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ON QUANTITATIVE FORMULATION OF NATIONWIDE HUMAN ENVIRONMENT INDEX: VISUALIZATION, EVALUATION, AND VALIDATION-I:
Proposed Human Environment Index in Light of Average Ranking and Rescaling Protocols

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On Quantitative Formulation of Nationwide Human Environment Index[1]

SECTION 1: HIGHLIGHTS

The law of human life, living, and human life cycle lies in supportive land, air, and water (LAW). Ancient scriptures express it very well:

"…when the land is not livable,
when the air is not breathable,
when the water is not drinkable,
man shall perish…"

The worldwide human perception of the above comes through intuitive perspective of green land, blue sky, and clean water. Now that nationwide data have become available worldwide to help consider perceptive measures of greenness of land, blueness of sky, and cleanness of water, it is now possible to attempt to formulate a composite human environment index as a simple, elegant, and defensible societal

[1] The authors are thankful to the Penn State Department of Statistics Cross-Disciplinary Classroom of Statistical Ecology and Environmental Statistics for a discussion forum among budding experts in Land, Air, Water Sciences, and Visualization Tools.

instrument for national citizenry to discuss, debate and deal with human-environment interface in a public policy and planning arena. A most important purpose that such a human environment index is expected to serve is to help stimulate national and international dialogue leading to indepth policy discussion and debate essential for sustainable environment and development.

A major purpose of this paper is to explore, investigate, and evaluate the proposed human environment index in light of any alternatives based on the concepts, methods, and tools available in the literature of individual indicators and integrated indicators.

For human species and humanity, each of the environmental components of land, air, and water is as important as another, and it is not possible to speak of one being more important than the other. This suggests that equal weight be assigned to each component in formulating the index.

As will be seen below, the three basic individual component indicators are essentially uncorrelated and orthogonal implying that they are measuring different aspects of the human-environment interface. Therefore, their unweighted sum/average has no danger of allotting inadvertent importance to one component over the other.

Each basic individual component indicator is a bonafide fractional proportion between zero and one. It is dimensionless, being a ratio of a part to the whole in the same units. The unweighted sum/average does not involve adding apples and oranges. And this approach can be satisfactory as long as the parts and the wholes represent satisfactory entities for which commensurate data are available, nationwide and worldwide.

Beauty lies in the eyes of the beholder. And that makes the difference. Indicators choice and their composites therefore become crucial when we view the environment in terms of landview, skyview, and waterview involving air, water, food, and shelter for the life support system for the humanity as we have known.

SECTION 2: THE GENERAL ISSUE OF COMBINING INDICATORS

The human-environment interface is multifaceted with land, air, water as three views or perspectives of that interface. Although in many ways these views are neither comparable nor combinable, it remains a strong and almost irresistible human urge to combine them into a single view and a corresponding linear ordering of countries according to the health of that interface.

Here, we examine the issues, challenges, and difficulties encountered in trying to combine multiple indicators into a single index. Consider a collection of objects where each object has an associated suite,

$$(I_1, I_2, ..., I_p),$$

of real-valued indicators. In the HEI context, the objects are countries and there are p=3 indicators. We suppose that all indicators are consistently oriented so that small values indicate "poor" conditions and large values indicate "good" conditions.

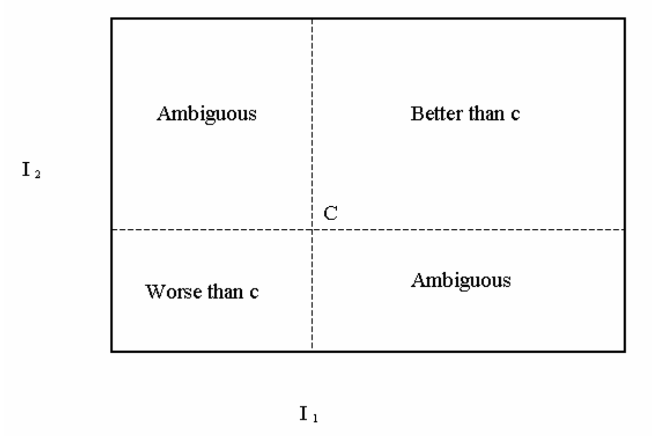
We would like to make comparative statements about two given objects C and C' with indicators

$$(I_1, I_2, \ldots, I_p) \text{ and } (I'_1, I'_2, \ldots, I'_p) .$$

If it happens that $I_j \le I_{j'}$ for all j, then then we say that C′ is intrinsically "better" than C (in the loose sense) and write

$$C \le C' \; .$$

When, on the other hand, the indicators are not unanimous in ranking C and C′, we have an ambiguous situation in which different investigators might rank C and C′ differently. Here there is no consensus ranking. The possibilities are indicated in the figure in the case of $p = 2$ indicators.



Resolution of the ambiguity can be accomplished (mathematically) by combining the indicators into an index:

$$index = H(I_1, I_2, ..., I_p)$$
$$= H(C).$$

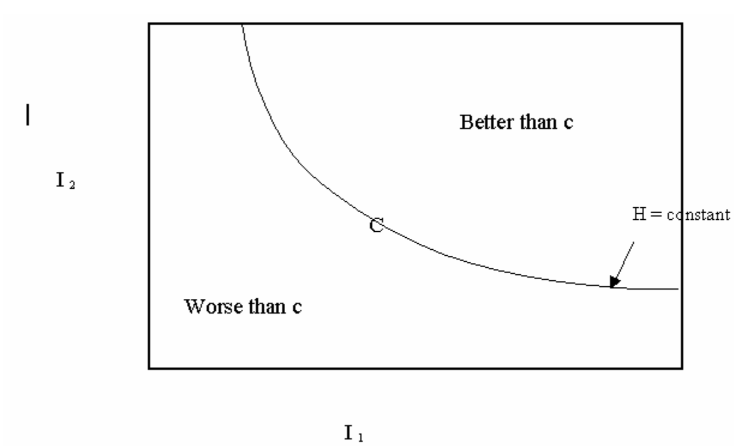
We will use letters like *H* and *G* to denote such combinations. The simplest combination is linear,

$$H = \alpha_1 I_1 + \alpha_2 I_2 + ... + \alpha_p I_p .$$

Each index defines a linear ordering on the set of objects by the rule:

$$C \le_H C' \text{ if and only if } H(C) \le H(C').$$

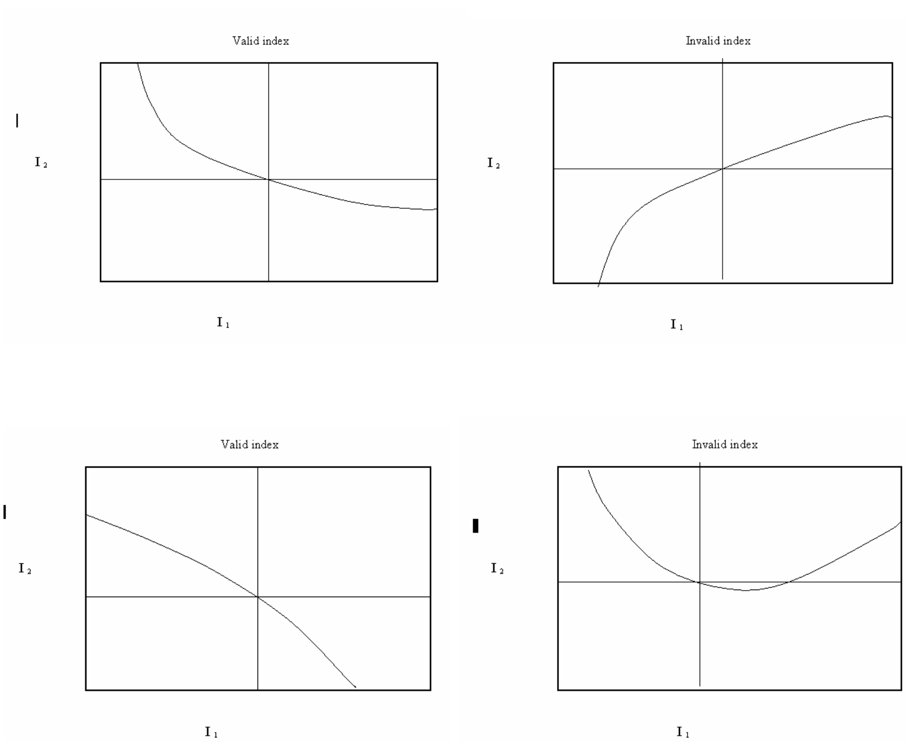
This can be seen pictorially in terms of the contour of *H* which passes through *C*.



However, for an index to be considered valid its ordering should be consistent with the intrinsic ordering, i.e.,

$$C \le C' \Rightarrow H(C) \le H(C')$$

Pictorially, this means that the contours of H must lie entirely within the ambiguous regions.



The mathematical conditions for an index to be valid are very simple:

•An index $H(I_1,...,I_p)$ is valid if and only H is monotone increasing in each variable separately.

• A differentiable index $H(I_1,...,I_p)$ is valid if and only if $\partial H / \partial I_j \geq o$ for all j.

• A linear index is valid if and only if $\alpha_j \geq 0$ for all j.

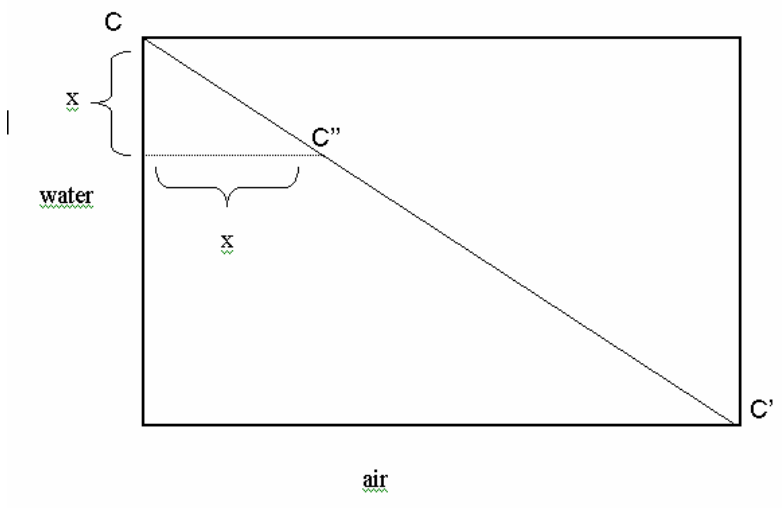
Validity is a very mild restriction and still leaves a lot of room for choosing an index. Any proposed choice should be considered in light of the "tradeoffs" or "substitutions" that are implied by the index's contours. As an example, consider the air-water index, which is the equally weighted average of the air and water indicators:

$$AWI = \frac{1}{2}air + \frac{1}{2}water$$

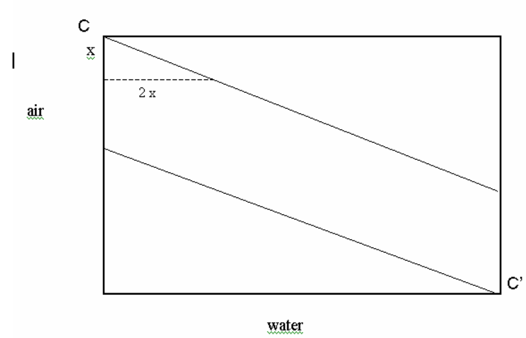
This index proclaims that the two situations,

$$C = (air = 0, water = 1) \text{ and } C' = (air = 1, water = 1)$$

are equivalent. More generally, all points on the cross-45° line are equivalent according to this index.



