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Identifying indicators of sustainable development using the global sustainability quadrant approach

Andres B. Tarte
Michigan Technological University

IDENTIFYING INDICATORS OF SUSTAINABLE DEVELOPMENT USING THE GLOBAL SUSTAINABILITY QUADRANT APPROACH

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ANDRES B. TARTE

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DEPARTMENT:

Civil and Environmental Engineering

Signatures:

Thesis Advisor: _____

Dr. Kurtis G. Paterson

Thesis Co-advisor: _____

Dr. Qiong Zhang

Department Chair: _____

Dr. William M. Bulleit

Date: _____

Identifying Indicators of Sustainable Development Using the Global Sustainability Quadrant Approach

Abstract

Advances in information technology and global data availability have opened the door for assessments of sustainable development at a truly macro scale. It is now fairly easy to conduct a study of sustainability using *the entire planet as the unit of analysis*; this is precisely what this work set out to accomplish.

The study began by examining some of the best known composite indicator frameworks developed to measure sustainability at the country level today. Most of these were found to value human development factors and a clean local environment, but to gravely overlook consumption of (remote) resources in relation to nature's capacity to renew them, a basic requirement for a sustainable state.

Thus, a new measuring standard is proposed, based on the *Global Sustainability Quadrant* approach[1]. In a two-dimensional plot of nations' *Human Development Index* (HDI) vs. their *Ecological Footprint* (EF) per capita, the Sustainability Quadrant is defined by the area where both dimensions satisfy the minimum conditions of sustainable development: an HDI score above 0.8 (considered 'high' human development), and an EF below the *fair Earth-share* of 2.063 global hectares per person.

After developing methods to identify those countries that are closest to the Quadrant in the present-day and, most importantly, those that are *moving* towards it over time, the study tackled the question: *what indicators of performance set these countries apart*?[2] To answer this, an analysis of raw data, covering a wide array of environmental, social, economic, and governance performance metrics, was undertaken. The analysis used country rank lists for each individual metric and compared them, using the Pearson Product Moment Correlation function, to the rank lists generated by the proximity/movement relative to the Quadrant measuring methods.

The analysis yielded a list of metrics which are, with a high degree of statistical significance, *associated* with proximity to – and movement towards – the Quadrant; most notably:

[1] The "Sustainable Development Quadrant" was introduced as such by Boutaud A., 2002, and has been used since in a couple of joint publications by the World Wildlife Fund (WWF) and the Global Footprint Network. The term 'Global' has been added here to emphasize that this is a standard set for a sustainable *global citizen,* meaning that sustainability is assessed in terms of the fair Earth-share of resources, and not in terms of any particular country's amount of resources.

[2] The countries identified by this approach are not the ones that usually top the "M*ost Developed*" lists available in the literature.

- Favorable for sustainable development: use of contraception, high life expectancy, high literacy rate, and urbanization.
- Unfavorable for sustainable development: high GDP per capita, high language diversity, high energy consumption, and high meat consumption.
- A momentary gain, but a burden in the long-run: high carbon footprint and debt.

These results could serve as a solid stepping stone for the development of more reliable composite index frameworks for assessing countries' sustainability.

Keywords: Sustainable development, sustainability indicators, global sustainability, sustainability quadrant, Ecological Footprint, Human Development Index.

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1. Introduction

This work started as an attempt to develop a set of relevant indicators to assess sustainable development in Panama. However, it quickly evolved and its scope was broadened to include the entire planet. This happened for two specific reasons:

- The lack of clear standards for what constitutes a nation that is developing itself in a sustainable fashion.
- The realization that advances in information technology and global data availability have opened the door for assessments of sustainable development at a truly macro scale. It is now fairly easy to conduct a study of sustainability using the entire planet as the unit of analysis.

After examining some of the approaches – composite indicator frameworks – used to assess sustainable development at the country level (Chapter 2), a new measuring standard was proposed, based on the *Global Sustainability Quadrant* approach (described in detail in Chapter 3), which combines Ecological Footprint and Human Development Index measures. A compilation and analysis of global data, covering a wide array of environmental, social, economic, and governance performance metrics[3], was undertaken with the purpose of finding those metrics associated with proximity to – and movement towards – the Sustainability Quadrant (Chapter 4). The results (Chapter 5) could serve as a solid stepping stone for the development of more reliable composite index frameworks for assessing countries' sustainability.

[3] The terms 'indicators' and 'metrics' are generally used to refer to qualitative and quantitative measures of sustainability, respectively (Jeon, et al., 2005). A metric can serve as an indicator when its validity has been proven.

2. Review of Composite Sustainability Indicator Frameworks

With the purpose of finding adequate measures of sustainable development at the country level, a review and brief comparative analysis of widely used composite indicator frameworks is conducted in this Chapter.

2.1. Introduction to Composite Indicator Frameworks

The construction of adequate and reliable indicators for sustainable development is a process that is constantly evolving. Countless different frameworks designed to measure sustainability have been published in the literature. Not surprisingly, many of these are subject to heavy criticism. Frey and Yaneske observe that "the fragmentation of a complex system into manageable chunks seems to have led to the loss of connections between individual characteristics and problems" (Frey, et al., 2007). Referring in concrete to the UNEP's Environmental Indicators for Central Asia, they continue stating that "each of the indicators is assessed separately, and no mechanism is made available to establish the interdependencies between social, economic, and environmental change trends."

The creation of *composite* indicators is an attempt to overcome such fragmentation. Composite indicator frameworks integrate indicators from several different subsystems or categories to arrive at a comprehensive score, index, or standardized unit. "While common frameworks still do not automatically lead to common measures and common measures may not lead to coordinated action, they are important components of an enabling environment and governance mechanism that can result in effective action for sustainability" (Pintér et al., 2005).

Another advantage of these composite indicator frameworks is that, because they deliver a comprehensive final score, they allow for comparisons in time (to assess progress), as well as across borders.

2.2. Composite Indicator Frameworks Included in the Review

The frameworks selected for this review are (1) widely referenced in the literature, and (2) have published their results for countries worldwide. A total of 10 frameworks were reviewed, they are listed in Table 2-1.

Table 2-1: Composite Indicator Frameworks Reviewed

Source: Compiled by the author.

	Composite Indicator Framework
1	Ecological Footprint (EF)
2	Human Development Index (HDI)
3	Environmental Performance Index (EPI)
4	Environmental Sustainability Index (ESI)
5	Sustainable Society Index (SSI)
6	Environmental Vulnerability Index (EVI)
7	Sustainable Development Index (SDI)
8	Prescott-Allen's Wellbeing Index (WI)
9	Happy Planet Index (HPI)
10	Quality of Life Index (QOL)

See Appendix A for an overview of these 10 indicator frameworks, including the entities that have developed and/or maintain them, calculation methodologies, and lists of the specific indicator categories they consider in their estimates.

It should be noted that the Human Development Index (HDI) and the Quality of Life Index (QOL) frameworks do not incorporate environmental considerations directly in their calculations. Nevertheless, they are included here because they are commonly used (especially the HDI) to assess development in general.[4] Furthermore, the HDI (along with the Ecological Footprint) plays an essential part in the conception of the Global Sustainability Quadrant, which will be introduced in Chapter 3.

2.3. Synthesis of Indicator Categories Considered by the Reviewed Frameworks

After detailed examination of the specific indicators used in all 10 reviewed frameworks, a compilation was made of the indicator categories covered by such. The approach used for this compilation follows Prescott-Allen's (2006) proposed structure of *subsystems* and *elements*, summed up in Table 2-2. The compilation itself appears in Table 2-3.

[4] The lack of the adjective 'sustainable' should not exclude an indicator framework from a discussion of sustainable development; after all, if it cannot be sustained through time, it probably should not be called 'development'.

Table 2-2: Hierarchical Indicator Structure

Source: Adapted from Prescott-Allen, 2006.

Level	Examples	
System	country or other geo-unit	
Subsystem	human subsystem	ecological subsystem
Element group	knowledge & culture	environmental quality
Element	knowledge	air & atmosphere
Subelement (indicator group)	education	local air quality
Indicator	educational attainment	ambient daily concentration of particulates

Table 2-3: Sustainability Indicator Subsystems and Elements Considered by the Reviewed Frameworks

Source: Compiled and classified by the author.

Subsystem	Element
A. Ecosystems and Natural Resources	Atmospheric balance
	Hydrologic balance
	Soil nutrient balance and arable land
	Biodiversity
	Forests and biomass
	Oceans, seas, and coasts
	Rivers, streams, and lakes
B. Human and Societal Wellbeing	Population growth
	Food security, nutrition
	Water quality and availability
	Overall health - access to health services
	Shelter
	Clean air
	Security
	Income
	Transportation
	Access to communications
	Social equality (includes gender)
	Family planning, access to reproductive health
	Knowledge, education
	Recreation opportunities, leisure time

Table 2-3 (continued)

Subsystem	Element
	Cultural diversity
C. Economy	Internalization of environmental and social costs
	Cultivated systems
	Fishing (wild)
	Energy
	Eco-Efficient technology in industry
	Forestry
	Tourism
	Mining
	Waste management
	Payment for ecosystem services
	Transport
	Housing, buildings, and infrastructure
D. Governance/Policies	Corruption
	Macroeconomic performance
	Public finance (debt)
	Social investment / aid
	Freedom
	Justice
	Civil society participation, awareness, and demands
	Preparedness and response to natural hazards
	Integrated Land-use planning
	Urban planning initiatives
	Fair trade policies
	Private sector commitment to good stewardship
	Sustainability integrated into national policies
	Integrated policy management
	Integrated knowledge management initiatives
	Participation in international collaboration

2.4. Comparing the Distinct Indicator Frameworks

A comparison of the composite indicator frameworks serves two purposes, (1) to assess individual countries' relative performance, and (2) to evaluate the frameworks themselves. Country scores for the 10 frameworks were compiled for 142 countries worldwide.[5] For each framework, countries were ranked according to their score (from best to worst). Table 2-4 lists these countries alphabetically and their corresponding scores.

[5] 142 is the minimum number of countries shared by the HDI and the EF analyses – the components of the Global Sustainability Quadrant, which will be introduced in Chapter 3.

Table 2-4: Composite Indicator Frameworks Reviewed – Country Ranks Worldwide

Note: An additional framework – the Eco (Deficit) or Reserve – is included in the table; it is a variation of the Ecological Footprint per capita approach, where the country's per capita footprint is subtracted from the country's total Biocapacity per capita to determine whether countries are living within their own limits. See Section 3.2.2. for more details about Ecological Footprint and Biocapacity.[6]

Source: Compiled by the author. See Appendix A for the Composite Indicator Frameworks' sources.

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
Albania	79	52	26	22	16	103	39	63	63	68	106
Algeria	58	75	62	93	114	54	87	101	48	71	100
Angola	19	122	138	119	125	13	139	94	122	..	27
Argentina	85	37	36	7	108	66	32	41	27	33	11
Armenia	49	65	58	42	26	23	70	28	99	74	95
Australia	139	3	43	11	61	19	13	13	107	5	7
Austria	124	12	6	8	5	129	6	4	38	17	121
Azerbaijan	77	73	76	95	117	119	77	110	75	75	108
Bangladesh	4	113	118	110	19	109	103	102	25	67	76
Belarus	110	50	40	44	38	20	41	39	132	89	85
Belgium	127	15	53	109	62	138	11	21	51	19	135

[6] The Ecological Footprint measures human consumption and puts it in terms of 'biologically productive land area' required to produce what we consume and assimilate our wastes. Biocapacity simply indicates the amount of biologically productive land area available within a country. They are both expressed in global hectares (gha.). When a country's Ecological Footprint is greater than its Biocapacity, it is incurring in an ecological deficit, meaning that it is importing Biocapacity (through imported products) and exporting its Footprint.

Table 2-4 (continued)

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
Benin	25	125	120	84	29	57	104	32	79	..	45
Bhutan	24	99	..	41	52	32	..	70	9	..	42
Bolivia	74	83	103	17	94	28	74	36	45	72	2
Bosnia Herzegovina	93	58	45	59	44	82	73	115	73	83	104
Botswana	106	95	92	32	115	1	82	26	133	93	16
Brazil	82	53	33	9	41	62	44	71	40	32	14
Bulgaria	90	44	52	68	56	98	40	50	112	49	59
Burkina Faso	69	137	134	94	58	15	117	95	115	..	84
Burundi	14	136	125	125	119	68	138	123	141	..	69
Cambodia	22	103	128	65	39	43	133	85	62	..	64
Cameroon	42	116	107	48	70	16	105	77	110	..	30
Canada	137	2	11	5	36	30	3	5	80	12	4
Central African Rep	54	141	121	23	89	2	119	67	130	..	6
Chad	61	134	133	99	107	11	135	106	134	..	34
Chile	94	31	28	40	20	67	38	59	29	25	36

Table 2-4 (continued)

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
China	73	72	99	128	71	125	66	130	19	52	111
Colombia	66	62	9	20	53	75	48	60	1	46	28
Congo	3	98	87	37	76	12	..	57	67	..	3
Congo Dem Rep	5	140	132	111	88	69	116	107	140	..	19
Costa Rica	81	40	5	16	10	120	27	37	2	28	86
Cote Divoire	16	130	97	86	84	25	109	86	117	..	32
Croatia	98	36	19	18	42	110	37	47	55	41	105
Cuba	63	39	38	51	14	102	34	61	4	..	98
Czech Republic	130	28	64	88	66	91	33	22	97	27	126
Denmark	140	11	24	24	13	112	12	9	69	7	125
Dominican Republic	51	69	31	116	85	100	54	42	18	69	97
Ecuador	78	54	21	49	81	80	71	30	35	44	66
Egypt	59	87	67	112	132	76	91	68	68	70	113
El Salvador	55	76	61	114	30	113	65	69	6	48	103
Eritrea	38	128	115	..	..	33	140	111	106	..	40
Estonia	135	33	18	25	73	60	22	40	138	59	22

Table 2-4 (continued)

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
Ethiopia	46	133	116	130	100	37	136	87	111	..	79
Finland	128	10	4	1	4	41	2	2	91	10	9
France	123	8	10	33	15	126	14	18	98	20	119
Gabon	44	80	60	10	21	8	89	48	76	..	1
Gambia	39	124	..	69	33	55	111	80	61	..	62
Georgia	29	70	35	54	7	39	36	51	71	76	43
Germany	114	20	12	29	18	122	10	7	54	21	124
Ghana	50	109	81	45	77	58	96	134	44	84	75
Greece	133	16	41	66	69	117	23	23	102	18	137
Guatemala	52	91	65	113	68	108	79	120	7	79	71
Guinea	43	131	129	79	87	34	129	72	92	..	31
Guinea-Bissau	18	135	130	75	91	46	127	78	103	..	24
Haiti	2	114	112	136	79	111	137	131	57	99	72
Honduras	65	88	69	85	104	49	80	81	5	80	58
Hungary	105	29	22	52	28	128	31	33	90	30	99
India	17	100	113	98	55	136	99	138	39	63	92

Table 2-4 (continued)

