Lane sub-district (with some minor area in Bang Krang)	Bang Lane & Bang Krang	Bang Yai & Muang Nonthaburi	26,273.35	-	-	5,022	5.23
14	Asa House Village sport field	Bang Yai sub-district	Bang Yai	Bang Yai	7,751.22	Group 4	17,395.81	2,197	7.92
15	Bang Yai youth center	Bang Yai sub-district	Bang Yai	Bang Yai	9,644.59				
16	Bang Khu Wiang interchange park	Plai Bang sub-district	Bang Khu Wiang	Bang Krui	39,729.17	-	-	5,442	7.30
17	Chaloem Kanchanaphisek park	Bang Sri Muang town	Bang Sri Muang	Muang Nonthaburi	142,318.13	Group 5	148,361.12	9,999	14.84
18	Bhumirak Chaloem Phrakiat park	Bang Sri Muang town	Bang Sri Muang	Muang Nonthaburi	6,042.99				
19	Bang Rak Yai park	-	Bang Rak Noi	Muang Nonthaburi	28,528.24	-	-	11,003	<u>2.59</u>

Table S7. List of public service green space and 500-meter accessibility area in Nonthaburi (cont.)

No.	List	Municipal	Sub-district	District	Area (m ²)	Cluster within 500 meters	Total area of cluster (m ²)	Population number	Service area/ Population (m ² /capita)
20	80 th Anniversary Celebration park	Nonthaburi city	Bang Khen	Muang Nonthaburi	18,312.00	-	-	16,518	<u>1.11</u>
21	Makutromsaran park	Nonthaburi city	Bang Krasor	Muang Nonthaburi	87,750.74	-	-	24,576	<u>3.57</u>
22	Public park, Ministry of Public Health	Nonthaburi city	Bang Khen	Muang Nonthaburi	63,657.37	-	-	14,433	<u>4.41</u>
23	72 nd Anniversary Celebration park (Prachaniwet 3)	Nonthaburi city	Tha Sai	Muang Nonthaburi	7,561.05	Group 6	64,843.07	47,746	<u>1.36</u>
24	Prachaniwet 3exercise park	Nonthaburi city	Tha Sai	Muang Nonthaburi	10,104.23				
25	Prachaniwet 2park (Soi Samakkhi (22/58	Nonthaburi city	Tha Sai	Muang Nonthaburi	2,536.86				
26	Prachaniwet 2park (Soi Samakkhi (12/58	Nonthaburi city	Tha Sai	Muang Nonthaburi	2,548.06				
27	Chaloem Phrakiat youth center, Nonthaburi city municipality	Nonthaburi city	Tha Sai	Muang Nonthaburi	22,435.69				
28	Prachaniwet 2park (Soi Samakkhi (9/58	Nonthaburi city	Tha Sai	Muang Nonthaburi	3,279.28				
29	Prachaniwet 2park, along Prapa canal	Nonthaburi city	Tha Sai	Muang Nonthaburi	6,331.27				
30	Prachaniwet 3Park (Soi 10, behind the golf driving range)	Nonthaburi city	Tha Sai	Muang Nonthaburi	2,735.30				
31	Prachaniwet 3park (Soi 12, behind Siam Commercial Bank)	Nonthaburi city	Tha Sai	Muang Nonthaburi	910.23				
32	Prachaniwet community park 3, Section 2South	Nonthaburi city	Tha Sai	Muang Nonthaburi	1,423.25				
33	Prachaniwet Park 3Soi 14 Intersection) 5Fountain courtyard)	Nonthaburi city	Bang Krasor	Muang Nonthaburi	1,327.67				
34	Prachaniwet park 3Soi 14 Intersection 11	Nonthaburi city	Bang Krasor	Muang Nonthaburi	2,408.94				
35	Prachaniwet park 3Soi 3/8 Intersection 12	Nonthaburi city	Tha Sai	Muang Nonthaburi	1,241.24				
36	Small park Soi Sirichai 1 Intersection 1	Nonthaburi city	Bang Khen	Muang Nonthaburi	293.99	-	-	8,903	<u>0.03</u>
37	Wat Sali Khophitaram health park	Bang Plub sub-district	Bang Plub	Pak Kret	10,489.82	-	-	2,378	<u>4.41</u>

Table S7. List of public service green space and 500-meter accessibility area in Nonthaburi (cont.)

No.	List	Municipal	Sub-district	District	Area (m ²)	Cluster within 500 meters	Total area of cluster (m ²)	Population number	Service area/ Population (m ² /capita)
38	Chaiyapruet Road park	Bang Plub sub-district	Bang Plub	Pak Kret	65,382.60	-	-	5,025	13.01
39	Somdet Phra Srinagarindra park	Pakkret city	Baan Mai	Pak Kret	155,470.01	-	-	7,844	19.82
40	Rajamangalaphisek educational park	Pakkret city	Baan Mai	Pak Kret	33,009.07	-	-	9,452	<u>3.49</u>
41	Water drop-shaped pool public park, Royal Irrigation Department	Pakkret city	Bang Talat	Pak Kret	19,498.06	-	-	6,775	<u>2.88</u>

***Remark:** The service areas/population italicized, and underlined value means lower than the criteria of the Office of Natural Resources and Environmental Policy and Planning, which defines the public service green space equal to 5 m²/capita in the service area