Supplementary Material

A CRITIC–TOPSIS Multi-Criteria Decision-Making Approach for Optimum Site Selection for Solar PV Farm

The detail calculation for all the four multi criteria decision making methods i-e CRITIC, TOPSIS, SAW AND MOORA are given in the following sections.

S1. Calculation for CRITIC Method:

Table S1. Decision matrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
A1	5.43	18.6	3.1	54.9	8.7	11020	519.6	877.56	287476	30	2624238	4.8	528964	8314	76.393	2354320
A2	5.94	28.2	3.6	60.4	9.2	9505	435.09	1072.6	202147	35	1845308	5.8	456221	7170	67.801	9261257
A3	5.6	26.5	4.4	52	9.2	8808	395.043	930.8	162935	38	1487360	6.5	422793	6645	62.45	1304688
A4	5.78	25.7	3	26.6	9.2	10074	467.45	1144.3	234207	33	2137970	5.4	483552	7600	72.379	8660885
A5	5.85	26.8	3.57	39.1	9.4	9220	428.92	1072.9	186117	36	1698977	6.1	442555	6956	66.632	858935

Table S2. Normalization matrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
A1	0	1	0.0714	0.1627	0	1	0	1	1	1	1	1	1	0	0	0.17797
A2	1	0	0.4286	0	0.7143	0.3151	0.6785	0.2688	0.3149	0.375	0.3149	0.4118	0.3149	0.6854	0.6162	1
A3	0.333	0.1771	1	0.2485	0.7143	0	1	0.8004	0	0	0	0	0	1	1	0.05305
A4	0.686	0.2604	0	1	0.7143	0.5723	0.4187	0	0.5723	0.625	0.5723	0.6471	0.5723	0.4278	0.2879	0.92855
A5	0.824	0.1458	0.4071	0.6302	1	0.1863	0.728	0.26768	0.1861	0.25	0.1861	0.2353	0.1861	0.8137	0.7001	0
STDV	0.401	0.3934	0.3959	0.4037	0.3725	0.3878	0.3773	0.41604	0.3878	0.381198767	0.3878	0.3844	0.3878	0.3878	0.3861	0.4909

Table S3. Correlation between Criteria.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
C1	1	−0.86	0.02	0.196	0.801	−0.511	0.483	−0.858	−0.511	−0.441	−0.511	−0.413	−0.511	0.51	0.392	0.542
C2	−0.859	1	−0.48	−0.14	−0.92	0.851	−0.85	0.6733	0.8515	0.8114	0.852	0.7875	0.8515	−0.85	−0.774	−0.33
C3	0.0201	−0.5	1	−0.41	0.388	−0.828	0.853	0.3106	−0.828	−0.868	−0.828	−0.873	−0.828	0.83	0.9089	−0.42
C4	0.1965	−0.14	−0.41	1	0.397	0.009	−0.05	−0.631	0.0093	0.0433	0.009	0.0345	0.0093	−0.01	−0.137	0.112
C5	0.8014	−0.92	0.388	0.397	1	−0.836	0.801	−0.706	−0.836	−0.792	−0.836	−0.786	−0.836	0.84	0.7356	0.079
C6	−0.511	0.851	−0.83	0.009	−0.84	1	−1	0.2562	1	0.9966	1	0.9937	1	−1	−0.986	0.169
C7	0.4827	−0.85	0.853	−0.05	0.801	−0.996	1	−0.227	−0.996	−0.996	−0.996	−0.991	−0.996	1	0.99	−0.13
C8	−0.858	0.673	0.311	−0.63	−0.71	0.256	−0.23	1	0.2564	0.1831	0.256	0.1586	0.2564	−0.26	−0.099	−0.64
C9	−0.511	0.852	−0.83	0.009	−0.84	1	−1	0.2564	1	0.9966	1	0.9936	1	−1	−0.986	0.169
C10	−0.441	0.811	−0.87	0.043	−0.79	0.997	−1	0.1831	0.9966	1	0.997	0.9986	0.9966	−1	−0.995	0.216
C11	−0.511	0.852	−0.83	0.009	−0.84	1	−1	0.2564	1	0.9966	1	0.9936	1	−1	−0.986	0.169
C12	−0.413	0.788	−0.87	0.034	−0.79	0.994	−0.99	0.1586	0.9936	0.9986	0.994	1	0.9936	−0.99	−0.994	0.265
C13	−0.511	0.852	−0.83	0.009	−0.84	1	−1	0.2564	1	0.9966	1	0.9936	1	−1	−0.986	0.169
C14	0.5113	−0.85	0.828	−0.01	0.836	−1	0.996	−0.256	−1	−0.997	−1	−0.994	−1	1	0.9863	−0.17
C15	0.392	−0.77	0.909	−0.14	0.736	−0.986	0.99	−0.099	−0.986	−0.995	−0.986	−0.994	−0.986	0.99	1	−0.25
C16	0.542	−0.33	−0.42	0.112	0.079	0.169	−0.13	−0.637	0.1691	0.2158	0.169	0.2646	0.1691	−0.17	−0.248	1