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
Indonesia	23	82	96	73	95	93	98	64	15	61	46
Iran	87	66	63	127	131	89	86	112	43	77	112
Ireland	134	4	32	19	92	96	8	11	81	1	120
Israel	121	21	46	60	122	133	29	65	85	31	141
Italy	120	17	23	67	51	137	20	19	41	6	132
Jamaica	32	67	50	105	43	134	43	52	31	55	89
Japan	122	7	20	28	24	141	15	16	66	15	138
Jordan	62	68	66	82	130	86	90	124	64	65	115
Kazakhstan	101	55	101	76	116	9	61	96	94	85	41
Kenya	28	110	90	97	46	40	131	116	96	..	56
Korea Republic	108	22	48	118	59	130	50	44	72	24	128
Kuwait	141	25	104	133	134	99	75	97	124	47	142
Kyrgyzstan	33	92	88	78	64	18	56	75	13	92	44
Laos	27	101	95	50	60	21	124	82	77	..	33
Latvia	103	35	8	13	9	44	16	12	127	57	20
Lebanon	95	60	85	124	111	139	64	88	56	..	127

Table 2-4 (continued)

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
Lesotho	30	120	..	..	..	61	106	73	136	..	65
Lithuania	97	34	15	21	11	90	17	17	116	54	37
Macedonia	118	51	70	87	67	94	42	55	86	78	129
Madagascar	31	108	126	62	78	59	121	99	46	..	23
Malawi	1	126	114	72	45	26	112	66	129	..	63
Malaysia	83	49	25	36	118	88	69	79	26	29	52
Mali	56	132	135	38	82	10	125	129	108	..	38
Mauritania	68	106	136	120	75	17	110	139	93	..	17
Mauritius	80	57	54	..	..	124	51	34	33	..	116
Mexico	102	41	44	90	112	83	47	125	23	26	117
Moldova Republic	40	85	82	56	17	97	53	91	113	88	61
Mongolia	104	84	94	70	103	5	62	31	34	..	5
Morocco	36	96	78	102	124	92	93	119	24	56	88
Mozambique	21	139	127	103	49	14	134	126	109	..	25
Myanmar	34	102	98	46	98	45	123	113	50	..	47
Namibia	107	97	83	30	101	3	68	56	87	..	12

Table 2-4 (continued)

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
Nepal	8	111	77	83	40	81	101	46	32	..	82
Netherlands	115	5	51	39	12	140	9	29	47	14	131
New Zealand	138	18	7	12	8	72	7	10	65	13	10
Nicaragua	70	90	73	63	35	48	94	89	12	66	35
Niger	57	138	139	100	109	6	126	121	128	..	54
Nigeria	45	119	119	96	74	107	113	108	114	97	81
Norway	136	1	3	2	3	50	1	3	84	3	102
Oman	119	42	86	81	136	29	84	135	53	58	122
Pakistan	13	105	117	126	121	131	120	132	82	82	83
Panama	96	46	30	26	34	24	35	53	3	39	50
Papua New Guinea	60	115	102	34	106	31	92	98	49	..	21
Paraguay	99	74	59	15	25	38	45	74	30	64	8
Peru	53	61	56	14	57	42	67	14	21	45	26
Philippines	15	77	57	121	72	142	83	92	11	36	77
Poland	112	30	39	101	93	121	28	43	83	40	118
Portugal	116	27	17	35	22	105	30	24	105	16	130

Table 2-4 (continued)

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
Romania	92	48	79	91	27	106	52	76	89	50	93
Russia	109	56	27	31	86	51	60	49	137	94	18
Rwanda	11	129	124	104	83	77	118	117	119	..	74
Saudi Arabia	86	43	74	131	137	52	88	141	60	62	114
Senegal	47	118	108	57	80	56	107	100	74	..	55
Sierra Leone	10	142	137	117	113	63	130	118	120	..	53
Singapore	113	24	..	..	..	143	49	35	100	9	136
Slovakia	100	32	16	47	23	79	24	27	101	37	91
Slovenia	117	23	14	27	48	127	25	15	52	22	123
South Africa	72	94	91	92	128	101	58	114	123	81	57
Spain	132	14	29	74	65	116	18	45	59	8	139
Sri Lanka	26	78	47	77	31	104	81	38	10	35	96
Sudan	84	112	122	135	127	53	108	136	125	..	48
Swaziland	7	107	111	..	..	22	..	83	142	..	39
Sweden	126	6	2	4	1	87	4	1	88	4	15
Switzerland	125	9	1	6	2	114	5	6	42	2	134

Table 2-4 (continued)

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
Syria	71	79	93	115	126	115	100	143	58	86	110
Tajikistan	6	93	75	129	90	47	76	122	16	96	68
Tanzania	37	117	106	61	96	35	122	109	104	98	60
Thailand	76	63	49	71	120	85	85	103	20	34	109
Togo	12	123	109	108	97	73	114	58	95	..	51
Trinidad and Tobago	75	45	84	134	99	135	46	62	28	43	67
Tunisia	64	71	55	53	105	84	63	93	14	73	94
Turkey	89	59	68	89	37	118	72	104	70	42	107
Turkmenistan	111	81	80	138	138	27	78	133	135	91	70
Uganda	48	121	110	55	54	64	132	142	126	90	87
Ukraine	88	64	71	106	50	95	59	105	139	87	73
United Arab Emirates	143	26	105	107	135	74	95	140	121	60	143
United Kingdom	129	19	13	64	47	132	21	25	78	23	133
United States of America	142	13	37	43	63	78	19	20	118	11	140
Uruguay	131	38	34	3	32	36	26	8	36	38	13
Uzbekistan	67	89	100	137	129	65	55	127	37	95	101

Table 2-4 (continued)

Composite Indicator Framework	Eco. Foot-print per capita (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sust. Society Index (SSI)	Env. Vulner-ability Index (EVI)	Sust. Dev. Index (SDI)	Well-being Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (global ha. per capita)
Latest measurement	2005	2006	2008	2005	2008	2005	2002	2001	2006	2005	2005
Number of countries	142	142	138	137	137	142	139	142	142	99	142
Country	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank	rank
Venezuela	91	47	42	80	110	71	57	54	17	51	49
Vietnam	41	86	72	122	6	123	97	90	8	53	90
Yemen	20	104	131	132	133	70	115	128	22	..	78
Zambia	9	127	123	58	102	7	128	137	131	..	29

Examining Table 2-4, it is not difficult to appreciate that there is very little consistency among the different frameworks. In order to determine the degree of correlation that exists between them, a Pearson Product – Moment Correlation analysis was performed. By applying the Pearson correlation function to the two country rank lists of any given pair of frameworks, the analysis yields a correlation coefficient (R) that indicates the type of relationship that exists between them.[7] Table 2-5 presents the results of the analysis in the form of a correlation matrix. See Section 4.4. for more information about the Pearson Correlation method.

[7] "If both variables increase together across countries, a positive correlation results in a value from 0 to +1.0. Conversely, an inverse relationship between the metrics would yield a negative correlation coefficient, between 0 and –1.0" (Wilson, et al., 2007). A value closer to 1.0 (or -1.0) indicates a stronger correlation.

Table 2-5: Correlation Matrix of Selected Composite Indicator Frameworks

Source: Created by the author using rank lists in Table 2-4.

Pearson Moment Correlation Coefficient (uses country rank lists)	Ecological Footprint Per capita - indexed (EF)	Human Dev. Index (HDI)	Env. Performance Index (EPI)	Env. Sustainability Index (ESI)	Sustainable Society Index (SSI)	Env. Vulnerability Index (EVI)	Sustainable Dev. Index (SDI)	Wellbeing Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Ecological (Deficit) or Reserve (gha. per capita)
Ecological Footprint Per capita - indexed (EF)	1.000										
Human Development Index (HDI)	**-0.847**	1.000									
Environmental Performance Index (EPI)	-0.665	0.864	1.000								
Environmental Sustainability Index (ESI)	-0.408	0.432	0.587	1.000							
Sustainable Society Index (SSI)	-0.178	0.359	0.524	0.545	1.000						
Environmental Vulnerability Index (EVI)	0.267	-0.493	-0.415	0.169	-0.203	1.000					
Sustainable Development Index (SDI)	-0.793	0.919	0.886	0.534	0.485	-0.428	1.000				
Wellbeing Index (WI)	-0.534	0.650	0.717	0.655	0.586	-0.179	0.749	1.000			
Happy Planet Index (HPI)	0.043	0.210	0.314	0.049	0.135	-0.332	0.221	0.077	1.000		
Quality of Life Index (QOL)	-0.627	0.842	0.699	0.478	0.439	-0.382	0.737	0.678	0.124	1.000	
Ecological (Deficit) or Reserve (gha. per capita)	0.350	-0.447	-0.271	0.293	0.013	0.709	-0.294	-0.034	-0.132	-0.229	1.000

As an example of how the results listed in Table 2-5 are interpreted, note the strong negative correlation between EF and HDI (-0.847); this indicates that countries that have low Ecological Footprints per capita (a 'good' thing) tend to have a low Human Development Index (a 'bad' thing).

2.5. Conclusion

The comparative analysis of composite indicator frameworks shows that most frameworks have negative correlations with the Ecological Footprint per capita (EF). Notable exceptions are the Happy Planet Index (HPI) and the Environmental Vulnerability Index (EVI), which are not surprising if examined carefully. The HPI is calculated using Ecological Footprint data (plus Life Expectancy measures combined with a subjective assessment of satisfaction with life). The EVI shows a weak, but positive, correlation with the EF; it also shows the strongest positive correlation with Ecological Reserves, meaning that countries that are less 'vulnerable' to disaster tend to have ecological reserves and not deficits, which makes perfect sense.

Now, why are these conclusions focusing on the EF? The reason is that, if the EF is considered as a valid approach, then all the other composite indicator frameworks reviewed are inadequate. But, is the EF a valid approach? It certainly is the only framework reviewed here where the final score obtained is based on 'real data,' not on weighting factors applied subjectively according to (expert) opinions. It is also the only comprehensive measure of human consumption, relative to ecosystem's carrying capacity, available today.

All this points to a general flaw in the usual approaches to assess sustainable development: they tend to value human development factors and a clean local environment, but gravely overlook overconsumption of remote resources and the exporting of pollution – which the EF does by allocating environmental impacts to the final consumer of goods and services, not to the producer. Can a country that is relying on more than its share of the Earth's resources to meet its needs be deemed 'sustainable'? These frameworks appear to be answering with a resounding 'yes'.[8] As long as this continues to be so, development within the ecological limits imposed by the planet's carrying capacity is unlikely to become a priority for policy makers.

[8] For example, with an Environmental Performance Index of 95.5, Switzerland ranks highest in the world. Nevertheless, according to EF figures, each Swiss person needs 3.7 more global hectares of biocapacity than their fair Earth-share (of 2.1 gha. per capita) to maintain his/her lifestyle.

3. What Should Sustainable Development Indicators Indicate?

> "'Do we have the right vision?' and 'do we have the right measurement system for attaining this vision?' are both critical questions that any entity interested in addressing sustainability must answer… The effectiveness of an indicator/metric system cannot be evaluated outside the context of how well it is able to measure the vision for which it was developed. Information quality attributes such as data completeness, accuracy, and precision also cannot be evaluated outside the context of these broader and more fundamental questions" (Mihyeon Jeon, et al., 2005).

3.1. What is Sustainable Development?

The ultimate purpose of this work is to identify indicators that could tell us if a country is on the right path towards achieving a sustainable state of development. In order to do that, one key question must be addressed first: *what does sustainable development mean?*

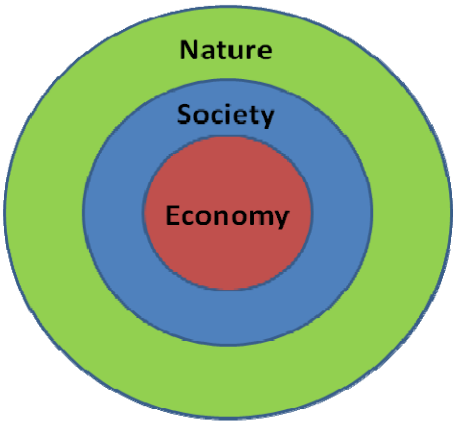
3.1.1. Classic Concepts of Sustainable Development

In its very essence, the concept of *sustainable development* implies development that can be sustained (through time). The most widely-used definition comes from the World Commission on Environment and Development (WCED), commonly referred to as the *Brundtland Report*. It states that sustainable development "…meets the needs of the present but does not compromise the ability of future generations to meet their own needs." Based on this definition, it could be argued that the only true form of development is the sustainable one. Any other kind of development (i.e., one that does compromise future generations' ability to meet their needs) is not development but eventual destruction.

A common approach to address sustainable development is to assess it from three separate dimensions: environmental, social, and economic dimensions, illustrated as three separate circles that have a small area in common. This approach has become known as the 'triple bottom line.' In reality, however, it is difficult to separate these dimensions into distinct categories, since they are inevitably linked. That is why it is preferable to view the three dimensions as concentric circles, one within the other: economic activity within the boundaries of society, and society within the boundaries of the natural environment.[9] This scheme is illustrated in Figure 3-1, whereas Figure 3-2 describes the very basic links between the three dimensions.

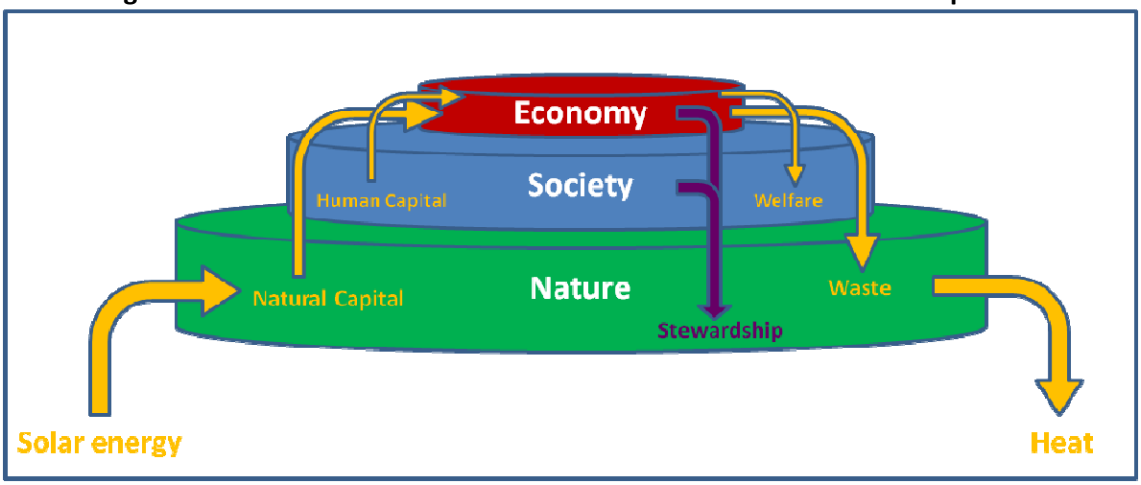
[9] See Appendix E for a brief history of the *concentric circles* approach to sustainability.

Figure 3-1: The Dimensions of Sustainable Development



Source: Adapted from Tarté, 2006.

Figure 3-2: Basic Links between the Dimensions of Sustainable Development



Source: Created by the author.

3.1.2. A Basic Equation for Sustainable Development

McDonach and Yaneske (2002) have suggested that, by dissecting the definition of sustainable development to its very basics, it could be represented using the following equation:

Sustainable development requirements (S) = anthropocentric requirements (A) + biocentric requirements (B)

The authors continue stating that, following this formula, there can be 4 types of states that sustain themselves through time:

Type 0:	0B + 0A	devoid of life
Type 1:	1B + 0A	pristine nature (humans optional)

Type 2:	**1B + 1A**	**current objectives of sustainable dev.**
Type 3:	0B + 1A	completely engineered environment

In broad terms, the type 2 state can only be achieved globally if all nations agree to (A) meet their human needs, while (B) "…preserving non-renewable resources and living within the natural renewing capacity of the biosphere" (Frey, et al., 2007). It is in following this type of logic where the foundation lies for the conception of the Global Sustainability Quadrant.

