FIG 2018 ISTANBUL

Presented at the FIG Congress 2018, May 6-11, 2018 in Istanbul, Turkey

XXVI FIG Congress 2018

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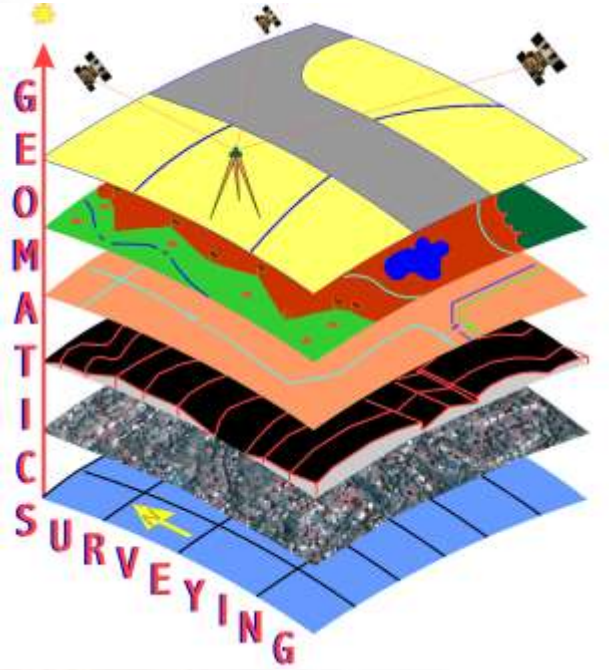
Assessment of Urban Forests by Using Weighted Linear Combination



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INTRODUCTION

- Especially in parallel with the gradual enlargement of urban areas, the concept of urban forest has emerged as a result of the need of people for green areas.
- With this project put into practice in 2003, totally 63 urban forests were put at service of people as of the end of year
- Analyzing the urban forests in details are difficult tasks and it takes long time to investigate. But the assessments can be made via main factors that have been determined by the specialists. These factors can be listed as location, altitude, size of forest area, flora, fauna, artificial and natural facilities in the area, and oxygen production.

INTRODUCTION

- Besides that, location-based Geographical Information Systems and decision-making methods are widely used now.
- Weighted Linear Combination method, one of the location-based assessment methods, is based on the weighted mean, in which the criteria are standardized within a common numeric range.
- The suitability value of each alternative is obtained from the sum of multiplications of the importance weights determined for criterion with the scores calculated within the scale.
- In this study, WLC method was used in order to GIS-based assessment of urban forests.

METHODOLOGY

- In this study, 63 urban forests were marked on the map of Turkey by using ArcGIS software. The characteristics of 63 urban forests in terms of 8 criteria were entered in feature table. By using WLC method in the software, the raster maps were created for each criterion and, by entering the weights, the suitability values of WLC method were obtained.