S2. Calculation for TOPSIS method

Table S4. Normalized Performance matrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
A1	0.424	0.328	0.388	0.51	0.4255	0.5052	0.52	0.383	0.5874	0.389	0.587	0.373	0.505	0.505	0.493	0.181
A2	0.464	0.497	0.451	0.561	0.45	0.4357	0.43	0.468	0.413	0.454	0.413	0.451	0.436	0.436	0.438	0.713
A3	0.438	0.467	0.551	0.483	0.45	0.4038	0.39	0.406	0.3329	0.492	0.333	0.506	0.404	0.404	0.403	0.1
A4	0.452	0.453	0.376	0.247	0.45	0.4618	0.46	0.5	0.4785	0.428	0.479	0.42	0.462	0.462	0.467	0.667
A5	0.457	0.472	0.447	0.363	0.4598	0.4227	0.43	0.468	0.3803	0.467	0.38	0.474	0.423	0.423	0.43	0.066

Table S5. Weighted Normalized Matrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
A1	0.029	0.019	0.028	0.032	0.0279	0.0273	0.04	0.026	0.0318	0.021	0.032	0.02	0.027	0.036	0.035	0.013
A2	0.031	0.029	0.032	0.035	0.0295	0.0236	0.03	0.031	0.0224	0.024	0.022	0.024	0.024	0.031	0.031	0.053
A3	0.029	0.027	0.04	0.03	0.0295	0.0219	0.03	0.027	0.018	0.026	0.018	0.027	0.022	0.029	0.028	0.007
A4	0.03	0.026	0.027	0.016	0.0295	0.025	0.03	0.034	0.0259	0.023	0.026	0.022	0.025	0.033	0.033	0.05
A5	0.031	0.027	0.032	0.023	0.0302	0.0229	0.03	0.031	0.0206	0.025	0.021	0.025	0.023	0.03	0.03	0.005

S3. SAW Method

Table S6. Normalized Decision Matrix.

	B	NB	B	NB	B	B	NB	NB	B	NB	B	NB	B	NB	NB	B
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
A1	0.914	1	0.705	0.485	0.926	1	0.76	1	1	1	1	1	1	0.799	0.817	0.254
A2	1	0.66	0.818	0.44	0.979	0.863	0.908	0.818	0.703	0.857	0.703	0.828	0.862	0.927	0.921	1
A3	0.943	0.702	1	0.512	0.979	0.799	1	0.943	0.567	0.789	0.567	0.738	0.799	1	1	0.141
A4	0.973	0.724	0.682	1	0.979	0.914	0.845	0.767	0.815	0.909	0.815	0.889	0.914	0.874	0.863	0.935
A5	0.985	0.694	0.811	0.68	1	0.837	0.921	0.818	0.647	0.833	0.647	0.787	0.837	0.955	0.937	0.093

STEP 3: Is to calculate the weighted sum and rank the alternatives

Table S7. Weighted Sum Matix.

W	0.067	0.058	0.072	0.063	0.066	0.054	0.069	0.067	0.054	0.053	0.054	0.053	0.054	0.071	0.071	0.074			
	B	NB	B	NB	B	B	NB	NB	B	NB	B	NB	B	NB	NB	B			
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	SUM	RANK	
A1	0.061	0.058	0.051	0.031	0.061	0.054	0.052	0.067	0.054	0.053	0.054	0.053	0.054	0.056	0.058	0.019	0.836599	3	ABHA
A2	0.067	0.038	0.059	0.028	0.064	0.047	0.062	0.055	0.038	0.046	0.038	0.044	0.047	0.065	0.065	0.074	0.837499	2	JEDDAH
A3	0.063	0.04	0.072	0.032	0.064	0.043	0.069	0.063	0.031	0.042	0.031	0.039	0.043	0.071	0.071	0.01	0.785274	4	DAMMAM
A4	0.065	0.042	0.049	0.063	0.064	0.049	0.058	0.052	0.044	0.048	0.044	0.048	0.049	0.062	0.061	0.069	0.86821	1	RIYADH
A5	0.066	0.04	0.058	0.043	0.066	0.045	0.063	0.055	0.035	0.044	0.035	0.042	0.045	0.068	0.066	0.007	0.778854	5	ALAHSA

S4. MOORA METHOD

STEP 1. Form the decision matrix

Table S8. Decision Matrix.