3.2. The Sustainability Quadrant Approach

The "Sustainable Development Quadrant" was introduced as such by Boutaud A., 2002, and has been used since in a couple of joint publications by the World Wildlife Fund (WWF) and the Global Footprint Network.[10] On a two-dimensional plot of nations' **Human Development Index** vs. **Ecological Footprint per capita**, the sustainability quadrant is defined by the area where both dimensions satisfy the minimum requirements of sustainable development. This approach follows the same basic logic set forth in the previous section, where the UNDP's Human Development Index (HDI) serves as a proxy for (A) anthropocentric requirements, and the Ecological Footprint (EF) is used to represent the (B) biocentric requirements part of the equation.

Brief overviews of these two components are provided in the following sections, before arriving at a more in-depth definition of the Global Sustainability Quadrant in Section 3.2.3.

3.2.1. The Human Development Index

The Human Development Index (HDI) was introduced by the United Nations Development Programme in 1990[11]. It has become arguably the most prominent indicator of socio-economic development used globally today. The HDI "measures a country's average achievements in three basic aspects of human development: health, knowledge, and a decent standard of living. Health is measured by life expectancy at birth; knowledge is measured by a combination of the adult literacy rate and the combined primary, secondary, and tertiary gross enrollment ratio; and standard of living by GDP per capita (PPP US$)" (UNDP, Human Development Reports website, 2009). The UNDP considers an HDI equal to, or above 0.8 to mean 'high' human development.

Table 3-1 lists the dimensions and weighting factors used to calculate the HDI.

[10] To name a few: WWF, GFN. Europe 2005: The Ecological Footprint; WWF, GFN. Asia-Pacific 2005: The Ecological Footprint and Natural Wealth.

[11] The HDI's calculation methodology was refined in 1999. Even though conceived in the 90s, using historical data, the UNDP has been able to calculate the HDI for past years, starting in 1975.

Table 3-1: Calculation of the Human Development Index

Source: Adapted from UNDP, 2008.

Dimension	weight
Life Expectancy Index	**1/3**
Education Index	**1/3**
Adult Literacy Rate	2/3
Combined Gross Enrollment Ratio	1/3
GDP Index	**1/3**

3.2.2. The Ecological Footprint

When thinking about trends that threaten humanity's sustainable development, population growth is usually at the top of the list. Even though the global growth rate is decreasing, it is ultimately in the rate of resource consumption where a population's true impact lies. The Ecological Footprint is a way to measure this consumption (the term 'footprint' symbolizes the mark humans leave on the planet), and to view it in light of the planet's carrying capacity. It puts human consumption in terms of the amount of 'biologically productive land and sea area,' or *biocapacity*, required to produce what is consumed and assimilate what is discarded.

> The area of land or sea available to serve a particular use is called biocapacity, and represents the biosphere's ability to meet human demand for material consumption and waste disposal. The Ecological Footprint and biocapacity accounts cover six land use types: cropland, grazing land, fishing ground, forest land, built-up land and carbon uptake land (to accommodate the Carbon Footprint). For each component, the demand [volume] for ecological services is divided by the yield [volume/land area] for those ecological services to arrive at the Footprint [land area] of each land use type. Ecological Footprint and biocapacity are scaled with yield factors and equivalence factors to convert this physical land demanded to world average biologically productive land called global hectares [gha.]. This allows for comparisons between various land use types with differing productivities. (Ewing, et al., 2008).

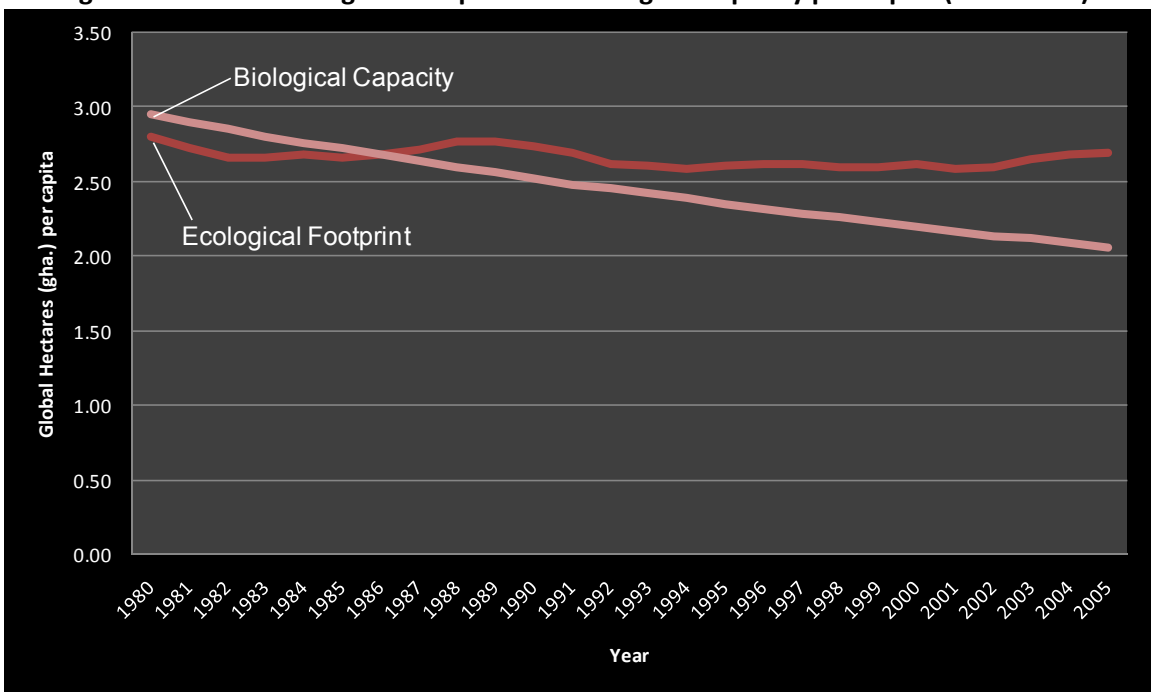
"The Ecological Footprint uses yields of primary products (from cropland, forest, grazing land and fisheries) to calculate the area necessary to support a given activity…. A nation's consumption is calculated by adding imports to and subtracting exports from its national production" (Global Footprint Network website, accessed on April 2009). This means that the burden of resource consumption is assigned to the final consumer, not to the producer. The usual approaches used to measure sustainability tend to overlook this allocation of consumption.

Thus, a clean environment is not necessarily a sign of a society with a sustainable lifestyle – it could be masking a country's exporting of its environmental impacts. An exporting of the footprint happens when a country's Ecological Footprint is larger than its biocapacity; in other words, it is incurring an ecological deficit.

Earth's amount of biocapacity available *per capita* is known as the fair *Earth-share*. The fair Earth-share is obtained by dividing Earth's total biocapacity (gha.) by its total population (number of persons). In 2005 (the year for which the latest measures are available), the fair Earth-share stood at 2.063 gha. per person. However, this fair Earth-share is being constantly reduced – despite some increases in productivity (e.g., agricultural yields)[12] – due to the increase in the world's population. This trend will continue until global population stabilizes, unless the overall biological productivity of the land increases, at least, at the same rate.

Figure 3-3 illustrates how biocapacity and ecological footprint per capita have changed over the last 25 years. According to these data, humanity's ecological footprint per capita surpassed the planet's biocapacity in 1986. After that moment, humanity entered into what is commonly known as 'overshoot,' meaning that it is living in a way that is consuming the natural capital.

Figure 3-3: World Ecological Footprint and Biological Capacity per Capita (1980-2005)



Sources: Global Footprint Network, *National Footprint Accounts*, 2008 edition. For more information about the Footprint methodology and calculation standards, contact Global Footprint Network at www.footprintnetwork.org.
Created by the author using MS Excel.

[12] Productivity of the land is indeed factored into the EF calculations. This means that the number of global hectares of cropland biocapacity entered into the footprint accounts is larger than the actual number of hectares of cropland.

3.2.3. The Global Sustainability Quadrant[13]

On a two-dimensional plot of nations' Human Development Index vs. Ecological Footprint per capita, the Sustainability Quadrant is defined by the area where the minimum requirements of sustainability are met. These minimum requirements are defined by the Quadrant approach as:

- For the HDI, a score above **0.8** (considered 'high' human development by the UNDP).

- For the EF, **2.063** global hectares per capita (the latest estimates, from 2005, indicate that there are 2.063 global hectares of biocapacity per person in the planet; this is a person's *fair Earth-share*, and it makes sense that it is set as a minimum requirement of sustainability).

The term 'Global' has been added here to emphasize that this is a standard set for a sustainable *global citizen*. This means that sustainability is assessed in terms of the fair Earth-share of biocapacity, and not in terms of any particular country's amount of biocapacity.

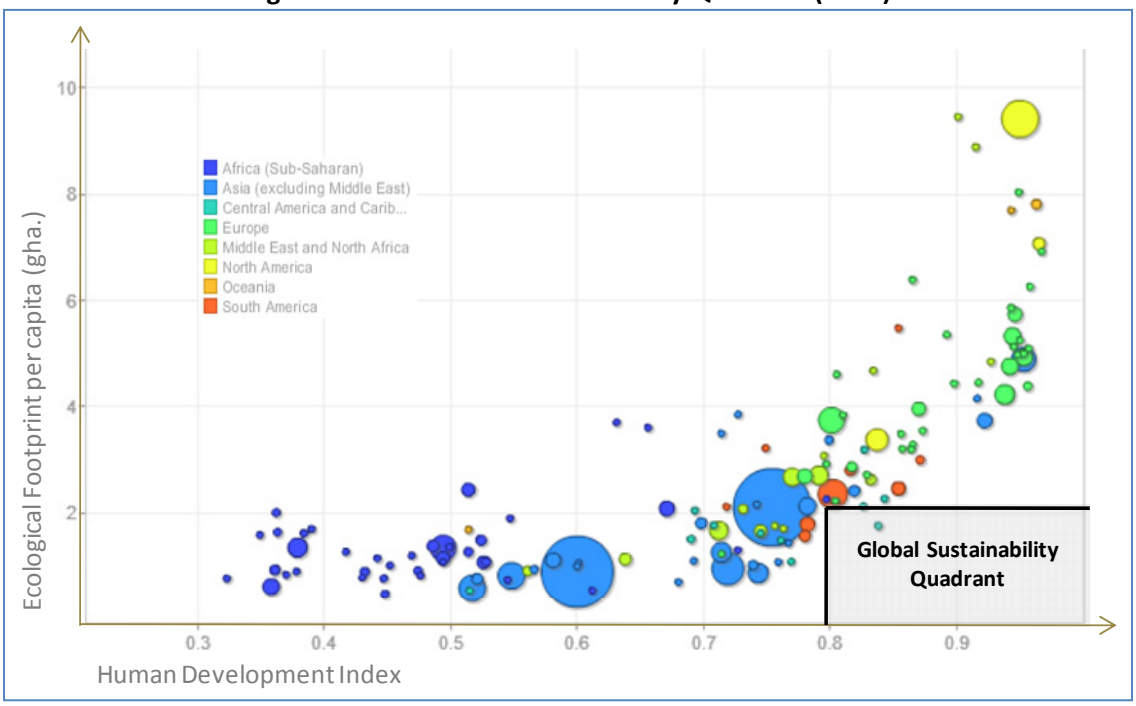
Figure 3-4 is a plot of EF vs. HDI that, using data from 142 countries, illustrates the Global Sustainability Quadrant; this isthe number of countries that have both Ecological Footprint and Human Development Index figures available for 2005[14].

[13] It should be noted that the Sustainability Quadrant approach is by no means the only effort that has been made to assess sustainable development by combining the EF and the HDI (or its components). Some of these efforts include:

- The Development Balance Index, proposed by Vintar Mally in her 2007 study, *Linking Socio-Economic Development and Environmental Pressure.* She proposes the following formula:
  Development balance index = ⅓ GDP index + ⅓ (½ education index + ½ life expectancy index) + ⅓ ecological footprint index
- The Sustainable Human Development Index, proposed by Kenneth Hermele in his 2006 paper, *Greening the Human Development Index*.
- The Happy Planet Index (described briefly in the previous chapter and in greater detail in Appendix A).

[14] As of this publication, 2005 is the most recent year when complete country measures for both HDI and EF are available, so it has been taken to represent the 'present-day' in this work.

Figure 3-4: The Global Sustainability Quadrant (2005)



Note: Each circle in the Figure represents a country; the size of the circle is relative to the country's total population.
Sources: EF data obtained from the Global Footprint Network, *National Footprint Accounts*. 2008 edition. (www.footprintnetwork.org.) HDI Time Series obtained from the United Nations Development Programme (UNDP), *Human Development Reports, 2008* (http://hdr.undp.org). Created by the author using Google Motion Chart and MS Power Point.

One thing that becomes evident by looking at Figure 3-4 is the 'development' pattern that nations seem to adhere to: as they advance their human development, their ecological footprint grows; they 'skim over' the Quadrant, which remains slightly within reach for a while, before shooting up into significant overconsumption. However, this does not mean that every country that improves its human development does it by increasing its footprint; there *are* exceptions. The *Movement Towards the Quadrant* assessment approach, which will be introduced in Section 4.3., allows us to identify the countries that are doing this, and to explore what sets them apart from the rest.

In the present-day, there is only one country inside the Quadrant: Cuba.[15] Does this mean that Cuba can be viewed as a model for global sustainability? Not necessarily. Even though Cuba has achieved high human development within the ecological limits imposed by the planet's biocapacity, its Footprint per capita is rapidly increasing,[16] so it is not expected to remain inside

[15] Cuba's case makes a very interesting study for sustainable development theorists. In his classic article, *The Tragedy of the Commons,* Garret Hardin (1968) observes that coercive public policies are the only way to avert the collapse of society brought upon by environmental degradation. Communist Cuba's presence inside the Sustainability Quadrant may have proven his point.
[16] As indicated by the EF Time Series.

the Quadrant for much longer. This illustrates why assessing historical trends is more relevant to identify globally replicable models of sustainable development than present-day proximity to the Quadrant.

3.2.4. Limitations of the Approach

The value of this work ultimately depends on whether the reader considers the Ecological Footprint and the Human Development Index as valid approaches or not.

If the components of the HDI (health, knowledge, and standard of living) are deemed not sufficient to indicate true human development, then, as a measure of sustainable development, the Sustainability Quadrant approach will inevitably fall short of delivering reliable results.

The Global Footprint Network acknowledges several limitations[17] in their EF methodology. Aside from the usual considerations of data reliability and measuring difficulties, the EF does not, and really cannot, incorporate the impacts of most types of pollutants (e.g., there is no 'SO_2 uptake land'), unless this pollution brings about severe degradation of measurable extents of land, thus resulting in a loss of their productivity (i.e., a reduction in biocapacity).

Also, the EF cannot account for biodiversity directly, only when it serves as carbon uptake land, or indirectly as the ecological services it provides impact the land's productivity. Thus, biodiversity as such is excluded from the 'biocentric requirements' part of the sustainability equation.

Human-caused climate change skeptics will also be quick to dismiss this approach, because the EF includes nations' carbon footprint (i.e., the amount of carbon uptake land needed to absorb the CO_2 emitted by human activities). If human carbon emissions were proven to have no incidence on climate change, most nations' ecological footprint would be greatly reduced.