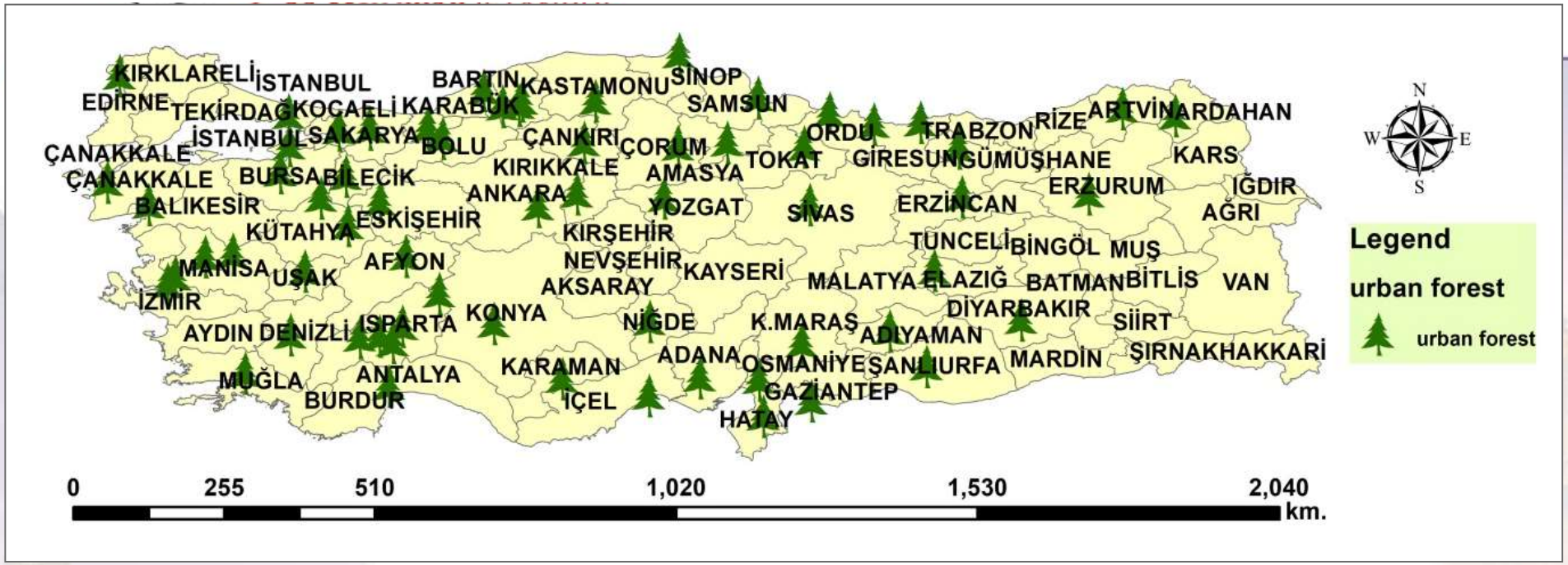
WEIGHTED LINEAR COMBINATION

- The decision-maker assigns the weights, which have relative importance, directly to a layer of characteristics map. The total score of each alternative is obtained from the sum of multiplications of importance weights determined for criteria. The suitability alternatives are calculated for each alternative, and the alternative having the highest suitability value is selected.

$$Xi = \begin{cases} \dfrac{a_{ik}^{q} - \min\limits_{i,q}\{a_{ik}^{q}\}}{r_{k}^{q}}, & for\ the\ k-th\ criterion\ to\ be\ maximized \\ \dfrac{\max\limits_{i,q}\{a_{ik}^{q}\} - a_{ik}^{q}}{r_{k}^{q}}, & for\ the\ k-th\ criterion\ to\ be\ minimized \end{cases}$$