Now consider the two situations. Under *C*, everyone has access to clean water but the society is entirely dependent on fossil fuel. Under C', there is no fossil fuel usage (e.g., entirely hydroelectric) but no one has safe water. Are these situations really equivalent? How many people would be willing to trade *C* for C'? More generally, the -45° contour implies that one should be willing to trade a reduction x in access to clean water for a reduction x in dependence on fossil fuel. Is this an acceptable tradeoff? If not—if one would demand a 2*x* reduction in fossil fuel usage—then the contours should have a different slope.



SECTION 3: HISTOGRAM-BASED FINDINGS

3.1 Summary

The air indicator histogram is positively skewed, whereas the water and land indicator histograms are negatively skewed. The land indicator starts out with a small frequency, becomes modest, and then increases sharply. The air indicator starts out with a modest frequency, increases to a peak, and then gradually diminishes. The water indicator starts out with a very small frequency, but explodes at the end, undergoing small incremental growth. It appears that quality land, quality air, and quality water are more scarce, whereas poor quality land, poor quality air, and poor quality water are more frequent in the world.

It may be interesting to compare the proposed human environment index with the average of air and water indicators. Interestingly, the air and water indicators are more important for individual human health, whereas the land has more of overall societal significance.

3.2 Histogram Plots and Box Plots

Histogram Plots

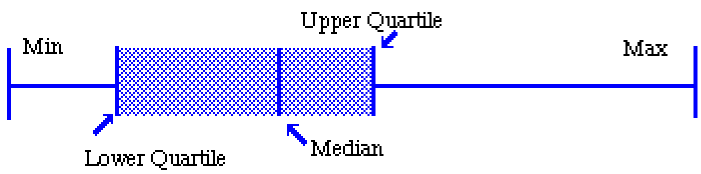
The histogram is obtained by splitting the range of the data into equal sized bins (called classes). Then for each bin, the number of points from the data set that fall into each bin is counted. The purpose of a histogram is to graphically summarize the distribution of a univariate data set.

The histogram graphically shows the following:

1. center (i.e., the location) of the data;
2. spread (i.e., the scale) of the data is;
3. skewness of the data;
4. presence of outliers; and
5. presence of multiple modes in the data.

Boxplot

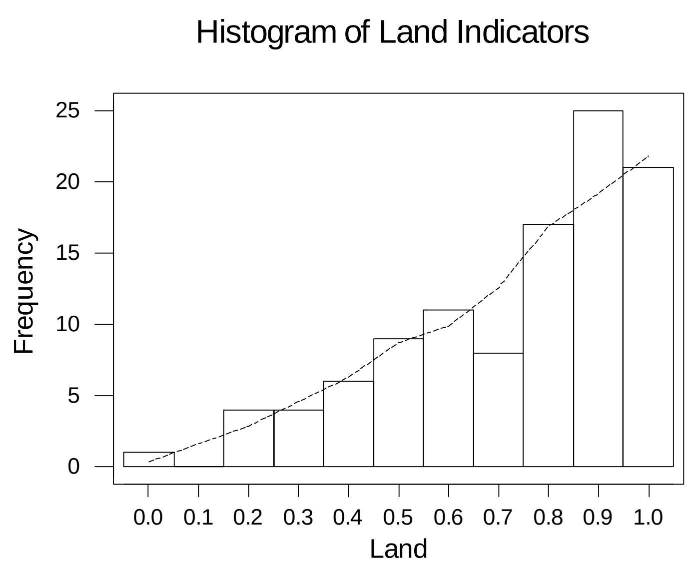
The idea of a Boxplot is due to the famous statistician Tukey. He wanted a simple pictorial representation of one or more data sets highlighting (and contrasting) location and spread. The basic idea is that for each dataset, you require a box consisting of a top-half (bottom-half), which represents the 25% of the data between the median and the upper- (lower-) quartile respectively.

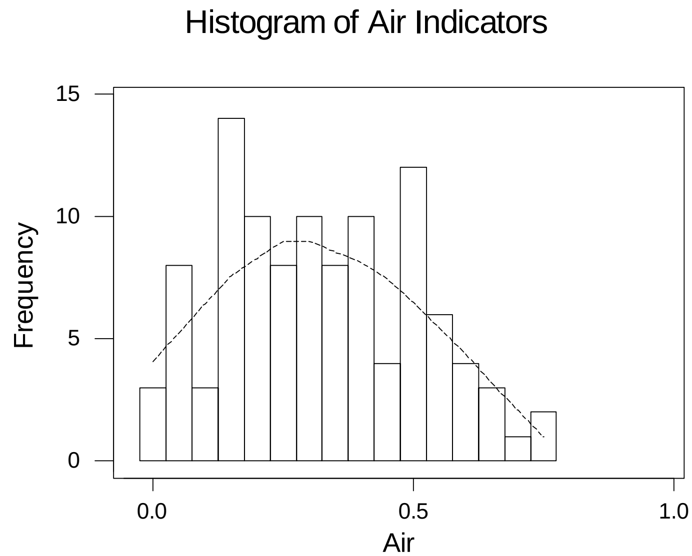


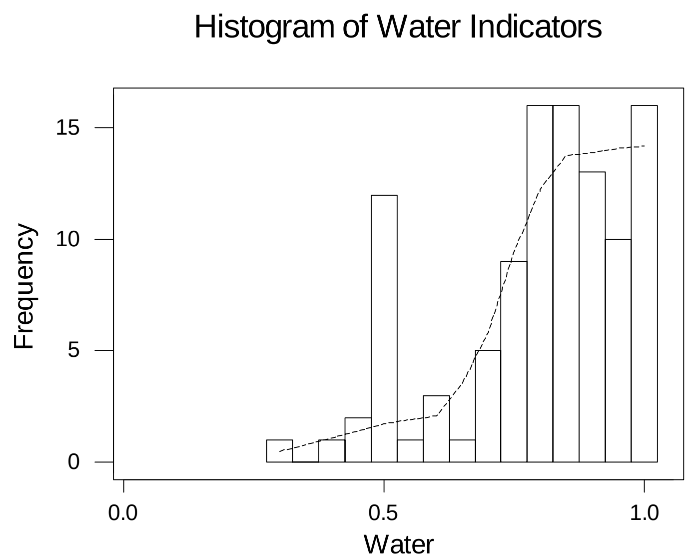
Descriptive Statistics: Air, Water, Land, HEI

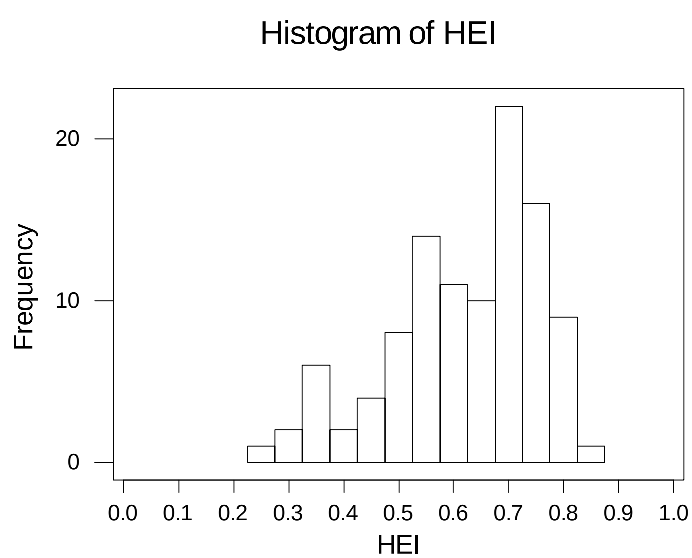
Variable	N	Mean	Median	TrMean	StDev	SE Mean
Air	106	0.3232	0.2961	0.3187	0.1841	0.0179
Water	106	0.7930	0.8351	0.8028	0.1701	0.0165
Land	106	0.7401	0.8036	0.7567	0.2368	0.0230
HEI	106	0.6188	0.6489	0.6250	0.1331	0.0129

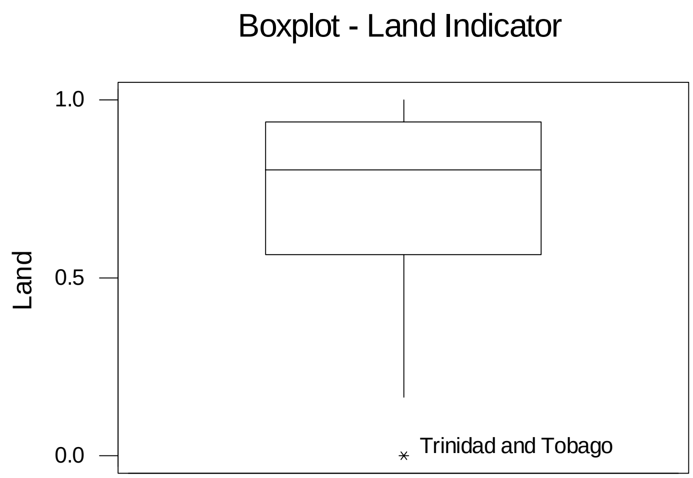
Variable	Minimum	Maximum	Q1	Q3
Air	0.0158	0.7563	0.1701	0.4770
Water	0.2900	0.9974	0.7273	0.9208
Land	0.0000	1.0000	0.5655	0.9368
HEI	0.2563	0.8503	0.5278	0.7239