But even with all its limitations considered, the Ecological Footprint is an invaluable tool in the assessment of sustainable development. It is the only comprehensive measure of human consumption relative to the limits imposed by the natural environment, available today. Moreover, it is based on 'real' and measurable data: yields of primary products, imports, and exports.

Finally, the Sustainability Quadrant approach itself does not factor in population growth. This means that, due to the resulting decrease in biocapacity per capita over time, the standard of sustainability will constantly be moving – the Quadrant will become progressively smaller.

[17] Appendix A provides a more in-depth overview of the EF approach, including limitations to its methodology and calculation standards.

3.3. Research Objective

The Global Sustainability Quadrant has set a target for global sustainable development: HDI >= 0.8, and EF=< 2.063 gha. per capita. The objective of this work is to:

- Identify the countries that are closest to the Quadrant in the present-day, and most importantly, those that are moving towards it in time, and to
- Determine what individual indicators of performance contribute to set these countries apart.

The first part of the objective will be achieved by devising a method to estimate proximity and historical movement in relation to the Quadrant, which would permit to rank countries accordingly. The latter part shall be accomplished by compiling data – a wide array of environmental, social, economic, and governance performance metrics – from all over the world and determining their relationship with proximity and/or movement relative to the Quadrant.

Put in different terms, this work aims to identify the metrics that are *associated with* the advancement (or the hindrance) of both types of sustainability requirements simultaneously. Note that the words used in the above description are 'associated with', not 'causing'. It is unrealistic to expect that this work will arrive at a new assessment index for global sustainability, much less a mathematical formula to model it. It can, however, provide a solid stepping stone for developing better indicators, and perhaps aid policy-makers and other researchers in future endeavors.

4. Methodology

This chapter explains how individual metrics are identified as potential indicators of sustainable development based on the Global Sustainability Quadrant Approach defined in Section 3.2. The following sections describe this process in detail, but it can be summed up, in very broad terms, as follows:

- The Ecological Footprint per capita is transformed into an index score so that countries' performance can be assessed in conjunction with the Human Development Index, thus giving both axes of the HDI vs. EF plot standardized units (index score).
- Methods are devised to calculate (1) present-day Distance From the Quadrant and (2) historical Movement Towards the Quadrant, and countries are ranked accordingly.
- Individual metrics (current figures, as well as historical trends) are selected for the analysis and a country rank list is created for each one.
- Each metric's rank list is then compared to the (1) present-day Distance From the Quadrant rank list, and/or to the (2) historical Movement Towards the Quadrant rank list using the Pearson Product – Moment Correlation function in order to find statistically significant correlations.

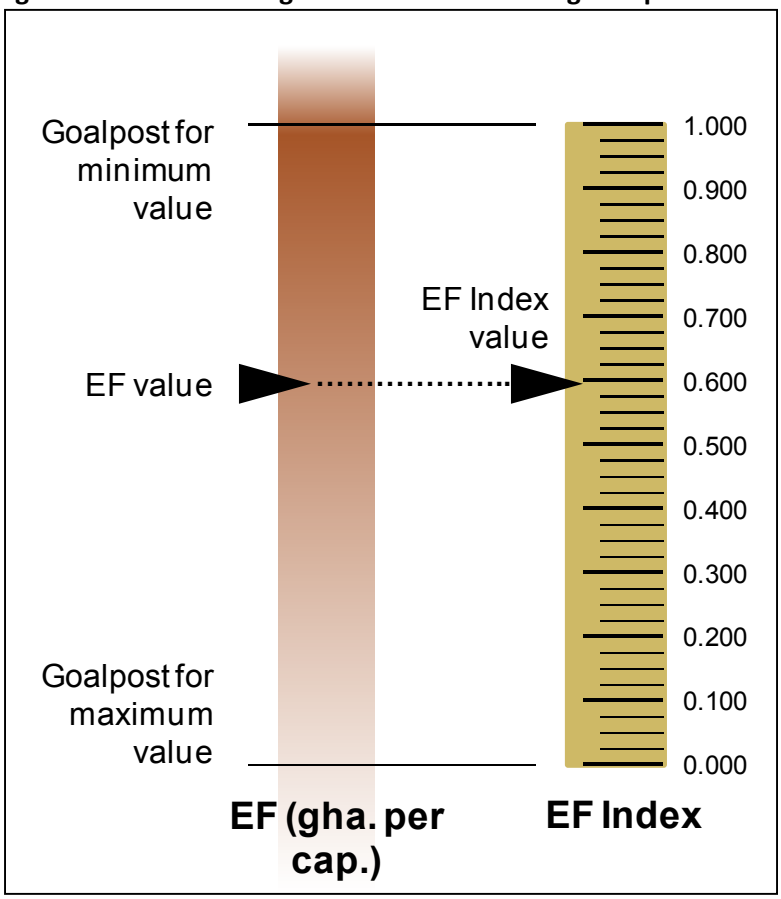
It should be noted that in this analysis, both the HDI and EF dimensions are given equal weight; in other words, an index point gained on any axis accounts for the same amount of overall progress. In reality, it is unlikely that both dimensions would have the same degree of influence on overall sustainable development. Nevertheless, to assess overall progress more accurately, the following question would have to be answered with certainty: *Is it easier to improve health, knowledge, and standard of living for the world's population, or to lower its consumption patterns?* Historical HDI and EF trends worldwide suggest that the former is the case, so the EF dimension should probably carry more weight in the Quadrant assessment approach. Still, any weighing factor added at this point – without further research into the matter – would be no more than an educated guess.

4.1. Transforming the Ecological Footprint Into an Index

To assess a country's Ecological Footprint per capita (EFpc) in conjunction with the Human Development Index (HDI), it is necessary to transform the global hectares per capita value into and index score between 0 and 1. This would give both axes of the HDI vs. EF plot standardized units (index score).

First, minimum and maximum values, known as *goalposts*, need to be set for the EFpc. Since a high EFpc is 'bad,' and a low EFpc is 'good,' the maximum goalpost will be equivalent to a score of 0.0, and the minimum will be equivalent to a 1.0. In other words, the EF Index improves (i.e., moves closer to 1) as the country's EFpc decreases. Figure 4-1 illustrates how this works.

Figure 4-1: Transforming EF into and Index using Goalpost Values



Source: Adapted from UNDP, 2008 (Technical Note 1).

Other approaches that combine EF and HDI measures (mentioned briefly in Section 3.2.), use different methods to set adequate EFpc goalpost values:

- "The ecological component of SHDI [**Sustainable Human Development Index**] has two limit values. The value 0 is defined as being equal to the largest country footprint (i.e. to the footprint of the USA which in 2001 equaled 9.5 ha/cap); the value 1 is set at the sustainability level for global equity [the fair *Earth-share*]" (Hermele, 2006). This approach rewards countries with footprints below the fair Earth-share, thus allowing some countries to have EF Index scores above 1.0.

- In the calculation of the **Happy Planet Index**, the New Economics Foundation has also transformed the Efpc into an indexed score. Their maximum goalpost is set at 15 gha. "Setting the maximum at 15 is well above highest value of 9.5 gha, but not as high as to imply that the current country scores are low in absolute terms. In any case, the impact of this maximum value comes out in the wash – it has no effect on the overall rank order of countries, only on the absolute scores." (Marks et. Al., 2006).

- **Development Balance Index** "Maximal value used for the ecological footprint index calculation was 10.0 global ha per capita. At the beginning of 21st century no country exceeded this limit, while in many countries ecological footprint was less than 1.0 global ha per capita. Therefore, minimum value was rounded up and set at 0.0 global ha per capita, representing (theoretically) minimal possible pressures on the environment." (Vintar Mally, 2007).

After testing several different methods and goalpost values, the approach that was chosen for this work is very similar to the one used in the third approach (Development Balance Index). The goalpost values were set as follows:

- The minimum value was set at 0.0 gha. per capita – a theoretical ideal representing zero environmental pressure.
- The maximum value was set at 10.3 gha. per capita – this value ensures that an EF Index score of 0.8 (which on the HDI is considered 'high') equals exactly 2.063 gha., the fair Earth-share in 2005; thus, countries with a score above 0.8 are living within the planet's carrying capacity, and can be considered to have 'high' EF scores. As a fortunate coincidence, the highest Efpc value found on the entire EF time series used in the analysis (from 1980 to 2005) was 10.3 gha. (for Norway, in 1980), which ensures that all countries in the analysis fall within the range set by the minimum and maximum goalposts.

After having set the desired goalpost values, the following formula is used to obtain the EF indexed score:

$$\text{EF Index} = \frac{\text{maximum value} - \text{actual value}}{\text{maximum value} - \text{minimum value}} \quad (1)$$

Plugging in the goalpost values, the formula becomes:

$$\text{EF Index} = \frac{10.3\ \text{gha.} - \text{actual value}}{10.3\ \text{gha.}} \quad (2)$$

Table 4-1 provides a sample of the 2005 EFpc values transformed into an Index for a few selected countries.

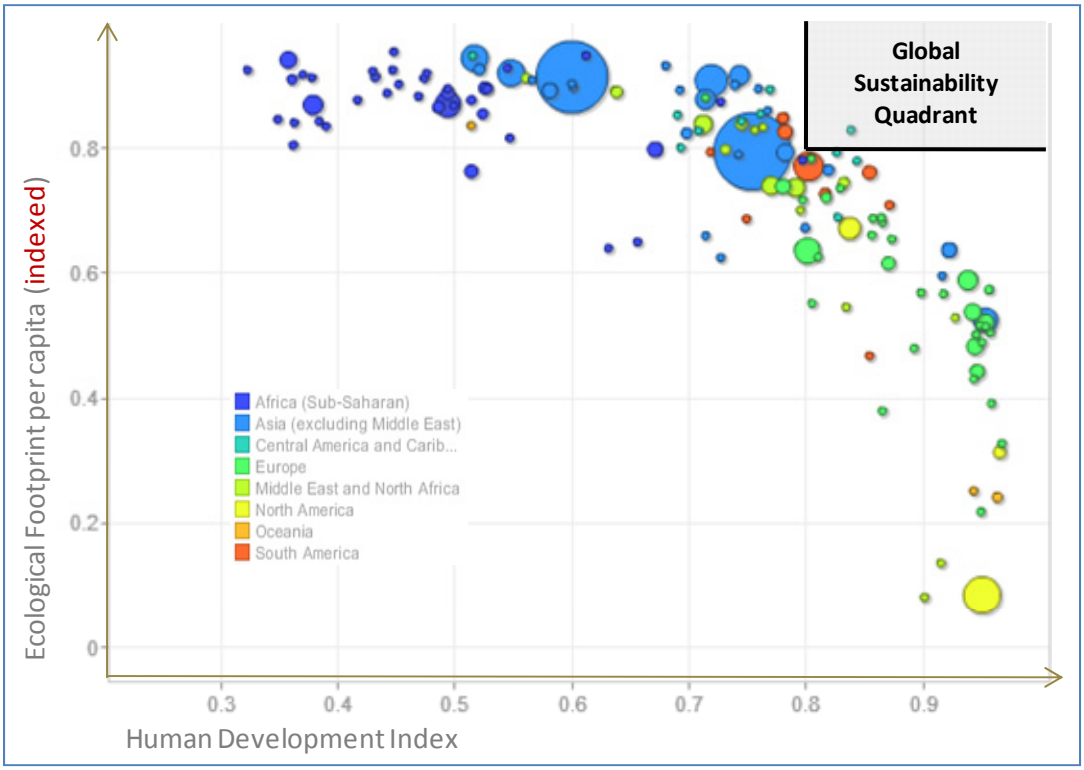
Table 4-1: Sample 2005 Ecological Footprint Values Transformed into an Index Score

Source: Created by the author.

Country	EF (gha. per capita)	EF Index
Malawi	0.47	0.954
Nicaragua	2.05	0.801
South Africa	2.08	0.798
Belgium	5.13	0.502
United Arab Emirates	9.46	0.082

Figure 4-2 plots the HDI vs. EF using the EF Index instead of the gha. per capita values. The Global Sustainability Quadrant is now defined by scores equal or greater than 0.8 on both axes. Since the desirable state (a low EFpc) is now a high index value on the vertical axis, the Quadrant appears on the upper right-hand corner. Nevertheless, the countries' relative proximity to each other and to the Quadrant remains unchanged (it is as though the image had been simply flipped on its horizontal axis).

Figure 4-2: The Global Sustainability Quadrant using the EF Indexed Score (2005)



Note: Each circle represents a country, the size of the circle is relative to the country's population.

Sources: Global Footprint Network, 2008; UNDP, 2008.

Created by the author using Google Motion Chart and MS Power Point.

4.2. Present-Day Distance From the Quadrant

As outlined in the Research Objective (Section 3.3.), part of this work's aim is to identify metrics that could serve as indicators associated with proximity to the Global Sustainability Quadrant in the present-day. In order to accomplish this, a method to calculate countries' Distance From the Quadrant has to be devised, so they can be ranked accordingly.

The countries selected for this analysis total 142, which is the number of countries that have both Ecological Footprint and Human Development Index figures available for 2005.[18] Thus, they are the only countries where it is now possible to estimate present-day Distance from the Global Sustainability Quadrant.