$$S = \sum Wi \,.Xi$$

RESULTS



Table

urban forest

Name	ID	City C	City Cent	Area	Area-Score	Oxygen	Oxygen-Score	Flora	Flora_Score	Fauna	Fauna-Scor	Facilities	Facilities-Score	Rain	Rain-Score	Elevation	Elevation
AFYONKARAHİSAR KENT ORMANI	3	40	0	40	0.003203	33.5	0.003908	6	0.25	7	0.25	7	0.307692	421	0.112026	0.156276	0.436261
ANKARA KENT ORMANI	5	35	0.125	650	0.064251	122.2	0.01451	2	0.05	17	0.75	8	0.384615	404	0.094553	0.215735	0.362072
KARAMAN YUNUS EMRE KENT ORMANI	38	15	0.625	135	0.01271	113	0.01341	6	0.25	7	0.25	9	0.461538	314	0.002055	0.254408	0.391239
KIRIKKALE KENT ORMANI	40	0	1	40	0.003203	33.5	0.003908	4	0.15	7	0.25	4	0.076923	383	0.07297	0.267302	0.671339
ERZURUM KENT ORMANI	23	5	0.875	717	0.070957	600	0.071616	7	0.3	2	0	10	0.538462	405	0.095581	0.267394	0
KONYA AKŞEHİR KENT ORMANI	44	10	0.75	580	0.057246	485.3	0.057907	8	0.35	6	0.2	6	0.230769	312	0	0.271567	0.477122
ADIYAMAN KENT ORMANI	2	21	0.475	110	0.010206	92.05	0.010906	8	0.35	6	0.2	6	0.230769	699	0.307461	0.274904	0.671734
UŞAK KENT ORMANI	61	7	0.825	172	0.016413	143.9	0.017103	6	0.25	4	0.1	7	0.307692	526	0.219938	0.284389	0.561255
KARABÜK YENİCE KENT ORMANI	37	4	0.9	31	0.002302	0.6	0	8	0.35	2	0	5	0.153846	497	0.190134	0.28593	0.726553
ERZİNCAN KENT ORMANI	22	15	0.625	500	0.049239	418.4	0.049911	13	0.6	5	0.15	8	0.384615	380	0.069887	0.294945	0.343902
NİĞDE KENT ORMANI	52	6	0.85	50	0.004203	41.8	0.0049	3	0.1	14	0.6	7	0.307692	339	0.027749	0.295989	0.468474
BOLU KENT ORMANI	11	14	0.65	131	0.01231	109.6	0.013004	7	0.3	3	0.05	10	0.538462	550	0.244604	0.297032	0.634949
KONYA MEVLANA KENT ORMANI	43	25	0.375	466	0.045837	390	0.046517	10	0.45	15	0.65	9	0.461538	312	0	0.298717	0.33886
ŞANLIURFA KENT ORMANI	59	6	0.85	280	0.027222	234.7	0.027955	6	0.25	6	0.2	7	0.307692	434	0.125385	0.299774	0.629279
ESKİŞEHİR KENT ORMANI	24	21	0.475	1207	0.120802	1077	0.120626	10	0.45	5	0.15	9	0.461538	348	0.036999	0.30394	0.610901
ELAZIĞ KENT ORMANI	21	20	0.5	437	0.042934	365.7	0.043612	15	0.7	7	0.25	8	0.384615	386	0.076053	0.304832	0.376575
DÜZCE KENT ORMANI	19	7	0.825	158	0.015012	132.2	0.015705	6	0.25	2	0	5	0.153846	809	0.510791	0.309203	0.864499
MANİSA GÖRDES KENT ORMANI	49	5	0.875	195	0.018715	163.2	0.01941	2	0.05	7	0.25	7	0.307692	686	0.384378	0.310715	0.696622
ADANA SAKIP SABANCI KENT ORMANI	1	12	0.7	31	0.002302	25.94	0.003005	1	0	8	0.3	9	0.461538	646	0.343268	0.316788	0.938351
SAKARYA KENT ORMANI	55	10	0.75	40	0.003203	33.1	0.00386	2	0.05	2	0	9	0.461538	646	0.648618	0.318041	0.962573
KOCAELİ KENT ORMANI	42	12	0.7	30	0.002202	25.1	0.002904	4	0.15	3	0.05	9	0.461538	831	0.533402	0.318044	0.83981
KÜTAHYA DOMANİÇ EBE ÇAMLIĞI KENT ORM	46	1	0.975	10	0.0002	8.4	0.000908	3	0.1	5	0.15	10	0.538462	521	0.2148	0.318817	0.602215
ISPARTA SÜTÇÜLER KENT ORMANI	31	12	0.7	40	0.003203	33.5	0.003908	11	0.5	11	0.45	8	0.384615	501	0.194246	0.31917	0.250127
KARABÜK KENT ORMANI	35	0	1	100	0.009207	83.7	0.009908	6	0.25	4	0.1	6	0.230769	497	0.190134	0.319243	0.825308
BURDUR KENT ORMANI	12	9	0.775	13	0.0005	55.2	0.006502	9	0.4	5	0.15	11	0.615385	425	0.116136	0.32244	0.484916
ÇORUM KENT ORMANI	16	6	0.85	117	0.010909	97.9	0.011605	11	0.5	7	0.25	8	0.384615	447	0.138746	0.333583	0.471414
KASTAMONU KENT ORMANI	39	11	0.725	37	0.002902	31.2	0.003633	6	0.25	15	0.65	8	0.384615	500	0.193217	0.334499	0.506876

RESULTS

In accordance with the scoring method in this study, 8 criteria were evaluated by the focus group consisting of forest engineers, and the weights were obtained (Table 1).

Table 1. Determining the Weights

No	Criterion	Mean score	Weight
1	Location	6.21	0.1460
2	Size of forest area	4.42	0.1039
3	Mean altitude	3.86	0.0907
4	Fauna	5.13	0.1206
5	Flora	6.05	0.1422
6	Precipitation level of region	4.26	0.1001
7	Oxygen production capacity	7.25	0.1704
8	Facilities within the forest area	5.36	0.1260