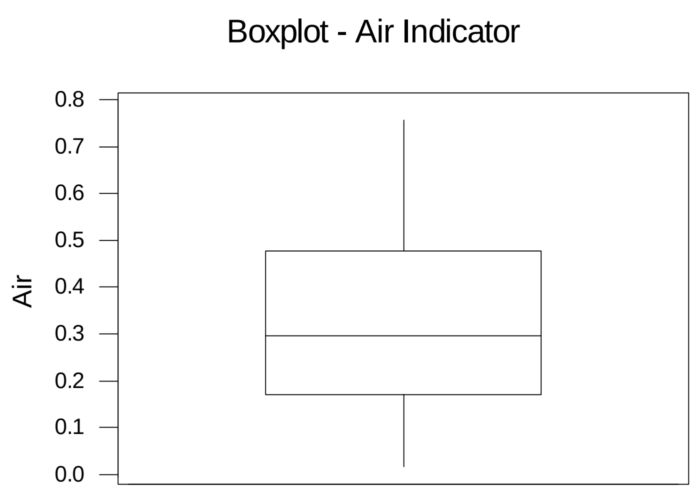


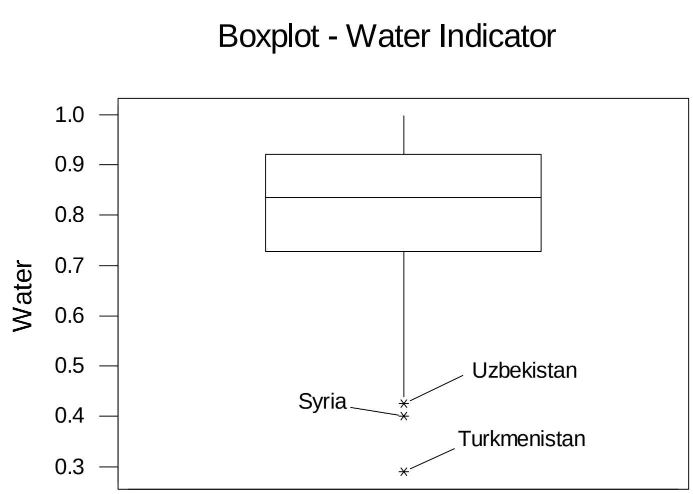

Histogram of Air Indicators
Frequency
15
10
5
0
0.0
0.5
1.0
Air


Histogram of Water Indicators
Frequency
15
10
5
0
0.0
0.5
1.0
Water


Histogram of HEI
Frequency
20
10
0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
HEI


Boxplot - Land Indicator
Land
1.0
0.5
0.0
Trinidad and Tobago


Boxplot - Air Indicator
Air
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

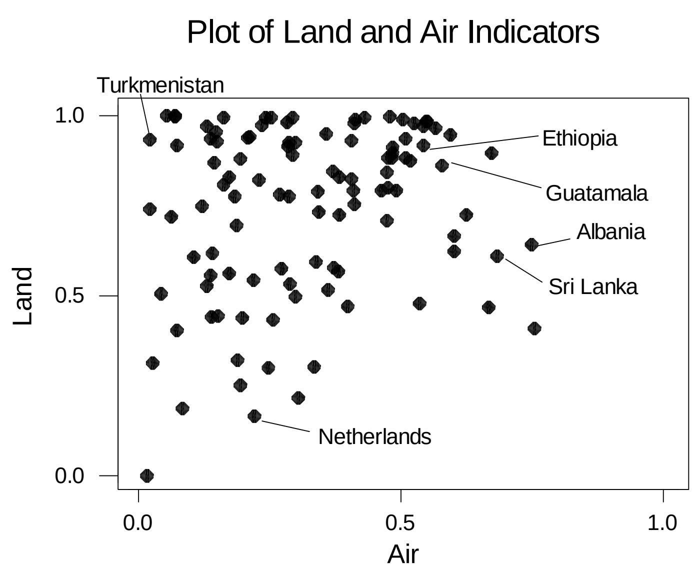

Boxplot - Water Indicator
Water
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
Uzbekistan
Syria
Turkmenistan

SECTION 4: SCATTERPLOT-BASED FINDINGS

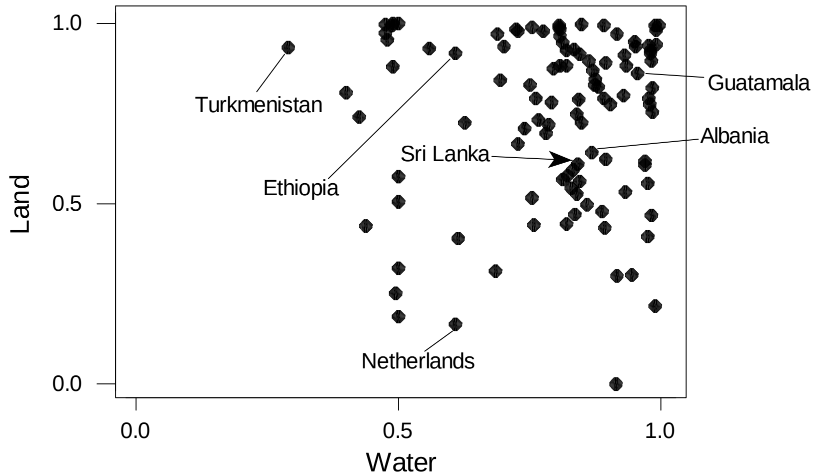
4.1 Summary

Each paired plot has a large scatter, and so also the triple scatterplot. Each pair of indicators is essentially uncorrelated. The three indicator columns are essentially linearly independent, and the three indicators may be taken to be orthogonal to each other, indicating that each indicator is informative, and adds to the information of the other two, and thus the composite index needs to be based on all the three. There does not seem to be any role for the principal components analysis type techniques that are useful for grouping together redundant sets of indicators (Saaty, 1980; Tram et al., 2000).

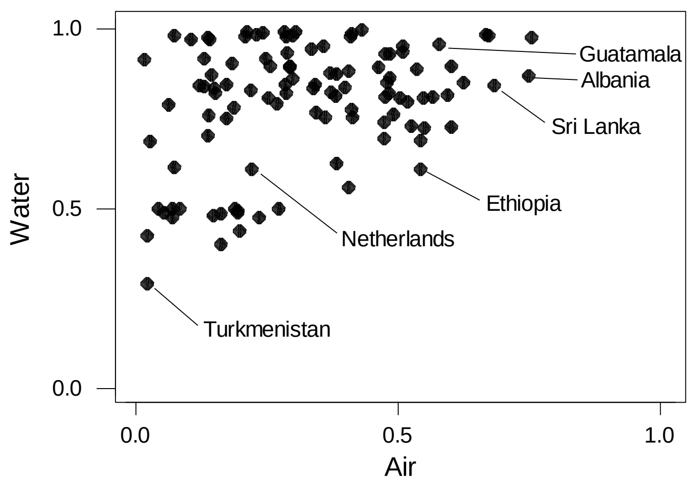
4.2 Scatter Plots



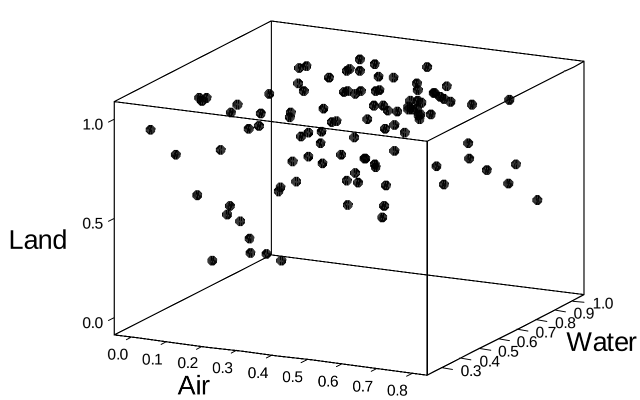
Plot of Land and Water Indicators



Plot of Air and Water Indicators



3D Plot of Land, Air, and Water Indicators



4.3 Correlation

The correlation coefficient measures the strength of the linear association between two interval/ratio scale variables. It does not distinguish explanatory from response variables and is not affected by changes in the unit of measurement of either or both variables. In this section, we checked the strength of the linear between any two indicators. Both parametric (Pearson's correlation) and nonparametric methods (Kendall's rank correlation and Spearman's Rank correlation) were used. We found that these three methods give us consistent results. The correlation was weak and negligible.

Pearson's Correlations: Land, Air, Water

	Land	Air
Air	0.192	
Water	0.019	0.357

Kendall's Rank Correlation

	Land	Air
Air	0.105	
Water	-0.020	0.159

Spearman's Rank Correlation

	Land	Air
Air	0.149	
Water	-0.032	0.250

4.4 Principal Component Analysis: land, air, water

Principal component analysis (PCA) involves a mathematical procedure that transforms a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables called *principal components*. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible.

When we looked at the output of the PCA, we found that if we could only illustrate 79.9% of the total variance if we used two principal components, which again proved that all three indicators are equally important.

Principal Component Analysis: Land, Air, Water

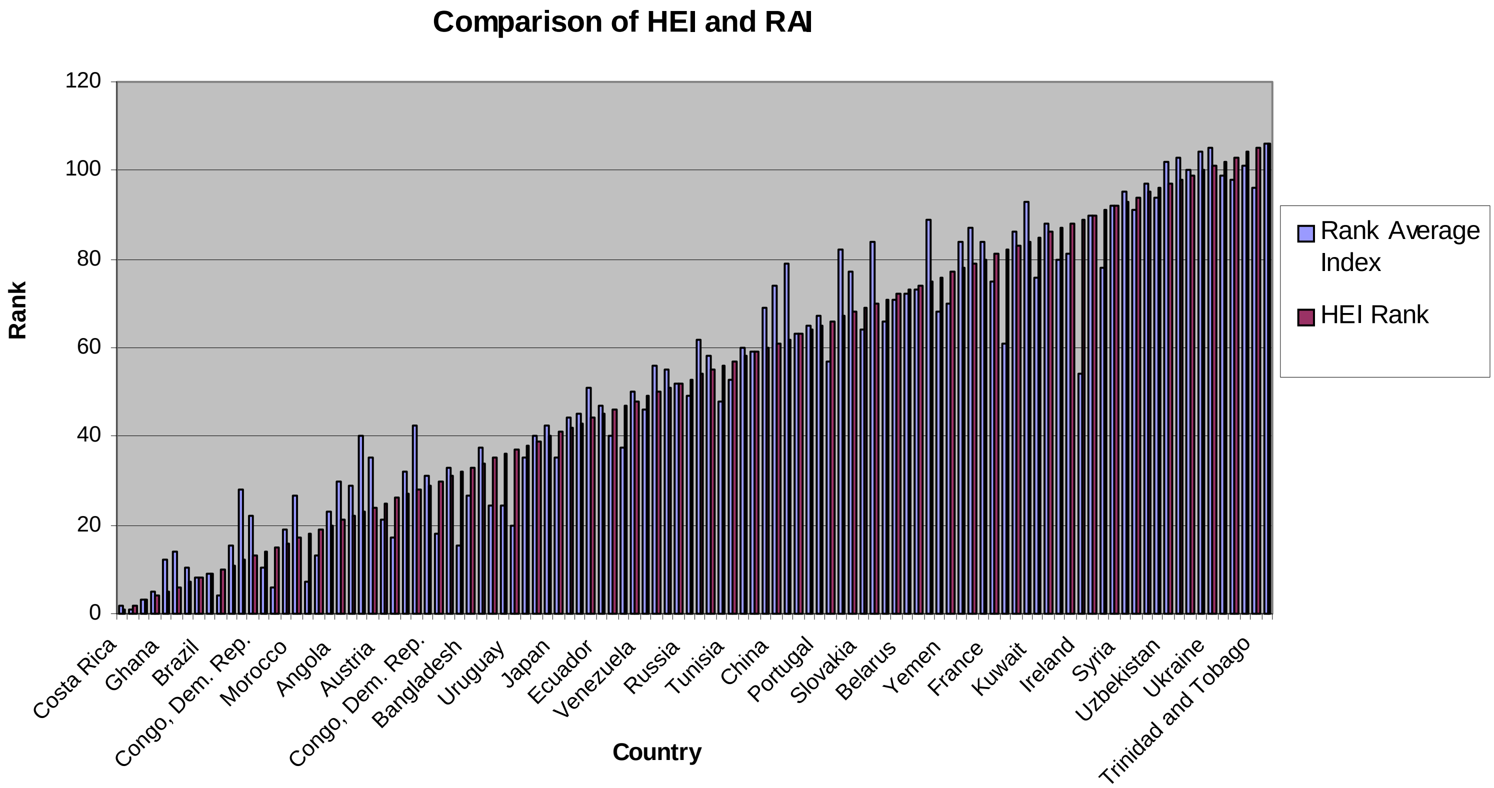
```
Eigenanalysis of the Correlation Matrix

Eigenvalue    1.4132    0.9843    0.6025
Proportion     0.471     0.328     0.201
Cumulative     0.471     0.799     1.000

Variable         PC1       PC2       PC3
Land          -0.353     0.881    -0.315
Air           -0.700    -0.026     0.714
Water         -0.621    -0.473    -0.626
```