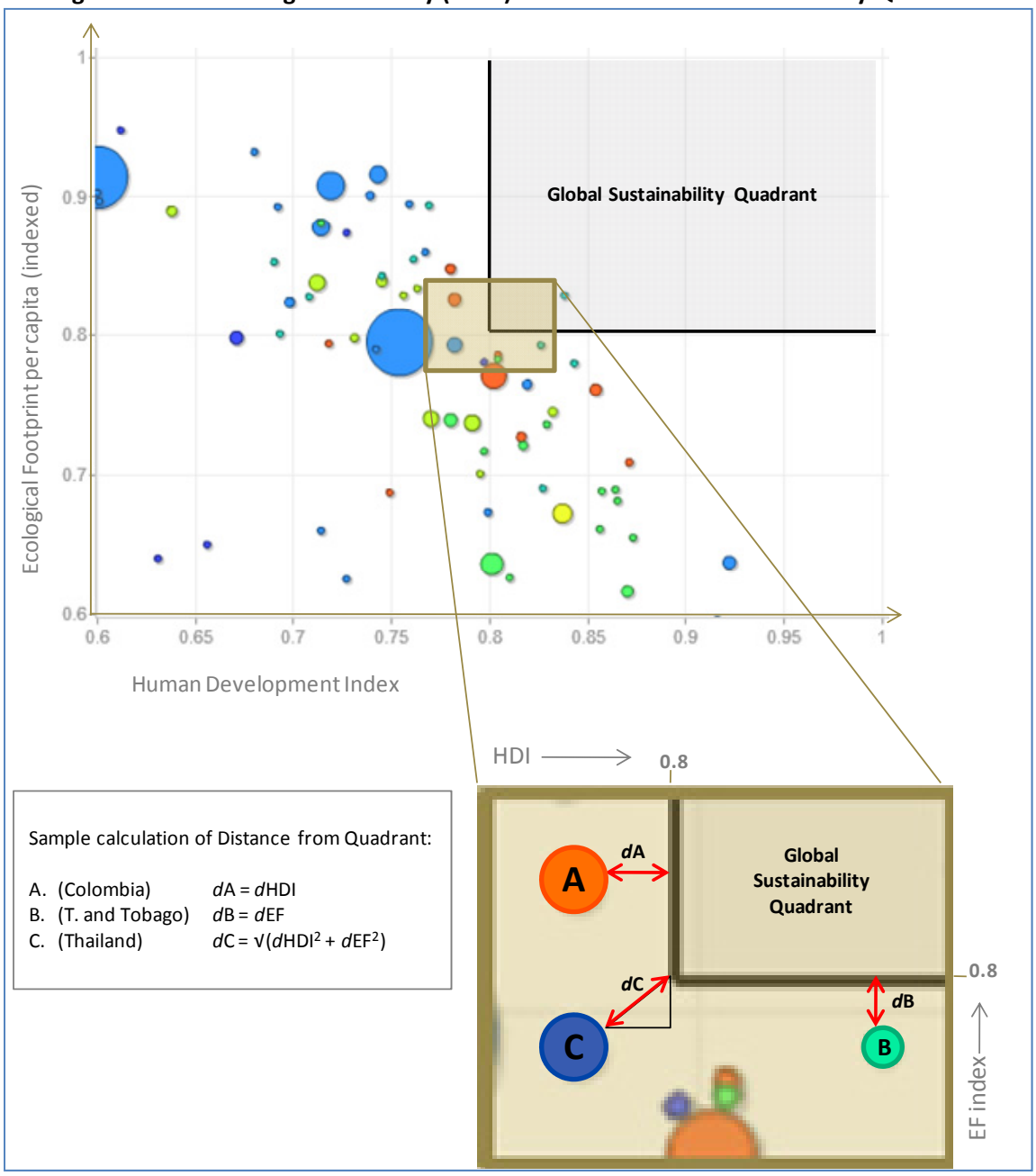
4.2.1. Calculating Present-day Distance From the Quadrant

Of all the countries included in the present-day analysis, only one (Cuba) is inside the Quadrant – both its HDI and EF Index are high (above 0.8). All the other countries either have only a high HDI, or a high EF Index, or neither. Estimating Distance From the Quadrant for those countries that rank high on one dimension is fairly easy: simply subtract the actual value from 0.8 on the axis where performance is not high. It is those countries that rank below 0.8 on both axes that present a calculation challenge. To estimate such countries' Distance From the Quadrant, the difference from 0.8 on each axis is first determined, and then the hypotenuse of the right angled triangle formed between the two differences – that is, the shortest distance to the Quadrant's lower corner (0.8, 0.8) – is calculated using the Pythagorean theorem.[19] Figure 4-3 illustrates how this is done.

[18] As of this publication, 2005 is the most recent year when complete country measures for both HDI and EF are available, so it has been taken to represent the 'present-day' in this work.

[19] Since both the HDI and EF index dimensions are given equal weight in this analysis, when plotted they form a coordinate system with equivalent units, which allows for the application of vector algebra principles.

Figure 4-3: Calculating Present-Day (2005) Distance from the Sustainability Quadrant



Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008.

4.2.2. Present-day Distance Country Rank List

After calculating present-day Distance From the Quadrant for all countries in the study, a list that ranks them according to their proximity to the Quadrant is created: Table 4-2. Note that the top ranking countries in this list are not the ones that usually top the "M*ost Developed*" lists published in the literature. As long as this continues to be so, development within the ecological limits imposed by the planet's carrying capacity is unlikely to become a priority for policy makers.

Table 4-2: Present-day (2005) Distance From the Quadrant – Country Rank List

Note: Country names are formatted to covey other relevant information about their sustainability-related performance. Names in *italics* indicate that these countries are running an ecological deficit (i.e., their Ecological Footprint per capita is larger than their own Biocapacity per capita); a name in **bold** font indicates that the country has a high Human Development Index (above 0.8), and a name that is highlighted indicates that the country's EF per capita is below the fair Earth-share of 2.063 gha. The desirable situation for any **country** would be to have ecological reserves (not deficit), high HDI, and a per capita EF below the fair Earth-share; unfortunately, not a single country meets all three criteria in the present-day

Source: Created by the author. Data from: Global Footprint Network, 2008; UNDP, 2008.

Country	Total Distance From the Quadrant	Rank
Cuba	0.000	1
Trinidad and Tobago	0.007	2
Ecuador	0.014	3
Albania	0.017	4
Colombia	0.018	5
Thailand	0.019	6
Mauritius	0.019	7
Peru	0.020	8
Costa Rica	0.020	9
Brazil	0.029	10
Jamaica	0.031	11
Armenia	0.033	12
Malaysia	0.035	13
Jordan	0.037	14
Argentina	0.038	15
Dominican Republic	0.039	16
Georgia	0.041	17
Tunisia	0.044	18

Table 4-2 (continued)

Country	Total Distance From the Quadrant	Rank
China	0.046	19
Saudi Arabia	0.055	20
El Salvador	0.055	21
Algeria	0.055	21
Philippines	0.057	23
Azerbaijan	0.059	24
Sri Lanka	0.061	25
Bulgaria	0.064	26
Turkey	0.064	27
Ukraine	0.065	28
Iran	0.067	29
Syria	0.069	30
Venezuela	0.073	31
Gabon	0.073	32
Romania	0.079	33
Indonesia	0.081	34
Bolivia	0.082	35
Bosnia Herzegovina	0.084	36
Moldova Republic	0.086	37
Vietnam	0.086	37
Egypt	0.088	39
Chile	0.091	40
Honduras	0.092	41
Lebanon	0.099	42
Uzbekistan	0.102	43
Nicaragua	0.107	44
Kyrgyzstan	0.108	45
Panama	0.110	46
Guatemala	0.110	47
Lithuania	0.111	48
Croatia	0.111	49
Slovakia	0.119	50
Tajikistan	0.120	51
Paraguay	0.123	52
Kazakhstan	0.127	53

Table 4-2 (continued)

Country	Total Distance From the Quadrant	Rank
Mexico	0.128	54
South Africa	0.129	55
Latvia	0.139	56
Hungary	0.145	57
Morocco	0.162	58
Korea Republic	0.163	59
Russia	0.164	60
Mongolia	0.164	61
Belarus	0.174	62
Poland	0.184	63
Congo	0.188	64
Turkmenistan	0.190	65
Laos	0.199	66
India	0.200	67
Bhutan	0.200	67
Singapore	0.204	69
Botswana	0.208	70
Germany	0.210	71
Myanmar	0.219	72
Netherlands	0.226	73
Portugal	0.231	74
Namibia	0.233	75
Slovenia	0.233	76
Cambodia	0.234	77
Yemen	0.239	78
Macedonia (TFYR)	0.247	79
Pakistan	0.252	80
Mauritania	0.253	81
Oman	0.254	82
Swaziland	0.255	83
Italy	0.262	84
Israel	0.270	85
Madagascar	0.272	86
Kenya	0.274	87
Japan	0.275	88
Ghana	0.276	89

Table 4-2 (continued)

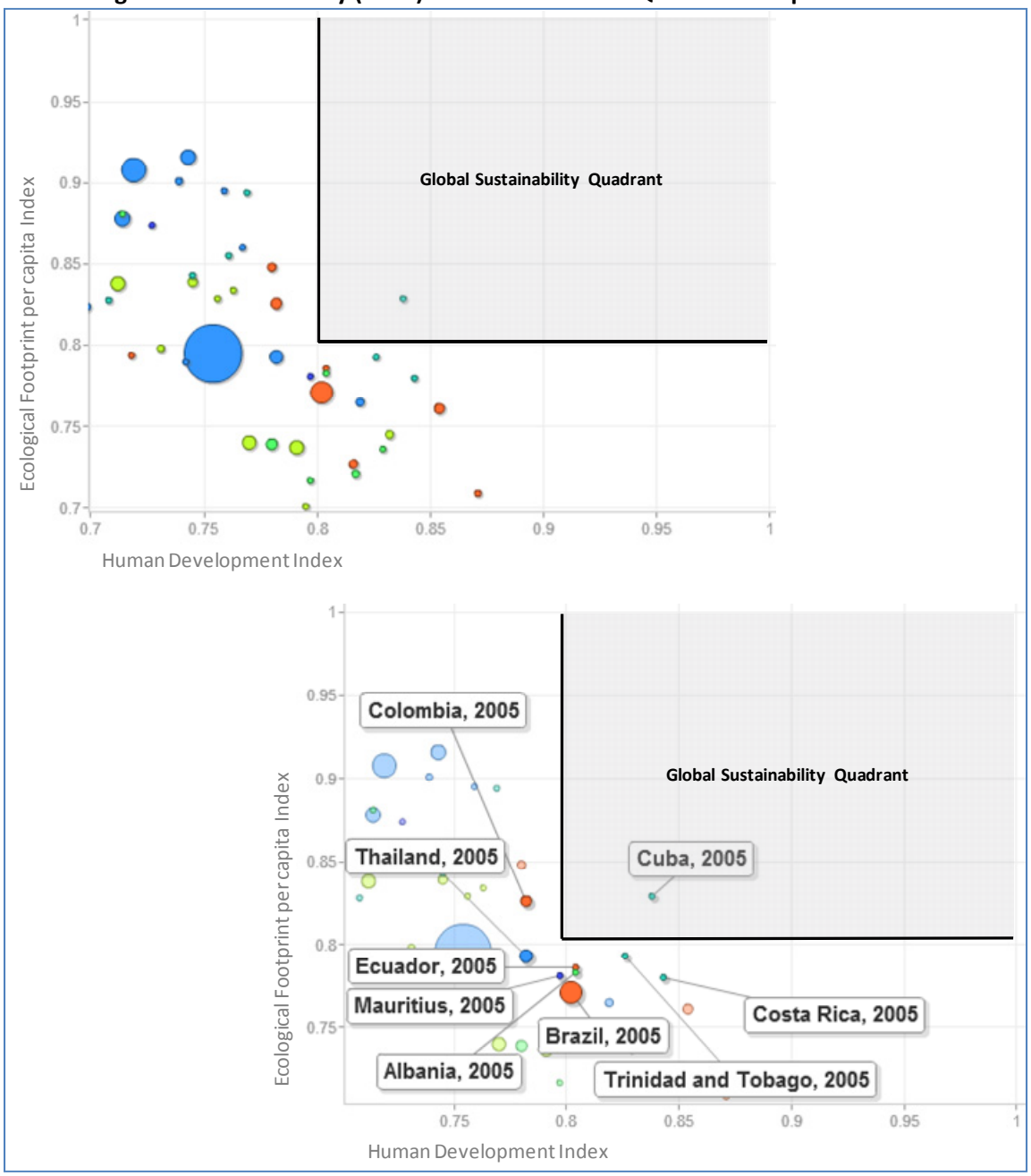
Country	Total Distance From the Quadrant	Rank
France	0.278	90
Nepal	0.279	91
Bangladesh	0.283	92
Austria	0.283	93
Haiti	0.285	94
Switzerland	0.286	95
Cameroon	0.286	96
Papua New Guinea	0.286	96
Sudan	0.288	98
Sweden	0.295	99
Belgium	0.298	100
Senegal	0.301	101
Lesotho	0.306	102
Tanzania	0.306	102
Nigeria	0.306	102
Finland	0.309	105
Uganda	0.314	106
United Kingdom	0.317	107
Czech Republic	0.320	108
Togo	0.324	109
Angola	0.326	110
Gambia	0.331	111
Uruguay	0.332	112
Benin	0.348	113
Malawi	0.352	114
Zambia	0.353	115
Spain	0.357	116
Eritrea	0.358	117
Cote D'Ivoire	0.368	118
Greece	0.369	119
Rwanda	0.370	120
Guinea	0.383	121
Ireland	0.408	122
Chad	0.410	123
Mali	0.416	124
Estonia	0.421	125

Table 4-2 (continued)

Country	Total Distance From the Quadrant	Rank
Ethiopia	0.421	126
Guinea-Bissau	0.422	127
Burundi	0.430	128
Niger	0.437	129
Burkina Faso	0.438	130
Mozambique	0.439	131
Congo Dem Rep	0.442	132
Central African Rep	0.451	133
Norway	0.471	134
Sierra Leone	0.477	135
Canada	0.486	136
New Zealand	0.547	137
Australia	0.558	138
Denmark	0.580	139
Kuwait	0.663	140
United States of America	0.715	141
United Arab Emirates	0.718	142

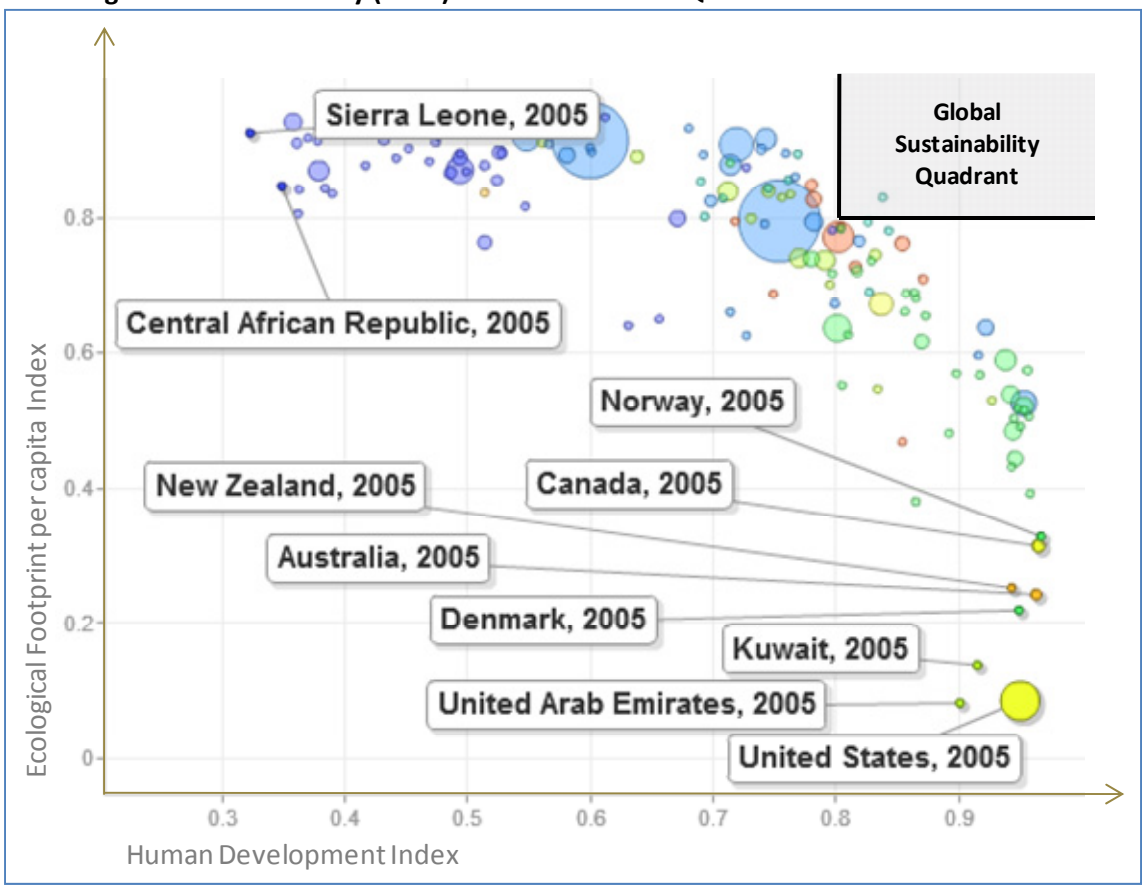
Figures 4-4 and 4-5 illustrate where the countries closest to, and farthest from, the Quadrant stand today (2005) on the EF vs. HDI plot, respectively.