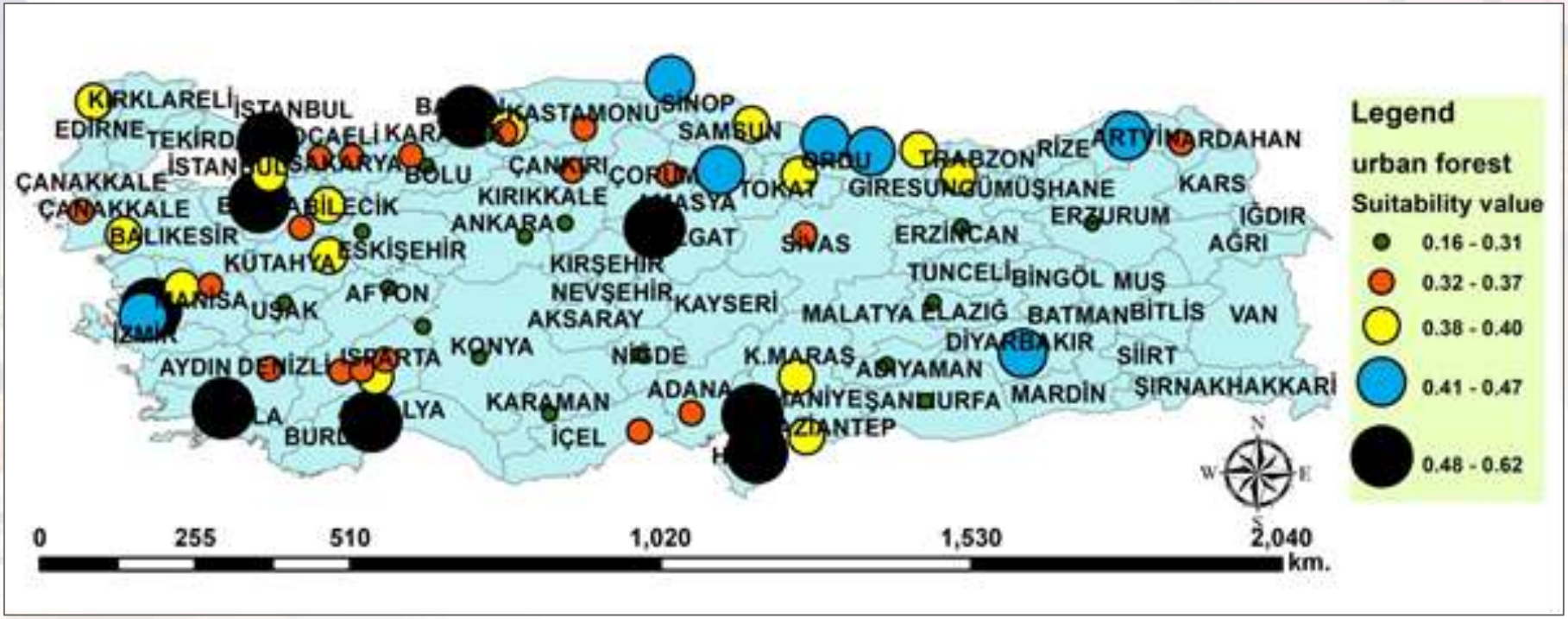
RESULTS

- By using the WLC method in software, the raster maps were created for each criterion. The suitability values in WLC method were calculated by entering the weights. In Table 2, there are the suitability (Si) values of first and last 5 urban forests.

Table 2. Suitability values used in assessing the urban forests

ID	Name of urban forest	Si
5	Antalya Urban Forest	0.6168
52	Osmaniye Urban Forest	0.5037
63	Zonguldak Urban Forest	0.4991
46	Manisa Urban Forest	0.4927
12	Bursa Urban Forest	0.4861
...	...	...
22	Erzurum Urban Forest	0.2674
39	Kırıkkale Urban Forest	0.2673
37	Karaman Y. Emre Urban Forest	0.2544
4	Ankara Urban Forest	0.2157
2	Afyonkarahisar Urban Forest	0.1563

RESULTS


KIRKLARELİ
İSTANBUL
EDİRNE
TEKİRDAĞ
ÇANAKKALE
BALIKESİR
KÜTAHYA
ESKİŞEHİR
BOLU
KASTAMONU
SİNOP
SAMSUN
ÇANKIRI
ÇORUM
AMASYA
TOKAT
ORDU
GİRESUN
TRABZON
RİZE
ARTVİN
ARDAHAN
GÜMÜŞHANE
KARS
ERZURUM
IĞDIR
AĞRI
ERZİNCAN
SİVAS
KIRIKKALE
ANKARA
KIRŞEHİR
NEVŞEHİR
AKSARAY
KAYSERİ
TUNCELİ
BİNGÖL
MUŞ
BİTLİS
VAN
MALATYA
ELAZIĞ
BATMAN
DİYARBAKIR
SİİRT
ŞIRNAKHAKKARİ
MARDİN
AFYON
UŞAK
İZMİR
AYDIN
DENİZLİ
ISPARTA
KONYA
NİĞDE
K.MARAŞ
ADANA
KARAMAN
İÇEL
GAZİANTEP
ŞANLIURFA
ADIYAMAN
0
255
510
1,020
1,530
2,040
km.
Legend
urban forest
Suitability value
0.16 - 0.31
0.32 - 0.37
0.38 - 0.40
0.41 - 0.47
0.48 - 0.62

CONCLUSION

- According to the assessment on map, it can be stated that the forests established in coastal regions are significantly suitable in terms of the examined criteria,
- The suitability values of forests located in inner regions are lower when compared to those located in coastal regions.
- It can be said that the climate of coastal region is better for urban forests.

THANK YOU VERY MUCH