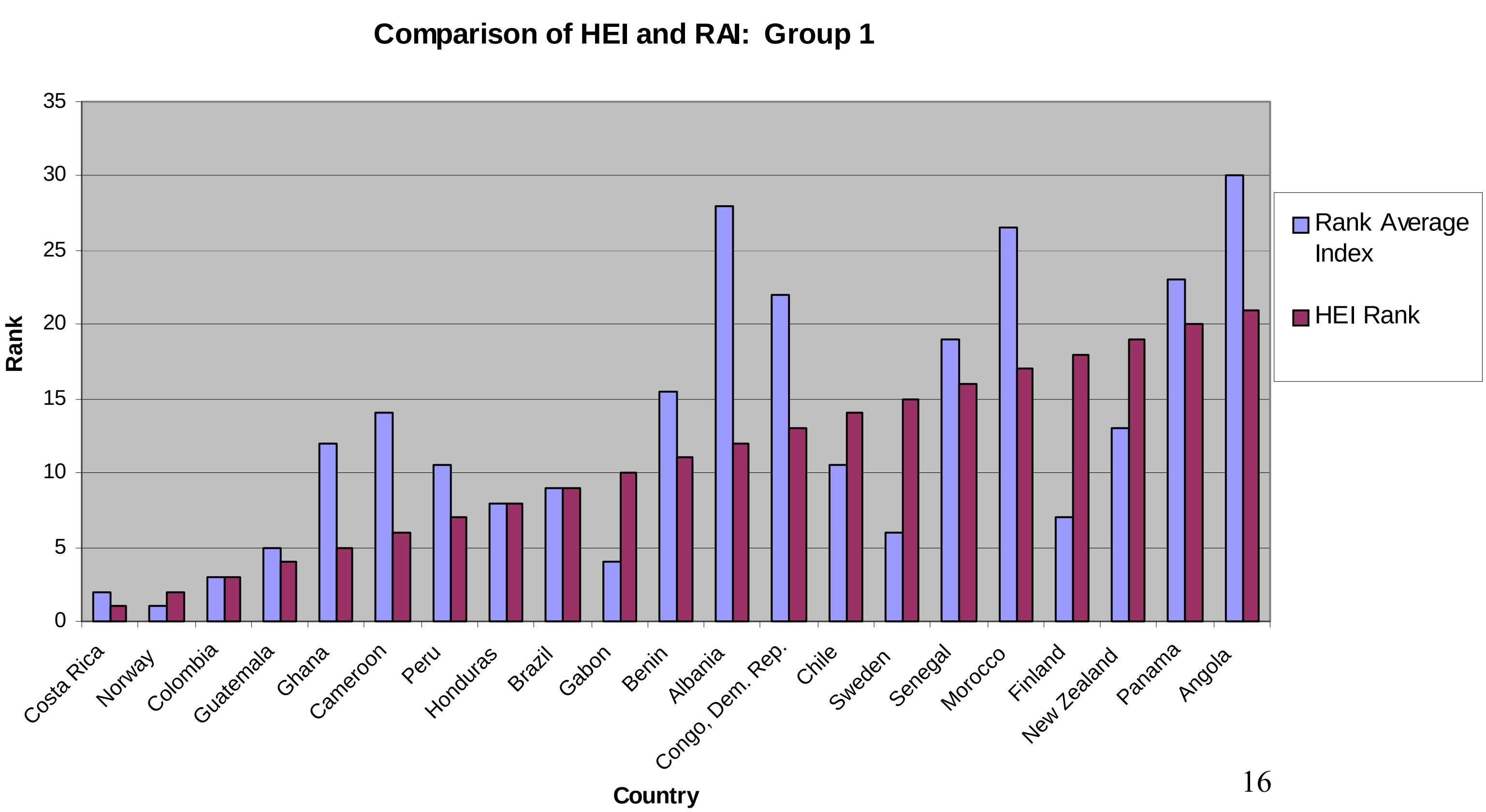
SECTION 5: RANK AVERAGED INDEX (RAI)

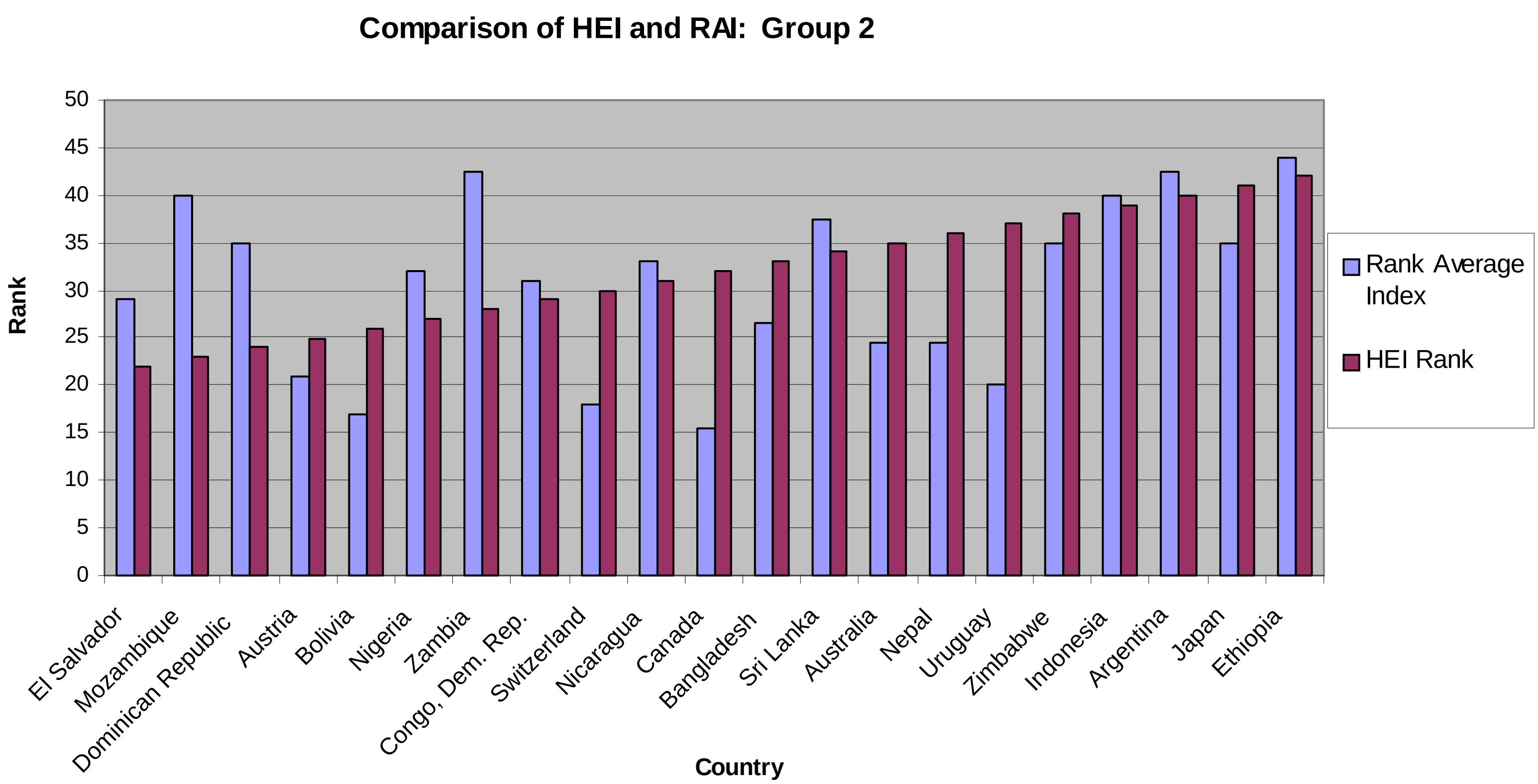
In the following section we will explore the Rank Averaged Index (RAI). This Index is calculated as follows:

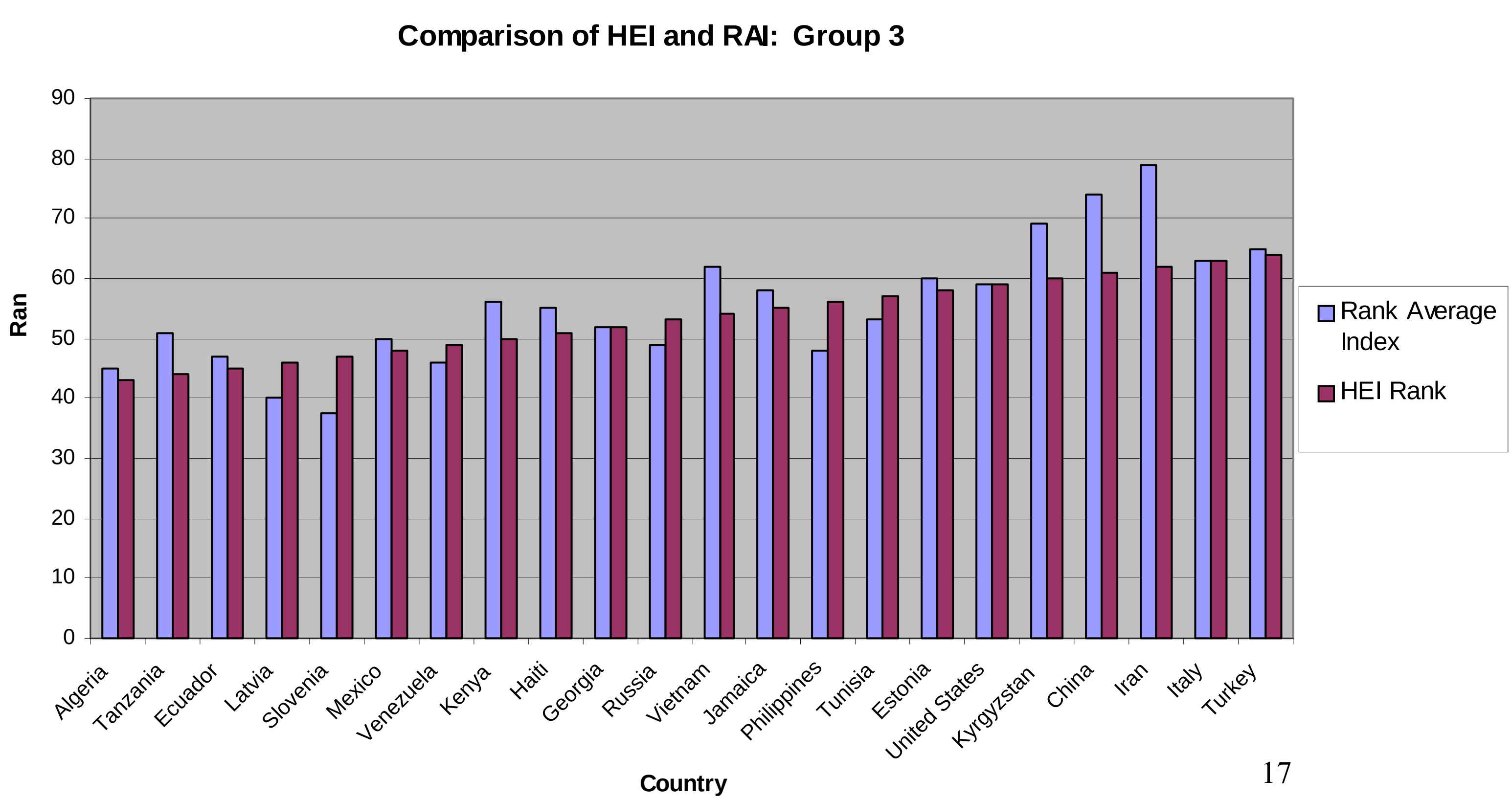
$$[Rank(Water) + Rank(Air) + Rank(Land)]/3 = RAI$$

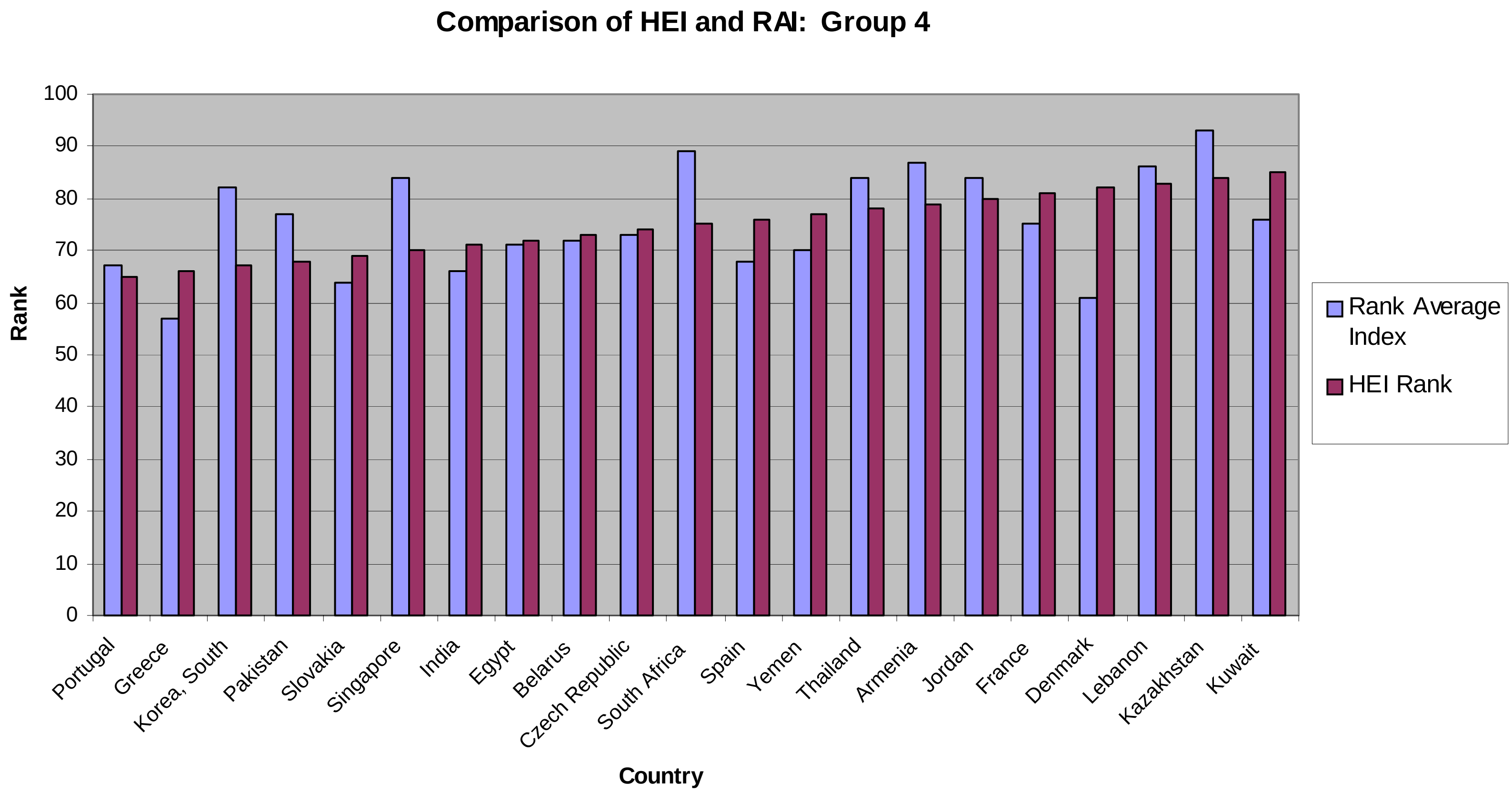
The correlation between HEI and RAI is extremely high with some ranking variation as expected.


Comparison of HEI and RAI
Rank
120
100
80
60
40
20
0
Costa Rica
Ghana
Brazil
Congo, Dem. Rep.
Morocco
Angola
Austria
Congo, Dem. Rep.
Bangladesh
Uruguay
Japan
Ecuador
Venezuela
Russia
Tunisia
China
Portugal
Slovakia
Belarus
Yemen
France
Kuwait
Ireland
Syria
Uzbekistan
Ukraine
Trinidad and Tobago
Country
Rank Average Index
HEI Rank

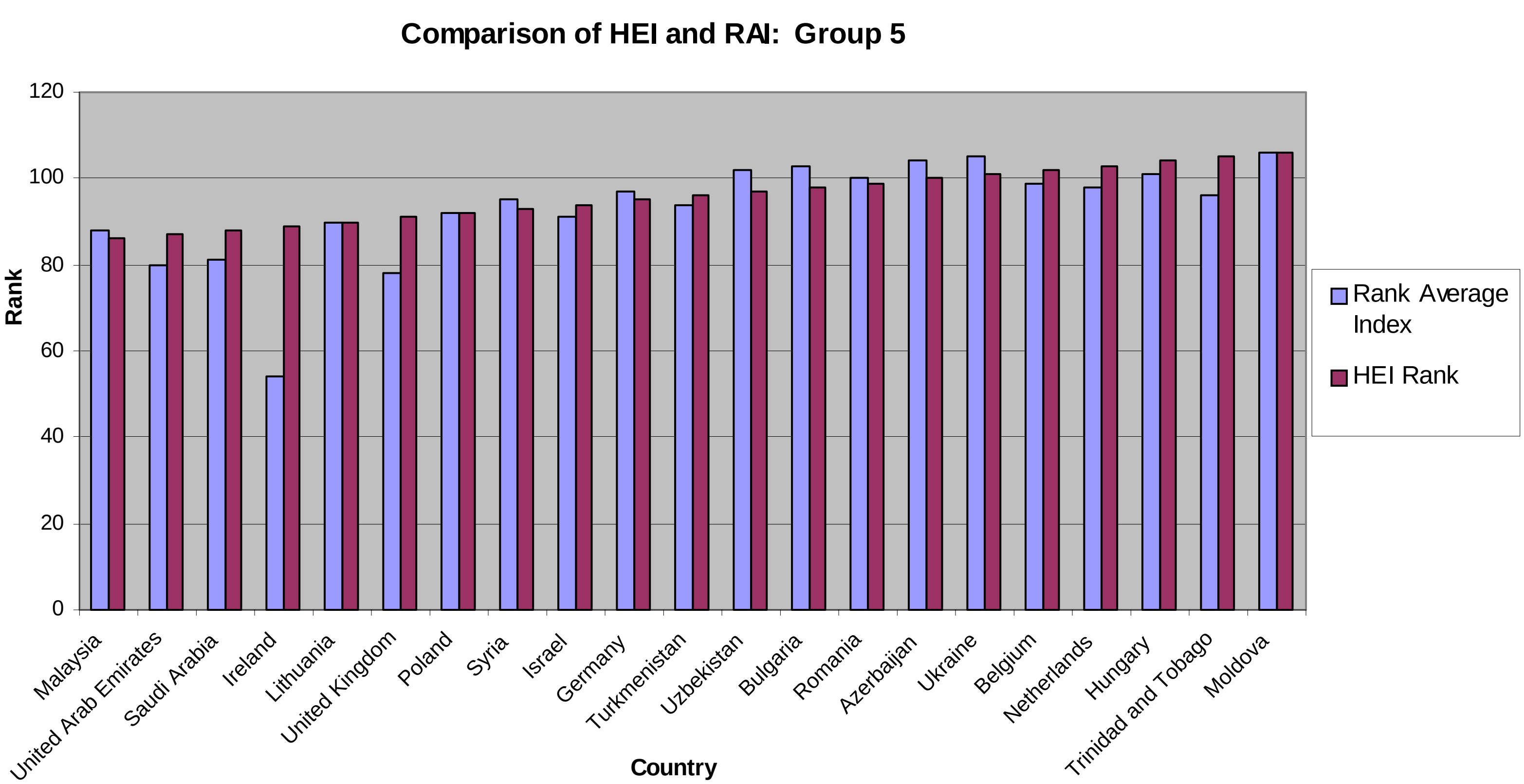

Comparison of HEI and RAI: Group 1
Rank
35
30
25
20
15
10
5
0
Costa Rica
Norway
Colombia
Guatemala
Ghana
Cameroon
Peru
Honduras
Brazil
Gabon
Benin
Albania
Congo, Dem. Rep.
Chile
Sweden
Senegal
Morocco
Finland
New Zealand
Panama
Angola
Country
Rank Average Index
HEI Rank