Figure 4-4: Present-day (2005) Distance From the Quadrant – Top Performers



Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008.

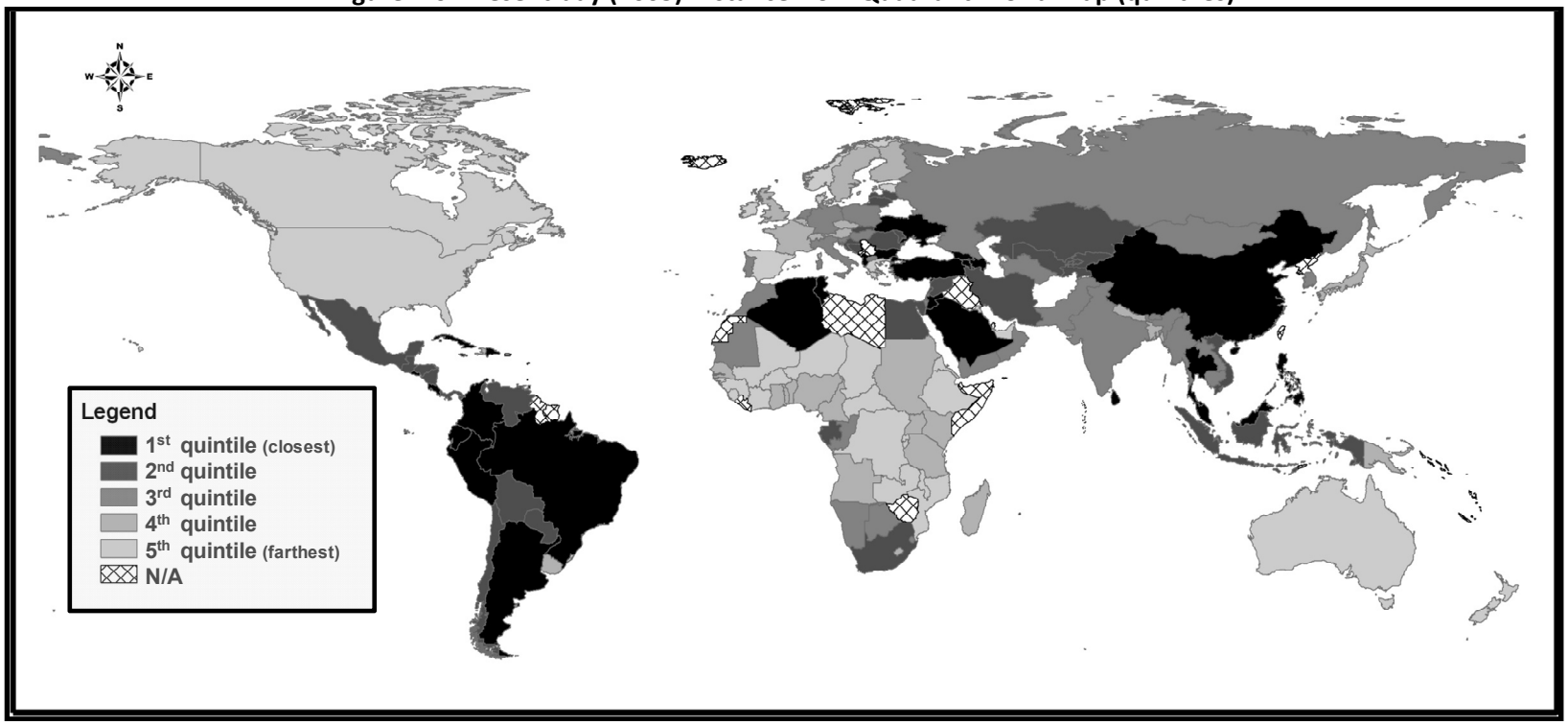
Figure 4-5: Present-day (2005) distance From the Quadrant – Bottom Performers



Source: Created by the author using Google Motion Chart and MS Power Point.

Figure 4-6 is a world map where countries have been shaded according to their Present-day Distance from the Quadrant; darker shades indicate closer proximity (i.e., good performance).

Figure 4-6: Present-day (2005) Distance from Quadrant World Map (quintiles)



Source: Created by the author using ArcMap. Data from: Global Footprint Network, 2008; UNDP, 2008. World boundaries shapefile obtained from: DIVA-GIS, Thematic Mapping. *World Countries Boundary File, World, 2002*. Licensed under a Creative Commons Attribution 3.0 License. Downloaded from: http://finder.geocommons.com/overlays/5603

4.2.3. Comparing the Present-day Distance From Quadrant Approach with other Composite Sustainability Indicator Approaches

Table 4-3 is an updated version of the Correlation Matrix of Selected Composite Indicator Approaches (Table 2.5.). It incorporates the Present-Day Distance from Quadrant approach into the analysis covered in Chapter 2.

Among the frameworks reviewed, the Happy Planet Index (HPI)[20] shows the best correlation with the Present-Day Distance from Quadrant approach (R=0.585). It is followed by the EPI, with a correlation coefficient (R=0.304) that is not particularly strong, but still significant. The most significant negative correlation (-0.357) was found with the Quality of Life Index (QOL), which indicates that what this approach values very often is in conflict with the requirements for sustainable development set by the Global Sustainability Quadrant.

[20] It is no surprise that the Happy Planet Index (HPI) shows the strongest positive correlation with the Distance from Quadrant approach, after all, it is calculated using EF and Life Expectancy measures (one of the components of the HDI). For more information about the HPI, see Appendix A, or visit the HPI website: http://www.happyplanetindex.org.

Table 4-3: Updated Indicator Correlation Matrix (Includes Distance From the Quadrant Approach)

Source: Created by the author using rank lists in Tables 2-4 and 4-2.

Pearson Moment Correlation Coefficient (uses country rank lists)	HDI + EF Distance from Quadrant	Ecological Footprint Per capita - indexed (EF)	Human Dev. Index (HDI)	Env. Perfor-mance Index (EPI)	Env. Sust. Index (ESI)	Sustainable Society Index (SSI)	Env. Vulnerabi-lity Index (EVI)	Sustainable Dev. Index (SDI)	Wellbeing Index (WI)	Happy Planet Index (HPI)	Quality of Life Index (QOL)	Eco. (Deficit) or Reserve (gha. per capita)
HDI + EF Distance from Quadrant	1.000											
Ecological Footprint Per capita - indexed (EF)	0.072	1.000										
Human Dev. Index (HDI)	0.189	**-0.847**	1.000									
Env. Perfor-mance Index (EPI)	0.319	-0.665	0.864	1.000								
Env. Sust. Index (ESI)	-0.027	-0.408	0.432	0.587	1.000							
Sustainable Society Index (SSI)	0.024	-0.178	0.359	0.524	0.545	1.000						
Env. Vulnerabi-lity Index (EVI)	-0.272	0.267	-0.493	-0.415	0.169	-0.203	1.000					
Sustainable Dev. Index (SDI)	0.197	-0.793	0.919	0.886	0.534	0.485	-0.428	1.000				
Wellbeing Index (WI)	-0.017	-0.534	0.650	0.717	0.655	0.586	-0.179	0.749	1.000			
Happy Planet Index (HPI)	0.583	0.043	0.210	0.314	0.049	0.135	-0.332	0.221	0.077	1.000		
Quality of Life Index (QOL)	-0.357	-0.627	0.842	0.699	0.478	0.439	-0.382	0.737	0.678	0.124	1.000	
Eco. (Deficit) or Reserve (gha. per capita)	-0.093	0.350	-0.447	-0.271	0.293	0.013	0.709	-0.294	-0.034	-0.132	-0.229	1.000

4.2.4. Limitations of the Present-day Distance From Quadrant the Approach

The Present-day Distance From Quadrant approach provides a good snapshot of *where* in relation to the sustainability Quadrant countries are positioned today, but reveals nothing about the direction they are moving in. Thus, *historical movement* in relation to the Quadrant promises to yield more interesting results for researchers and policy-makers alike.

4.3. Historical Movement Towards the Quadrant

The purpose of this approach is to rank a country's performance based on the changes in its HDI and EF Index over time. Following the UNDP's approach for assessing the HDI's historical trends (UNDP, 2008), three time periods are considered here:

- Long-term: 1980 to 2005
- Medium-term: 1990 to 2005
- Short-term: 2000 to 2005

4.3.1. Calculating Movement Towards the Quadrant

In the HDI vs. EF Index plot used to represent the Global Sustainability Quadrant, there are four possible directions for 'movement' in time:

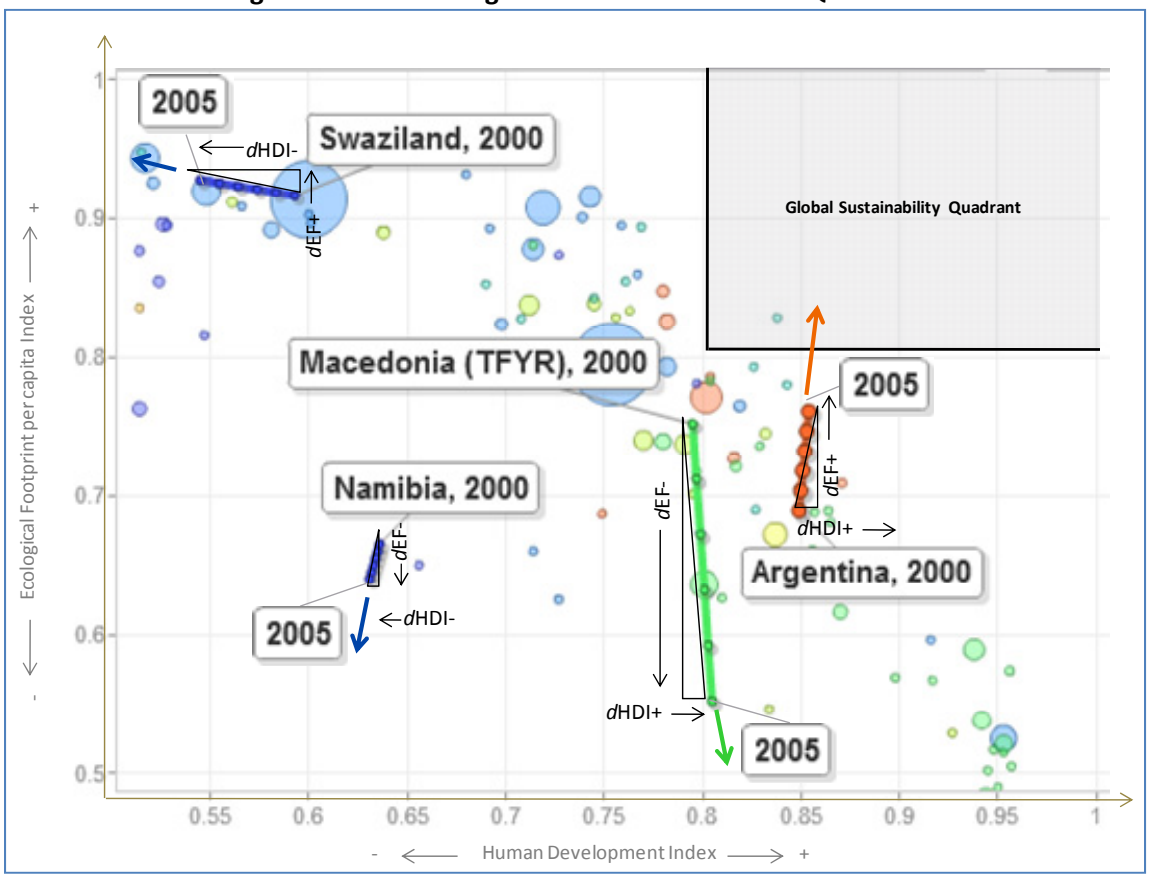
- Increase in HDI and increase in EF Index: +, +
- Increase in HDI and decrease in EF Index: + , –
- Decrease in HDI and increase in EF Index: –, +
- Decrease in HDI and decrease in EF Index: –, –

Naturally, a country that exhibits (+, +) movement is getting closer to the Quadrant, whereas a country that moves in the (–, –) direction is moving away from it. The challenge when attempting to rank countries according to their performance in time lies in dealing with (+ , –) and (–, +) movement, which depending on the magnitude of movement on each axis, could be moving closer to, or farther from, the Quadrant.

An approach[21] similar to the shortest-distance (hypotenuse) method used to calculate present-day Distance From the Quadrant was considered, but it was eventually discarded in favor of a simple sum of movement on both axes. Still, the two approaches yielded very similar country rank lists (between them, a Pearson correlation coefficient close to 0.9 was found on all three time periods). Figure 4-7 illustrates the calculation method for a sample of four countries, each exhibiting movement in one of the four possible directions.

[21] The approach calculated the difference in distance from the ultimate goal of EF Index = 1 and HDI = 1 on two distinct moments in time.

Figure 4-7: Calculating Movement Towards the Quadrant



Sample calculation of Movement Towards the Quadrant:

Argentina (2000-2005):	*d*HDI = +0.005,	*d*EF = +0.072,	Movement = +0.077
Macedonia (2000-2005):	*d*HDI = +0.010,	*d*EF = -0.200,	Movement = -0.190
Namibia (2000-2005):	*d*HDI = -0.005,	*d*EF = -0.025,	Movement = -0.030
Swaziland (2000-2005):	*d*HDI = -0.048,	*d*EF = +0.011	Movement = -0.037

Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008.

4.3.2. Limitations of the Movement Towards the Quadrant Approach

This approach ultimately aims to identify attributes that mutually advance (or hinder) both requirements of sustainable development (high HDI and low EF) in a country. Now, a particular country may show most of its movement on the HDI axis, whereas another one may show movement of the same magnitude mostly on the EF axis, and yet, they will be regarded by this approach as showing equal progress in the direction of the Quadrant. If, for example, a reduction in meat consumption per capita was found to be correlated with Movement Towards the Quadrant; does this mean that it correlates with simultaneous progress on both dimensions? Or is it correlated with only one of them, so strongly, that it overshadows the other? Unfortunately, answering these questions is beyond the scope if this work.

4.3.3. Historical Movement Towards the Quadrant Country Rank Lists

This section presents the country rank lists for historical movement on all three time periods analyzed. Unfortunately, historical HDI data for Cuba, the only country presently inside the Quadrant, is not available, so it could not be included in the analysis. Nevertheless, it is worth noting that Cuba's Ecological Footprint per capita is steadily increasing, so it very unlikely that it would have appeared among the top movers .

4.3.3.1. Long-term

The countries included in the long-term movement analysis are 69, which is the number of countries where both Ecological Footprint and Human Development Index figures are available for both 1980 and 2005. Thus, they constitute the only countries where it now is possible to estimate long-term movement towards the Global Sustainability Quadrant. Table 4-4 ranks these countries from largest overall Movement Towards the Quadrant, to largest overall movement away from it.

Table 4-4: Long-term (1980 to 2005) Movement Towards the Quadrant – Country Rank List

Note: Numbers in **bold** font on the Overall Movement column indicate (+, +) movement. Numbers in parenthesis indicate negative movement.

Source: Created by the author. Data from: Global Footprint Network, 2008; UNDP, 2008.

Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
Norway	0.328	0.067	**0.395**	1
Argentina	0.231	0.064	**0.295**	2
Nepal	0.017	0.213	**0.230**	3
Uruguay	0.150	0.080	**0.230**	4
Germany	0.148	0.072	**0.220**	5
Hungary	0.145	0.072	**0.217**	6
United Arab Emirates	0.057	0.158	**0.215**	7
Indonesia	0.010	0.199	**0.209**	8
Trinidad and Tobago	0.177	0.027	**0.204**	9
Egypt	(0.026)	0.229	0.203	10
Bangladesh	0.008	0.186	**0.194**	11
Finland	0.097	0.086	**0.183**	12
Morocco	0.010	0.167	**0.177**	13
Costa Rica	0.092	0.083	**0.175**	14
Bolivia	0.012	0.159	**0.171**	15
Swaziland	0.169	0.000	**0.169**	16
Brazil	0.050	0.118	**0.168**	17

Table 4-4 (continued)

Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
India	(0.006)	0.172	0.166	18
Guinea-Bissau	0.030	0.134	**0.164**	19
Canada	0.090	0.073	**0.163**	20
Paraguay	0.086	0.076	**0.162**	21
Pakistan	(0.001)	0.162	0.161	22
Guatemala	(0.003)	0.161	0.158	23
France	0.077	0.078	**0.155**	24
Syrian Arab Republic	0.018	0.130	**0.148**	25
Burundi	0.043	0.103	**0.146**	26
South Africa	0.131	0.014	**0.145**	27
El Salvador	(0.031)	0.175	0.144	28
Turkey	(0.026)	0.168	0.142	29
China	(0.090)	0.225	0.135	30
Denmark	0.066	0.068	**0.134**	31
Dominican Republic	0.006	0.123	**0.129**	32
Benin	0.016	0.105	**0.121**	33
Australia	0.027	0.093	**0.120**	34
Netherlands	0.050	0.069	**0.119**	35
Belgium	0.038	0.076	**0.114**	36
Iran	(0.100)	0.211	0.111	37
Rwanda	0.035	0.074	**0.109**	38
Peru	0.012	0.095	**0.107**	39
Venezuela	0.052	0.054	**0.106**	40
Haiti	0.022	0.084	**0.106**	41
Philippines	0.008	0.093	**0.101**	42
Malaysia	(0.064)	0.154	0.090	43
Singapore	(0.043)	0.132	0.089	44
Sri Lanka	(0.005)	0.092	0.087	45
Botswana	(0.031)	0.118	0.087	46
Switzerland	0.029	0.057	**0.086**	47
Sweden	0.008	0.075	**0.083**	48
Burkina Faso	(0.022)	0.103	0.081	49
Mozambique	(0.001)	0.080	0.079	50
Jordan	(0.057)	0.133	0.076	51

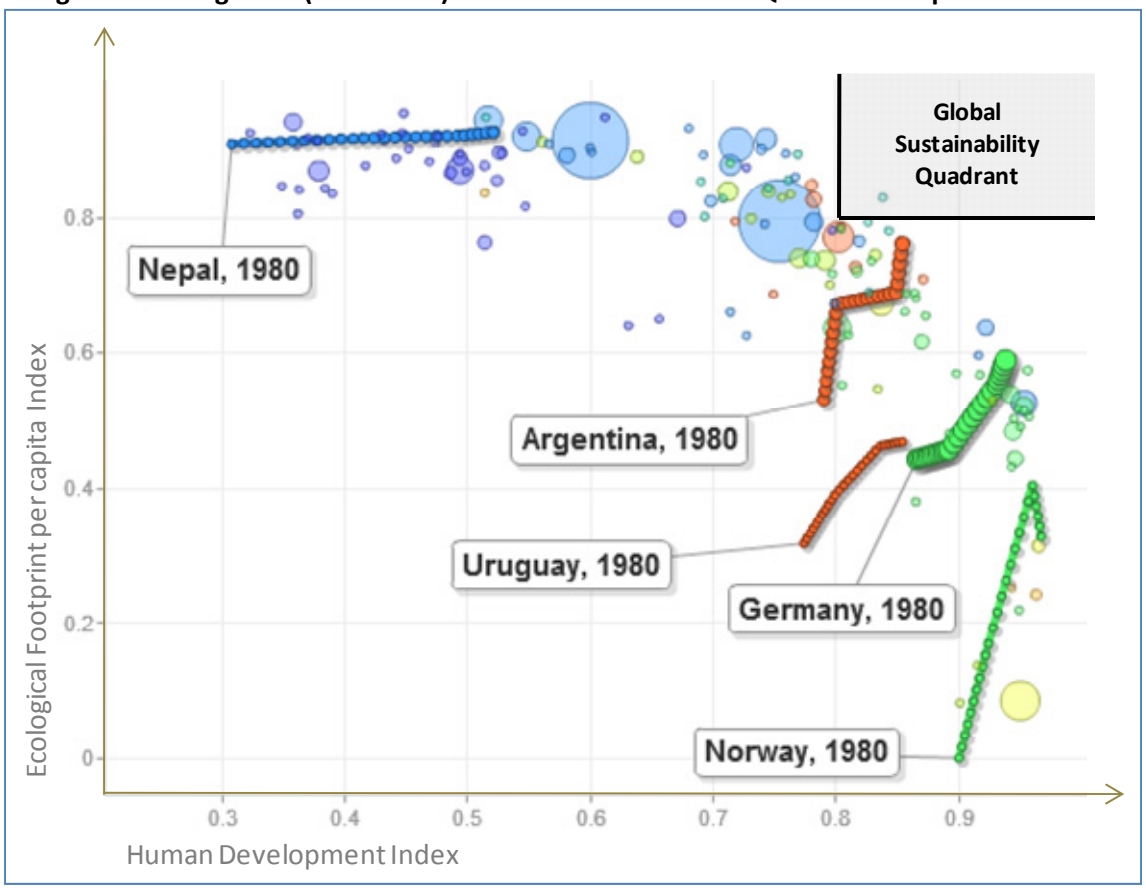
Table 4-4 (continued)

Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
Ecuador	(0.022)	0.097	0.075	52
Austria	(0.015)	0.084	0.069	53
Chile	(0.063)	0.125	0.062	54
Panama	(0.018)	0.071	0.053	55
Thailand	(0.089)	0.138	0.049	56
Ireland	(0.078)	0.121	0.043	57
Italy	(0.047)	0.087	0.040	58
Central African Republic	0.017	0.020	**0.037**	59
Mexico	(0.056)	0.089	0.033	60
United Kingdom	(0.056)	0.086	0.030	61
Portugal	(0.150)	0.134	(0.016)	62
Japan	(0.083)	0.067	(0.016)	63
New Zealand	(0.112)	0.083	(0.029)	64
United States	(0.095)	0.058	(0.037)	65
Spain	(0.159)	0.094	(0.065)	66
Greece	(0.210)	0.092	(0.118)	67
Israel	(0.245)	0.100	(0.145)	68
Kuwait	(0.724)	0.103	(0.621)	69

Figure 4-8 illustrates, on the EF vs. HDI plot, how the top 5 performers in the period have moved closer to the Quadrant. In turn, Figure 4-9 illustrates how the bottom 5 performers have moved away from the Quadrant during the same period (1980 to 2005).

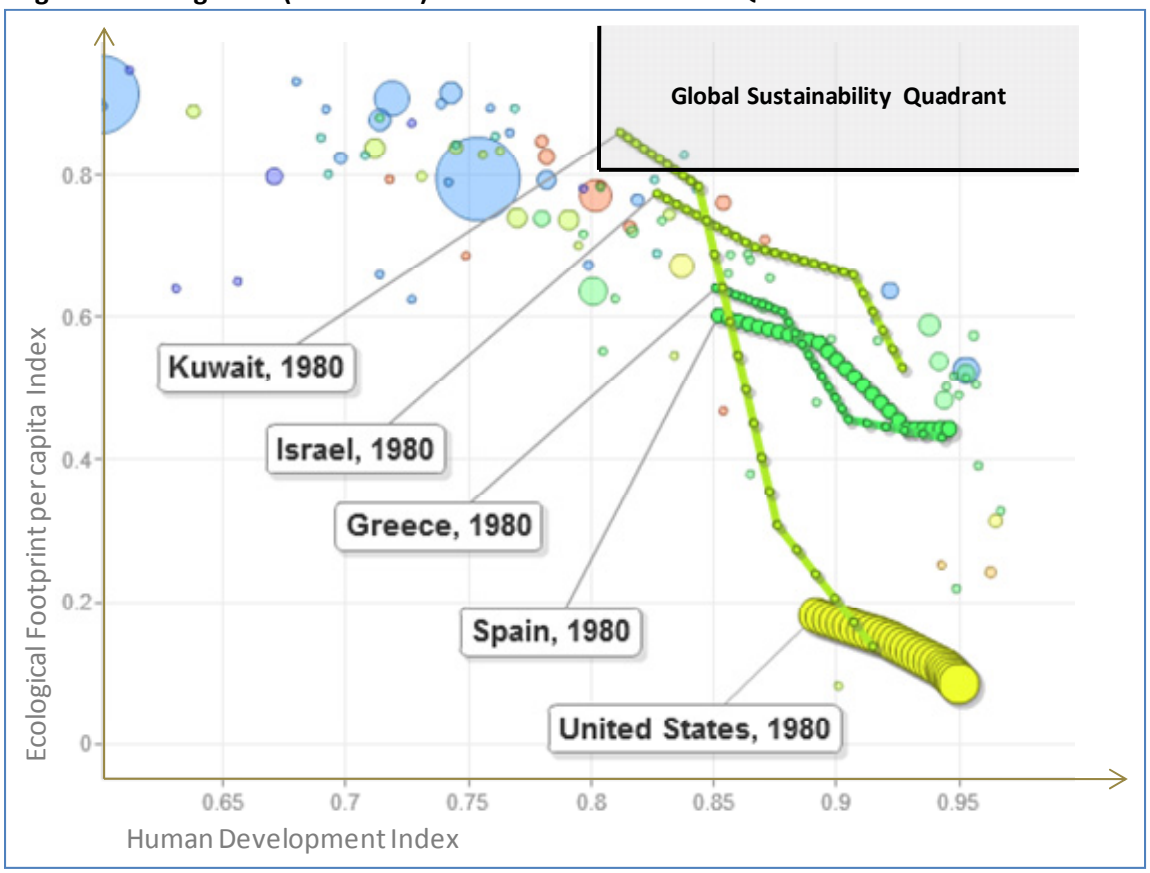
Notice that the 5 countries with the worst performance in the long term all show progress on the HDI; it is their drastically increasing ecological footprint what has taken them far away from the Sustainability Quadrant.

Figure 4-8: Long-term (1980-2005) Movement Towards the Quadrant – Top 5 Performers



Note: The countries' labels point to the period's starting year; the last point along the progression represents the period's end year (2005).
Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008.

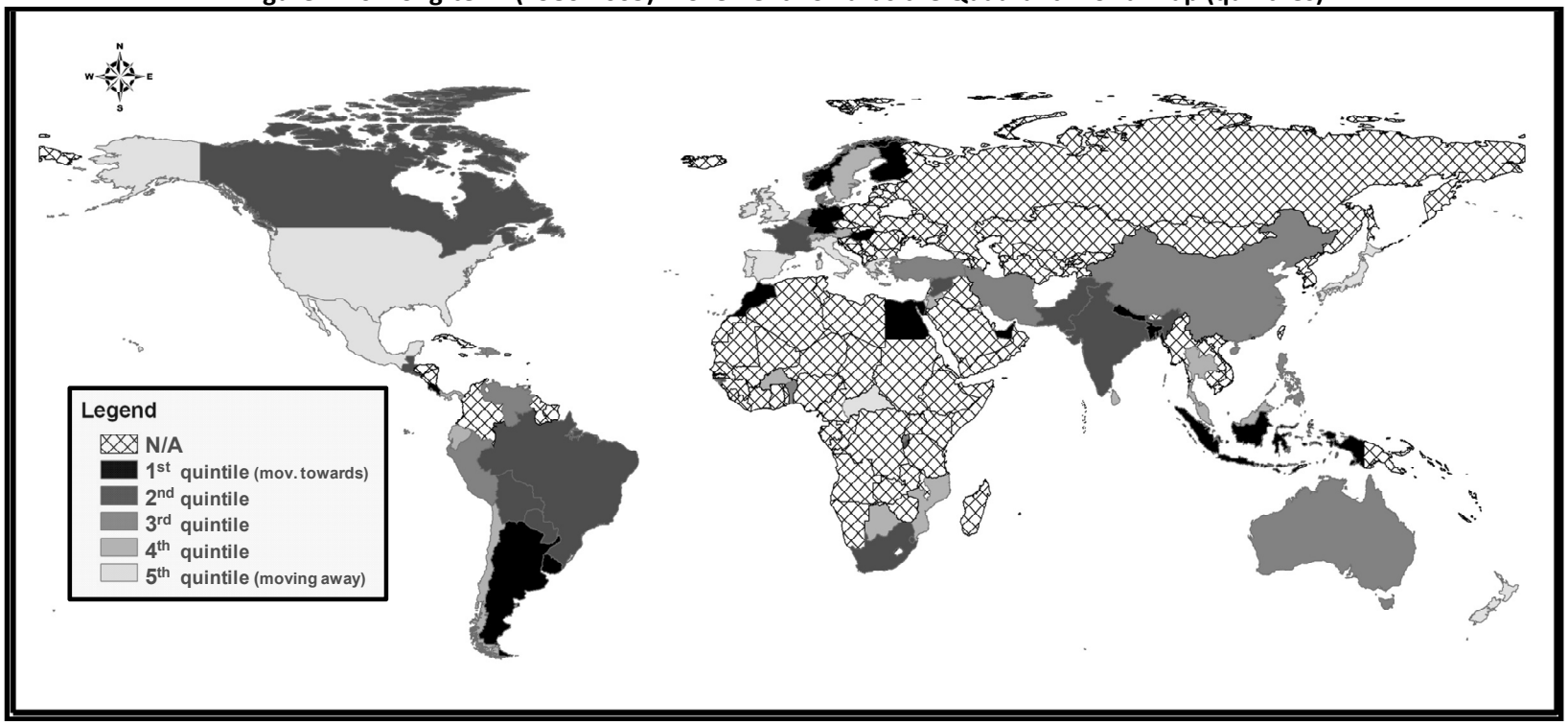
Figure 4-9: Long-term (1980-2005) Movement Towards the Quadrant – Bottom 5 Performers



Note: The countries' labels point to the period's starting year; the last point along the progression represents the period's end year (2005).
Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008.

Figure 4-10 is a world map where countries have been shaded according to their Long-term Movement Towards the Quadrant; darker shades indicate significant movement towards it (i.e., good performance over the period), whereas lighter shades indicate that the country is moving away from it.

Figure 4-10: Long-term (1980-2005) Movement Towards the Quadrant World Map (quintiles)



Source: Created by the author using ArcMap. Data from: Global Footprint Network, 2008; UNDP, 2008. World boundaries shapefile obtained from: DIVA-GIS, Thematic Mapping. *World Countries Boundary File, World, 2002*. Licensed under a Creative Commons Attribution 3.0 License. Downloaded from: http://finder.geocommons.com/overlays/5603

4.3.3.2. Medium-term

The countries included in the medium-term movement analysis are 83, which is the number of countries where both Ecological Footprint and Human Development Index figures are available for both 1990 and 2005. Thus, they constitute the only countries where it is now possible to estimate medium-term movement towards the Global Sustainability Quadrant. Table 4-5 ranks these countries from largest overall Movement Towards the Quadrant to largest overall movement away from it.