	B	NB	B	NB	B	B	NB	NB	B	NB	B	NB	B	NB	NB	B
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
A1	5.43	18.6	3.1	54.9	8.7	11020	519.6	877.56	287476	30	2624238	4.8	528964	8314	76.393	2354320
A2	5.94	28.2	3.6	60.4	9.2	9505	435.09	1072.6	202147	35	1845308	5.8	456221	7170	67.801	9261257
A3	5.6	26.5	4.4	52	9.2	8808	395.043	930.8	162935	38	1487360	6.5	422793	6645	62.45	1304688
A4	5.78	25.7	3	26.6	9.2	10074	467.45	1144.3	234207	33	2137970	5.4	483552	7600	72.379	8660885
A5	5.85	26.8	3.57	39.1	9.4	9220	428.92	1072.9	186117	36	1698977	6.1	442555	6956	66.632	858935

STEP 2. CALCULATE THE PERFORMANCE SCORE
STEP 3. CALCULATE THE NORMALISED MATRIX
STEP 4. CALCULATET THE DISTANCE TO IDEAL SOLUTION
STEP 5. RANK THE ALTERNATIVES.

Table S9. Performance score.

	B	NB	B	NB	B	B	NB	NB	B	NB	B	NB	B	NB	NB	B
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
A1	29.48	346	9.61	3014	75.69	1E+08	3E+05	8E+05	8E+10	900	7E+12	23.04	3E+11	7E+07	5836	6E+12
A2	35.28	795.2	12.96	3648	84.64	9E+07	2E+05	1E+06	4E+10	1225	3E+12	33.64	2E+11	5E+07	4597	9E+13
A3	31.36	702.3	19.36	2704	84.64	8E+07	2E+05	9E+05	3E+10	1444	2E+12	42.25	2E+11	4E+07	3900	2E+12
A4	33.41	660.5	9	707.6	84.64	1E+08	2E+05	1E+06	5E+10	1089	5E+12	29.16	2E+11	6E+07	5239	8E+13
A5	34.22	718.2	12.74	1529	88.36	9E+07	2E+05	1E+06	3E+10	1296	3E+12	37.21	2E+11	5E+07	4440	7E+11
	12.8	56.76	7.98	107.7	20.444	21814	1009	2291	489435	77.16	4E+06	12.857	1E+06	16457	155	1E+07

Table S10. Normalized Matrix.

NM	B	NB	B	NB	B	B	NB	NB	B	NB	B	NB	B	NB	NB	B	
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	Y
A1	0.424	0.328	0.388	0.51	0.4255	0.5052	0.515	0.383	0.5874	0.389	0.5874	0.3733	0.5052	0.505	0.49	0.1812	0.108877
A2	0.464	0.497	0.451	0.561	0.45	0.4357	0.431	0.468	0.413	0.454	0.413	0.4511	0.4357	0.436	0.44	0.7129	0.04074
A3	0.438	0.467	0.551	0.483	0.45	0.4038	0.392	0.406	0.3329	0.492	0.3329	0.5056	0.4038	0.404	0.4	0.1004	−0.53952
A4	0.452	0.453	0.376	0.247	0.45	0.4618	0.463	0.5	0.4785	0.428	0.4785	0.42	0.4618	0.462	0.47	0.6667	0.385842
A5	0.457	0.472	0.447	0.363	0.4598	0.4227	0.425	0.468	0.3803	0.467	0.3803	0.4745	0.4227	0.423	0.43	0.0661	−0.48603

Table S11. Weigthed Normalized Matrix.

W	0.067	0.058	0.072	0.063	0.0656	0.0541	0.069	0.067	0.0541	0.053	0.0541	0.0535	0.0541	0.071	0.07	0.0743	
WNM	B	NB	B	NB	B	B	NB	NB	B	NB	B	NB	B	NB	NB	B	
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	Y
A1	0.029	0.019	0.028	0.032	0.0279	0.0273	0.035	0.026	0.0318	0.021	0.0318	0.02	0.0274	0.036	0.03	0.0135	−0.00711
A2	0.031	0.029	0.032	0.035	0.0295	0.0236	0.03	0.031	0.0224	0.024	0.0224	0.0241	0.0236	0.031	0.03	0.053	0.003094
A3	0.029	0.027	0.04	0.03	0.0295	0.0219	0.027	0.027	0.018	0.026	0.018	0.027	0.0219	0.029	0.03	0.0075	−0.03588
A4	0.03	0.026	0.027	0.016	0.0295	0.025	0.032	0.034	0.0259	0.023	0.0259	0.0225	0.025	0.033	0.03	0.0495	0.020476
A5	0.031	0.027	0.032	0.023	0.0302	0.0229	0.029	0.031	0.0206	0.025	0.0206	0.0254	0.0229	0.03	0.03	0.0049	−0.0362

STEP 5

3	ABHA
2	JEDDAH
4	DAMMAM
1	RIYADH
5	ALAHSA