Comparison of HEI and RAI: Group 2
Rank
50
45
40
35
30
25
20
15
10
5
0
Rank Average Index
HEI Rank
El Salvador
Mozambique
Dominican Republic
Austria
Bolivia
Nigeria
Zambia
Congo, Dem. Rep.
Switzerland
Nicaragua
Canada
Bangladesh
Sri Lanka
Australia
Nepal
Uruguay
Zimbabwe
Indonesia
Argentina
Japan
Ethiopia
Country


Comparison of HEI and RAI: Group 3
Ran
90
80
70
60
50
40
30
20
10
0
Rank Average Index
HEI Rank
Algeria
Tanzania
Ecuador
Latvia
Slovenia
Mexico
Venezuela
Kenya
Haiti
Georgia
Russia
Vietnam
Jamaica
Philippines
Tunisia
Estonia
United States
Kyrgyzstan
China
Iran
Italy
Turkey
Country



Comparison of HEI and RAI: Group 4
Rank
100
90
80
70
60
50
40
30
20
10
0
Portugal
Greece
Korea, South
Pakistan
Slovakia
Singapore
India
Egypt
Belarus
Czech Republic
South Africa
Spain
Yemen
Thailand
Armenia
Jordan
France
Denmark
Lebanon
Kazakhstan
Kuwait
Country
Rank Average Index
HEI Rank



Comparison of HEI and RAI: Group 5
Rank
120
100
80
60
40
20
0
Malaysia
United Arab Emirates
Saudi Arabia
Ireland
Lithuania
United Kingdom
Poland
Syria
Israel
Germany
Turkmenistan
Uzbekistan
Bulgaria
Romania
Azerbaijan
Ukraine
Belgium
Netherlands
Hungary
Trinidad and Tobago
Moldova
Country
Rank Average Index
HEI Rank

Correlations: HEI, Rank Average Index

```
Pearson correlation of HEI Rank and Rank Average Index = 0.964
P-Value = 0.000
```

Top 20 Countries

	HEI	RAI
1	Costa Rica	Norway
2	Norway	Costa Rica
3	Columbia	Columbia
4	Guatemala	Gabon
5	Ghana	Guatemala
6	Cameroon	Sweden
7	Peru	Finland
8	Honduras	Honduras
9	Brazil	Brazil
10	Gabon	Peru
11	Benin	Chile
12	Albania	Ghana
13	Congo, Dem. Rep.	New Zealand
14	Chile	Cameroon
15	Sweden	Benin
16	Senegal	Canada
17	Morocco	Bolivia
18	Finland	Switzerland
19	New Zealand	Senegal
20	Panama	Uruguay

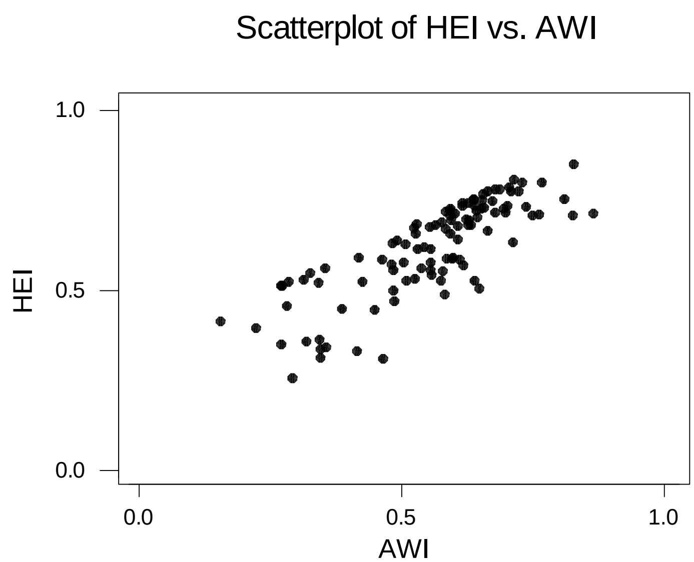
Bottom 20 Countries

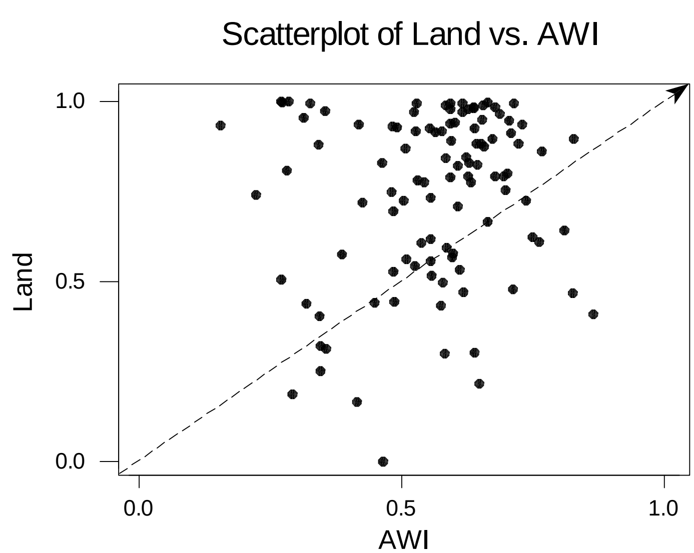
	HEI	RAI
87	United Arab Emirates	Armenia
88	Saudi Arabia	Malaysia
89	Ireland	South Africa
90	Lithuania	Lithuania
91	United Kingdom	Israel
92	Poland	Poland
93	Syria	Kazakhstan
94	Israel	Turkmenistan
95	Germany	Syria
96	Turkmenistan	Trinidad and Tobago
97	Uzbekistan	Germany
98	Bulgaria	Netherlands
99	Romania	Belgium
100	Azerbaijan	Romania
101	Ukraine	Hungary
102	Belgium	Uzbekistan
103	Netherlands	Bulgaria
104	Hungary	Azerbaijan
105	Trinidad and Tobago	Ukraine
106	Moldova	Moldova

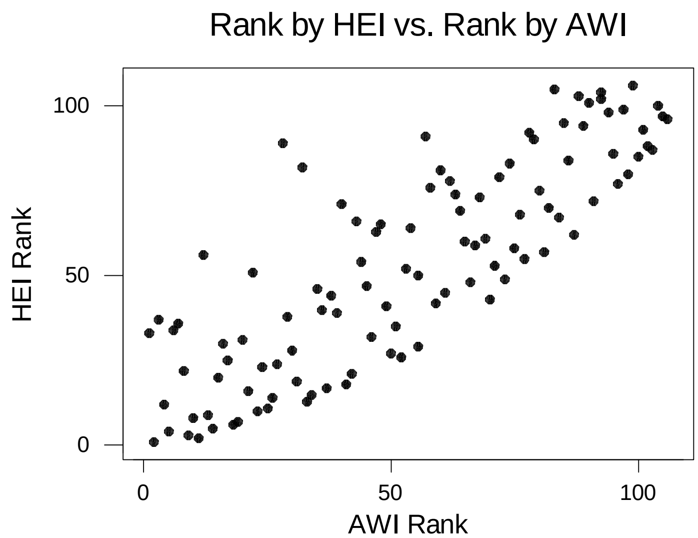
SECTION 6: AIR WATER INDEX (AWI) AND SENSITIVITY ANALYSIS

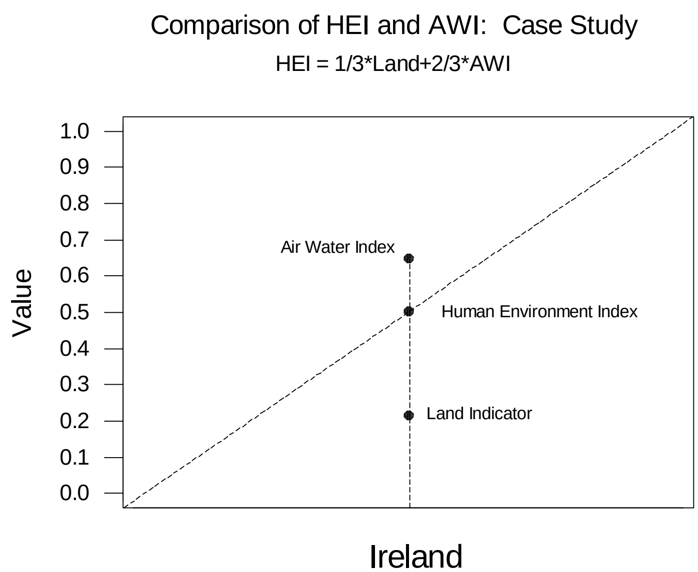
6.1 Air Water Index

The scatter plot of HEI vs. AWI indicates that the country ranked higher by AWI is also likely to be ranked higher by HEI. The plot of AWI vs. HEI shows similar trend, however the plot is more scattered. Notice that HEI=1/3*land+2/3*AWI, we can have a rough guess of HEI from the scatter plot of LAND vs. AWI.






Rank by HEI vs. Rank by AWI
HEI Rank
AWI Rank
0
50
100
0
50
100


Comparison of HEI and AWI: Case Study
HEI = 1/3*Land+2/3*AWI
Value
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Air Water Index
Human Environment Index
Land Indicator
Ireland

6.2 Sensitivity Analysis

The analytic hierarchy process (AHP) partitions a collection of indicators into groups so that indicators within a group are somewhat redundant of one another. Indicators within each group are combined (usually linearly with equal weights) to form second stage indicators and the second stage indicators are then combined into an overall index.

AHP uses principal component analysis to group the indicators. For each indicator, the loadings are examined and brackets are placed around the loading having the largest magnitude. Roughly speaking, this selects the principal component to which the indicator contributes most heavily. Each principal component then has a (possible empty) set of bracketed loadings and corresponding indicators.

Referring to the table below, there are two groups:
$\{land, air\}$, $\{water\}$.

This redundancy grouping is consistent with the correlations, all of which are negligible except for land-air. The AHP thus suggest an overall index having the form,

$$\text{Index} = (1-\alpha)\left(\tfrac{1}{2}\,land + \tfrac{1}{2}\,air\right) + \alpha \,.\, water,$$

where the weight α remains to be chosen. Note that HEI results when $\alpha = 1/3$.

We have reservations, however about using AHP groupings in this context because the land-air correlation is very small ($r^2 < 10\ \%$) indicating very little redundancy between land and air. Here, we think it is better to form the groupings on policy and scientific grounds rather than statistical considerations. The air and water indicators relate rather directly to short term human health impacts while the land indicator (ground cover) is longer range and broader societal impact.

Accordingly, the grouping
$\{air, water\}$, $\{land\}$
seems more appropriate here and would suggest indices of the form

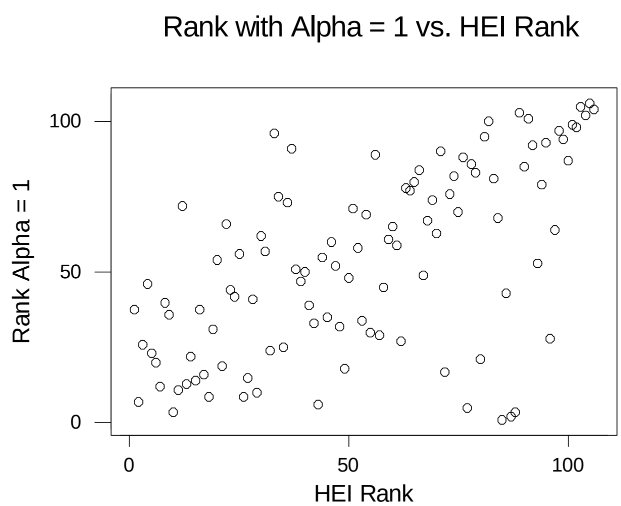
$$(1-\alpha)\left(\tfrac{1}{2}\,air + \tfrac{1}{2}\,water\right) + \alpha \,.\, land$$

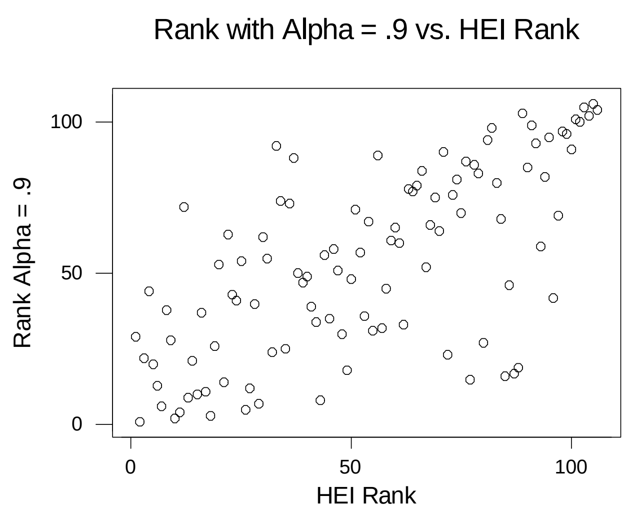
Once again, the HEI index results when $\alpha = 1/3$

New Index=$(1-\alpha)*(\text{air}+\text{water})/2+\alpha*\text{land}$. Adjust the value of α in the interval [0, 1] and observe how the new index changes compared with HEI.

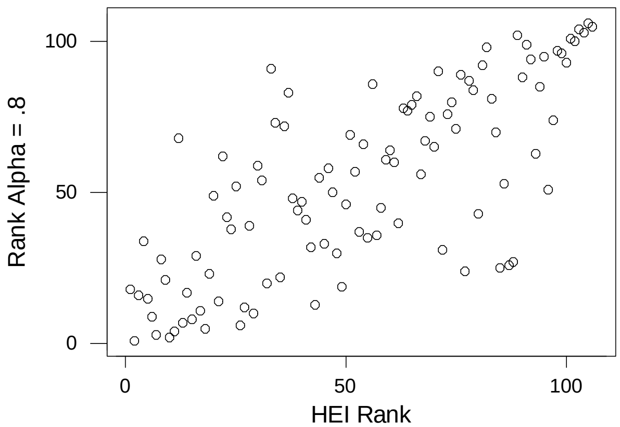
The series of plots describe the relationship between rank by the new index and rank by HEI as α changes in [0,1]. When α=0, the new index is actually AWI; When α=1, the new index is equal to land indicator.

From the plot, we can see that α=0.3, the new index almost has a linear relationship with HEI. This is not surprising when we recall that the new index is HEI when α=1/3.

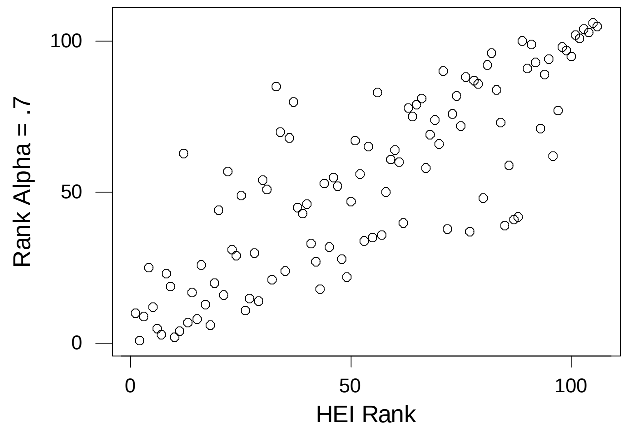




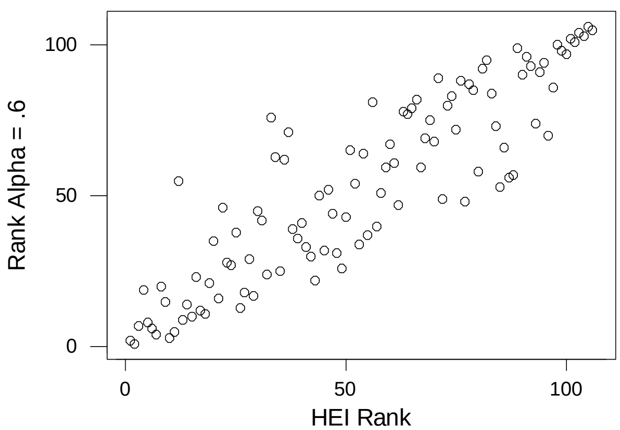
Rank with Alpha = .8 vs. HEI Rank



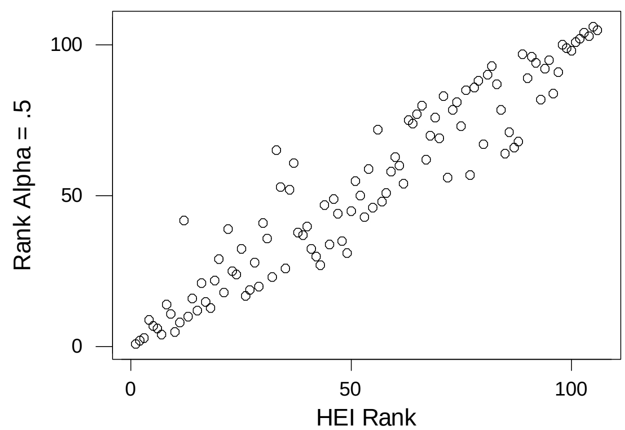
Rank with Alpha = .7 vs. HEI Rank



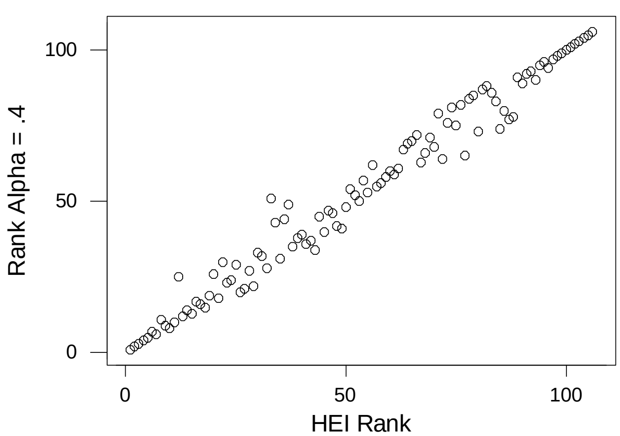
Rank with Alpha = .6 vs. HEI Rank



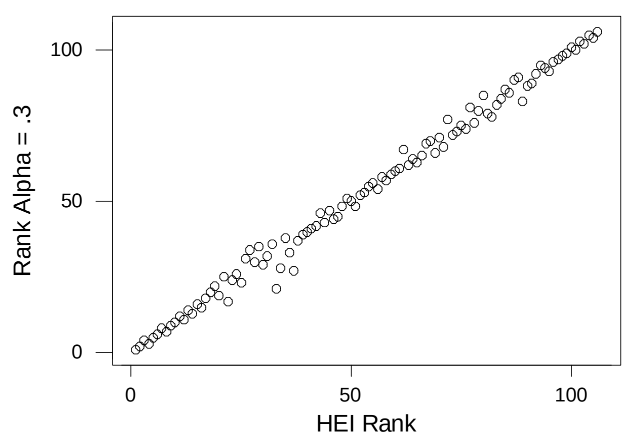
Rank with Alpha = .5 vs. HEI Rank

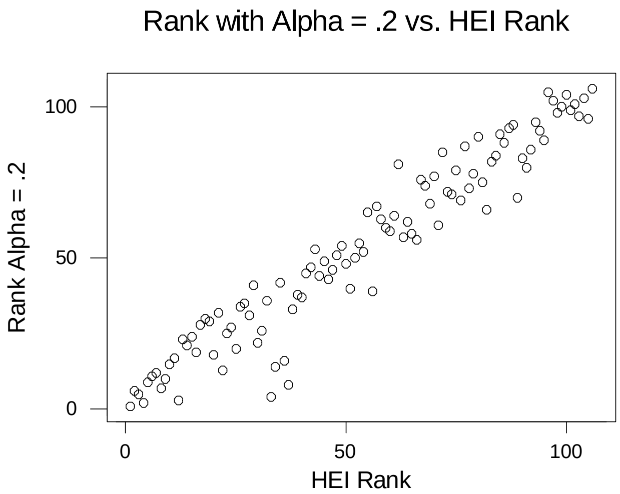


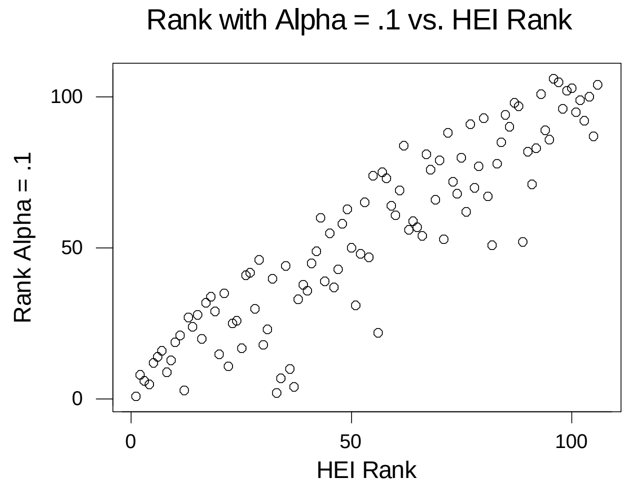
Rank with Alpha = .4 vs. HEI Rank

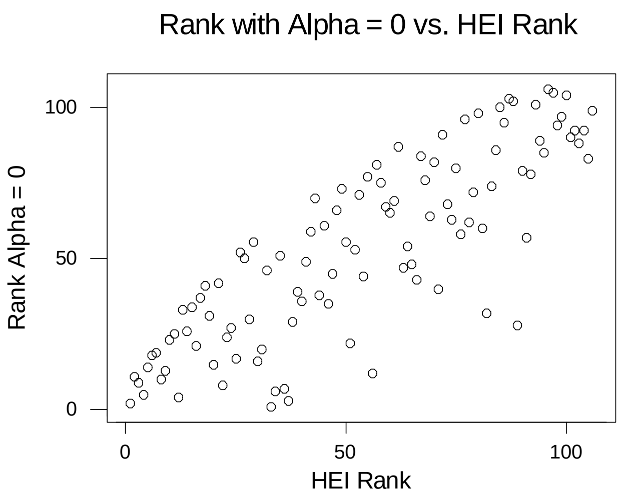


Rank with Alpha = .3 vs. HEI Rank



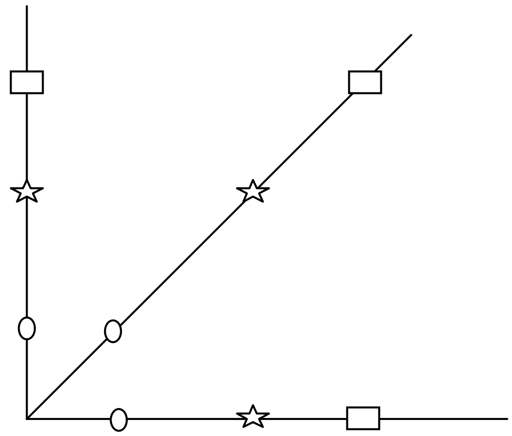






SECTION 7: MORE INDICATORS DO NOT NECESSARILY MEAN MORE INFORMATION AND MORE DISCRIMINATION

Consider a situation in which one indicator column is the same as another indicator column, because the second indicator value is the same as the first indicator value. It is clear from the following figure that the second column does not add information/ discrimination to the first column. This is the situation when there is a strong underlying correlation between the two indicators. Recently, Landscape Ecology has discovered that some fifty landscape fragmentation pattern indicators amount to essentially five to ten indicators.



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Biosketches

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Appendix

HEI with revised data:
For land - % undomesticated land to total land area

For air – (**air indicator1** + **air indicator2**) / 2, where **air indicator1** = renewable energy use to total energy use; **air indicator2** = GDP per unit energy use, based on maximum and minimum concept
For water – (**water indicator1** + **water indicator2**) / 2, where **water indicator1** = ratio of water available after annual withdrawals to internal water resources; **water indicator2** = ratio of people having access to an improved water source to total population

HEI.Rank	Country	HEI	Land	Air	Water
1	Costa Rica	0.8503	0.8951	0.6729	0.9829
2	Norway	0.8078	0.9955	0.4305	0.9974
3	Colombia	0.7996	0.9376	0.5087	0.9525
4	Guatemala	0.7988	0.8606	0.5789	0.9569
5	Ghana	0.7856	0.9467	0.5950	0.8150
6	Cameroon	0.7810	0.9665	0.5671	0.8093
7	Peru	0.7806	0.9847	0.5484	0.8088
8	Honduras	0.7764	0.8832	0.5097	0.9363
9	Brazil	0.7759	0.9112	0.4850	0.9315
10	Gabon	0.7757	0.9977	0.4797	0.8498
11	Benin	0.7670	0.9888	0.5042	0.8080
12	Albania	0.7537	0.6411	0.7500	0.8700
13	Congo, Dem Rep	0.7528	0.9833	0.5503	0.7248
14	Chile	0.7526	0.9487	0.3571	0.9521
15	Sweden	0.7519	0.9818	0.2824	0.9917
16	Senegal	0.7479	0.8951	0.4845	0.8642
17	Morocco	0.7441	0.9785	0.5247	0.7292
18	Finland	0.7423	0.9951	0.2418	0.9900
19	New Zealand	0.7353	0.9256	0.2984	0.9819
20	Panama	0.7347	0.7987	0.4750	0.9305
21	Angola	0.7342	0.9710	0.5429	0.6887
22	El Salvador	0.7336	0.7258	0.6250	0.8500
23	Mozambique	0.7303	0.8756	0.5182	0.7970
24	Dominican Republic	0.7284	0.8817	0.4826	0.8208
25	Austria	0.7273	0.7924	0.4105	0.9790
26	Bolivia	0.7272	0.9951	0.2934	0.8929
27	Nigeria	0.7228	0.9804	0.4111	0.7768
28	Zambia	0.7227	0.8828	0.4761	0.8094
29	Congo, Rep	0.7193	0.9905	0.4126	0.7549
30	Switzerland	0.7169	0.7533	0.4113	0.9860
31	Nicaragua	0.7159	0.7919	0.4634	0.8925
32	Canada	0.7147	0.9407	0.2113	0.9921
33	Bangladesh	0.7135	0.4075	0.7563	0.9767
34	Sri Lanka	0.7116	0.6088	0.6839	0.8421

35	Australia	0.7085	0.9381	0.2087	0.9787
36	Nepal	0.7074	0.6229	0.6021	0.8971
37	Uruguay	0.7073	0.4683	0.6689	0.9845
38	Zimbabwe	0.7037	0.8227	0.4066	0.8817
39	Indonesia	0.6973	0.8451	0.3700	0.8767
40	Argentina	0.6950	0.8279	0.3821	0.8751
41	Japan	0.6942	0.8918	0.2937	0.8970
42	Ethiopia	0.6906	0.9183	0.5434	0.6100
43	Algeria	0.6853	0.9960	0.2521	0.8078
44	Tanzania	0.6821	0.7928	0.4908	0.7627
45	Ecuador	0.6814	0.9137	0.2842	0.8461
46	Latvia	0.6810	0.7766	0.2868	0.9797
47	Slovenia	0.6788	0.8219	0.2295	0.9850
48	Mexico	0.6775	0.9247	0.2866	0.8214
49	Venezuela	0.6727	0.9712	0.1292	0.9176
50	Kenya	0.6703	0.8435	0.4732	0.6943
51	Haiti	0.6652	0.6657	0.6018	0.7282
52	Georgia	0.6582	0.7884	0.3411	0.8451
53	Russia	0.6569	0.9170	0.0724	0.9813
54	Viet Nam	0.6408	0.7075	0.4734	0.7416
55	Jamaica	0.6380	0.9295	0.1487	0.8357
56	Philippines	0.6346	0.4783	0.5363	0.8893
57	Tunisia	0.6316	0.9301	0.4061	0.5586
58	Estonia	0.6290	0.8704	0.1445	0.8721
59	United States	0.6208	0.7746	0.1829	0.9050
60	Kyrgyzstan	0.6145	0.7319	0.3434	0.7682
61	China	0.6140	0.7806	0.2684	0.7929
62	Iran	0.5916	0.9365	0.1366	0.7019
63	Italy	0.5912	0.5775	0.3724	0.8237
64	Turkey	0.5883	0.5924	0.3382	0.8344
65	Portugal	0.5875	0.5670	0.3813	0.8141
66	Greece	0.5849	0.5325	0.2879	0.9342
67	Korea, South	0.5846	0.8290	0.1734	0.7513
68	Pakistan	0.5780	0.7243	0.3834	0.6263
69	Slovakia	0.5767	0.6177	0.1413	0.9712
70	Singapore	0.5709	0.7500	0.1211	0.8417
71	India	0.5691	0.4708	0.3992	0.8373
72	Egypt	0.5614	0.9740	0.2353	0.4750
73	Belarus	0.5607	0.6064	0.1045	0.9712
74	Czech Republic	0.5560	0.5551	0.1363	0.9765
75	South Africa	0.5546	0.6958	0.1866	0.7815
76	Spain	0.5524	0.4981	0.2984	0.8606
77	Yemen	0.5488	0.9963	0.1626	0.4874

78	Thailand	0.5437	0.5149	0.3613	0.7550
79	Armenia	0.5310	0.5437	0.2192	0.8302
80	Jordan	0.5278	0.9560	0.1474	0.4800
81	France	0.5277	0.4320	0.2561	0.8952
82	Denmark	0.5271	0.3011	0.3347	0.9455
83	Lebanon	0.5265	0.5609	0.1726	0.8461
84	Kazakhstan	0.5232	0.7190	0.0626	0.7879
85	Kuwait	0.5228	1.0000	0.0684	0.5000
86	Malaysia	0.5205	0.8788	0.1932	0.4897
87	United Arab Emirates	0.5141	0.9997	0.0526	0.4900
88	Saudi Arabia	0.5137	0.9977	0.0684	0.4750
89	Ireland	0.5039	0.2155	0.3047	0.9916
90	Lithuania	0.4992	0.5270	0.1300	0.8406
91	United Kingdom	0.4878	0.2994	0.2471	0.9170
92	Poland	0.4715	0.4424	0.1513	0.8207
93	Syria	0.4567	0.8085	0.1616	0.4000
94	Israel	0.4488	0.5735	0.2729	0.5000
95	Germany	0.4461	0.4400	0.1391	0.7590
96	Turkmenistan	0.4145	0.9324	0.0211	0.2900
97	Uzbekistan	0.3955	0.7409	0.0208	0.4250
98	Bulgaria	0.3638	0.4044	0.0732	0.6139
99	Romania	0.3583	0.4392	0.1971	0.4386
100	Azerbaijan	0.3492	0.5058	0.0418	0.5000
101	Ukraine	0.3415	0.3117	0.0261	0.6867
102	Belgium	0.3366	0.3205	0.1892	0.5000
103	Netherlands	0.3313	0.1635	0.2208	0.6097
104	Hungary	0.3129	0.2495	0.1942	0.4950
105	Trinidad and Tobago	0.3104	0.0000	0.0158	0.9153
106	Moldova	0.2563	0.1851	0.0837	0.5000