Table 4-5: Medium-term (1990 to 2005) Movement Towards the Quadrant – Country Rank List

Note: Numbers in **bold** font on the Overall Movement column indicate (+, +) movement. Numbers in parenthesis indicate negative movement.

Source: Created by the author. Data from: Global Footprint Network, 2008; UNDP, 2008.

Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
Canada	0.220	0.030	**0.250**	1
Singapore	0.151	0.066	**0.217**	2
Norway	0.159	0.043	**0.202**	3
Germany	0.133	0.046	**0.179**	4
Romania	0.124	0.037	**0.161**	5
Argentina	0.089	0.053	**0.142**	6
Guinea-Bissau	0.039	0.102	**0.141**	7
Guatemala	(0.001)	0.137	0.136	8
Hungary	0.072	0.062	**0.134**	9
Tunisia	(0.004)	0.131	0.127	10
Bangladesh	(0.003)	0.127	0.124	11
Nepal	0.009	0.114	**0.123**	12
Switzerland	0.080	0.036	**0.116**	13
Egypt	(0.025)	0.140	0.115	14
Chile	0.033	0.079	**0.112**	15
Morocco	(0.011)	0.122	0.111	16
Uganda	0.028	0.082	**0.110**	17
Finland	0.061	0.047	**0.108**	18
India	(0.001)	0.106	0.105	19
Rwanda	(0.004)	0.107	0.103	20
Indonesia	0.007	0.096	**0.103**	21
Brazil	0.009	0.094	**0.103**	22
Pakistan	(0.005)	0.105	0.100	23
Poland	0.034	0.065	**0.099**	24

Table 4-5 (continued)

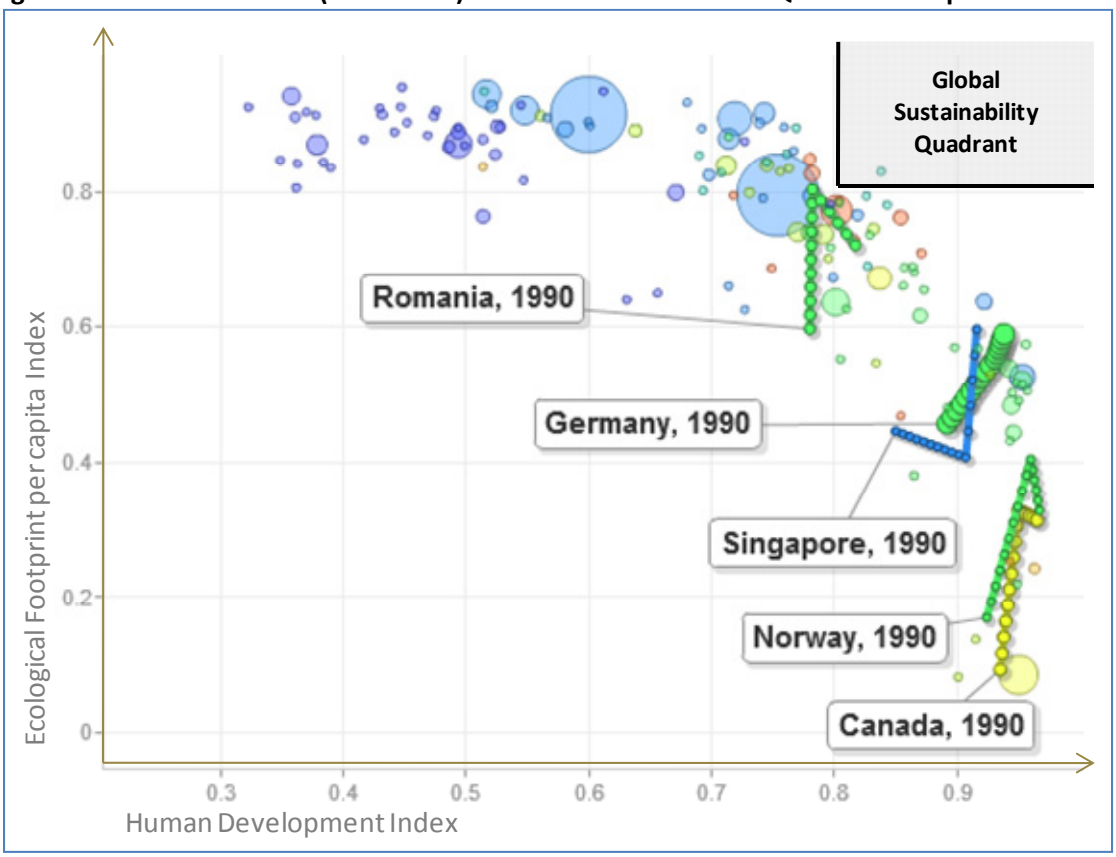
Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
Bolivia	0.008	0.091	**0.099**	25
Netherlands	0.051	0.040	**0.091**	26
Costa Rica	0.035	0.055	**0.090**	27
Colombia	0.008	0.079	**0.087**	28
Belgium	0.044	0.043	**0.087**	29
Paraguay	0.044	0.042	**0.086**	30
Mozambique	(0.003)	0.087	0.084	31
Malawi	0.021	0.062	**0.083**	32
Senegal	(0.001)	0.082	0.081	33
Benin	0.007	0.074	**0.081**	34
Algeria	(0.019)	0.100	0.081	35
Haiti	0.007	0.073	**0.080**	36
Dominican Republic	(0.018)	0.097	0.079	37
China	(0.070)	0.147	0.077	38
South Africa	0.103	(0.027)	0.076	39
Myanmar	(0.022)	0.096	0.074	40
Syrian Arab Republic	(0.035)	0.106	0.071	41
Tanzania	0.013	0.058	**0.071**	42
Turkey	(0.020)	0.091	0.071	43
Philippines	0.016	0.049	**0.065**	44
Denmark	0.013	0.051	**0.064**	45
Burundi	0.017	0.044	**0.061**	46
Viet Nam	(0.057)	0.117	0.060	47
El Salvador	(0.031)	0.090	0.059	48
France	0.012	0.045	**0.057**	49
Congo	0.029	0.027	**0.056**	50
Ireland	(0.026)	0.081	0.055	51
Venezuela	0.022	0.029	**0.051**	52
Peru	(0.024)	0.074	0.050	53
United Kingdom	(0.010)	0.056	0.046	54
United Arab Emirates	(0.022)	0.067	0.045	55
Ecuador	(0.019)	0.064	0.045	56
Burkina Faso	(0.023)	0.064	0.041	57
Sri Lanka	(0.016)	0.055	0.039	58

Table 4-5 (continued)

Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
Nigeria	(0.004)	0.042	0.038	59
Thailand	(0.054)	0.090	0.036	60
Australia	(0.031)	0.063	0.032	61
Italy	(0.024)	0.056	0.032	62
Japan	(0.009)	0.037	0.028	63
Saudi Arabia	(0.063)	0.090	0.027	64
Malaysia	(0.064)	0.083	0.019	65
Iran	(0.082)	0.099	0.017	66
Portugal	(0.054)	0.069	0.015	67
Côte d'Ivoire	0.017	(0.010)	0.007	68
Austria	(0.043)	0.050	0.007	69
Swaziland	0.072	(0.072)	(0.000)	70
Mexico	(0.068)	0.064	(0.004)	71
Panama	(0.073)	0.064	(0.009)	72
Central African Republic	0.008	(0.018)	(0.010)	73
Mauritius	(0.092)	0.080	(0.012)	74
Zambia	0.016	(0.034)	(0.018)	75
Sweden	(0.083)	0.053	(0.030)	76
United States	(0.065)	0.030	(0.035)	77
New Zealand	(0.098)	0.062	(0.036)	78
Spain	(0.121)	0.053	(0.068)	79
Trinidad and Tobago	(0.115)	0.029	(0.086)	80
Botswana	(0.067)	(0.024)	(0.091)	81
Greece	(0.177)	0.065	(0.112)	82
Namibia	(0.121)	(0.022)	(0.143)	83

Figure 4-11 illustrates, on the EF vs. HDI plot, how the top 5 performers in the period have moved closer to the Quadrant. In turn, Figure 4-12 illustrates how the bottom 5 performers have moved away from the Quadrant during the same period (1990 to 2005).

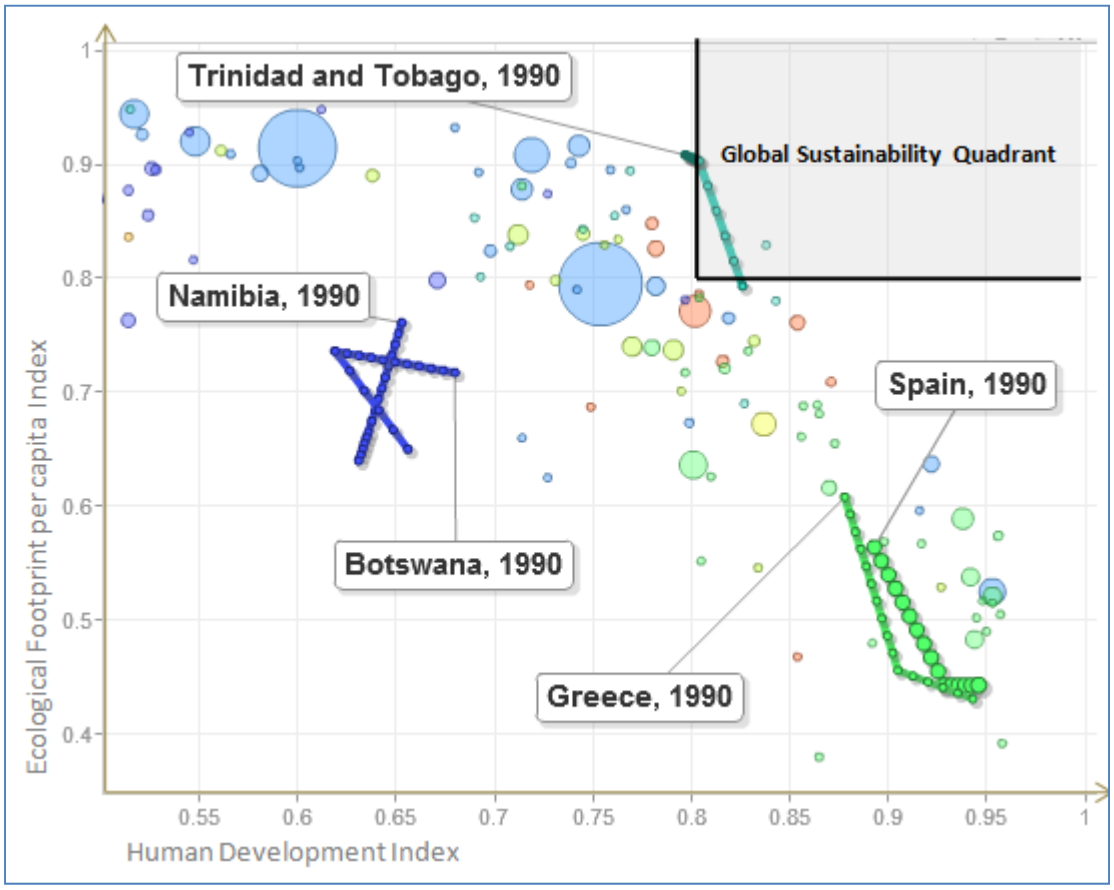
Figure 4-11: Medium-term (1990-2005) Movement Towards the Quadrant – Top 5 Performers



Note: The countries' labels point to the period's starting year; the last point along the progression represents the period's end year (2005).
Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008.

In Figure 4-11, notice that 3 of the top 5 performers (Romania, Norway, and Canada) in the medium term have actually reversed their positive movement in the last 5 years (by increasing their Ecological Footprint).

Figure 4-12: Medium-term (1990-2005) Movement Towards the Quadrant – Bottom 5 Performers

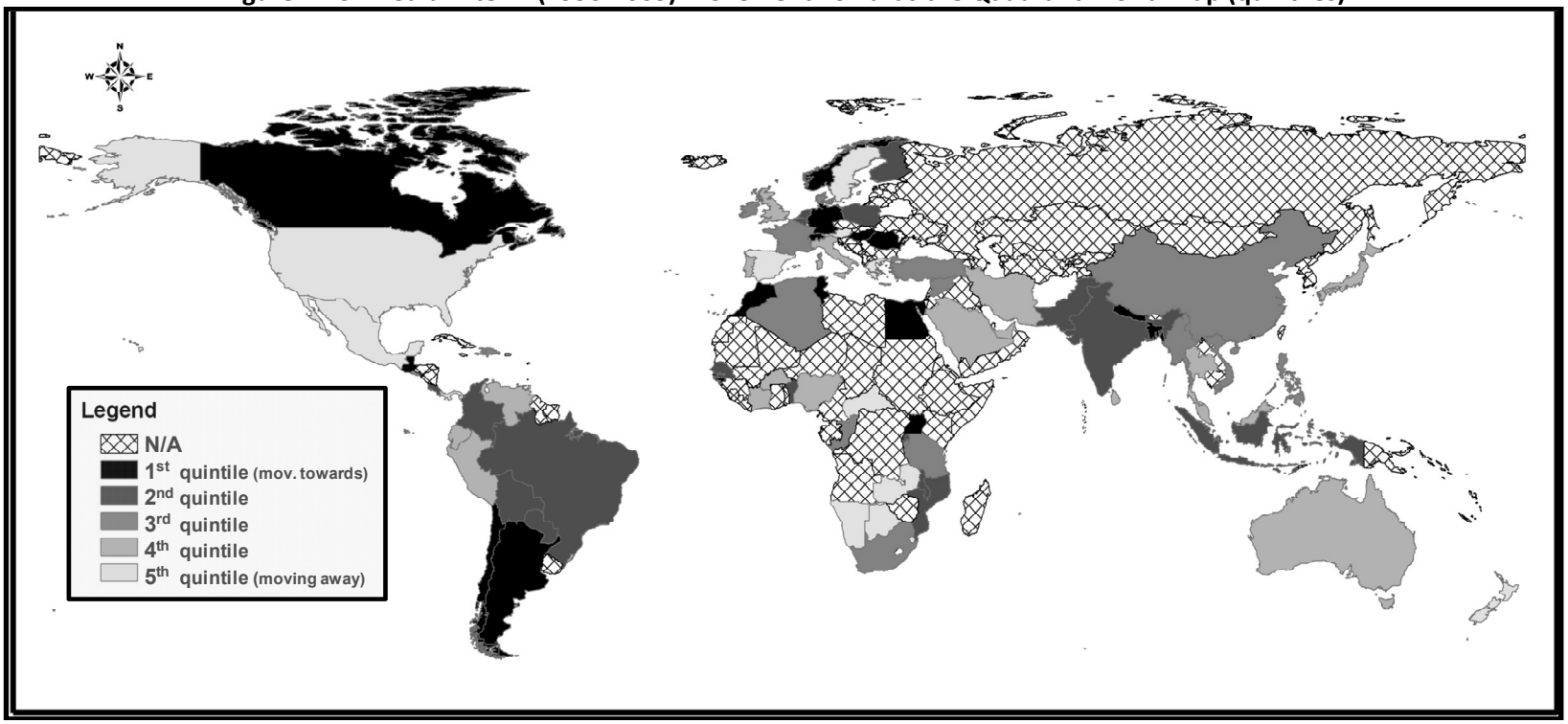


Note: The countries' labels point to the period's starting year; the last point along the progression represents the period's end year (2005).
Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008.

In Figure 4-12, notice Trinidad and Tobago's brief stint across the Quadrant; its increasing EF has taken it just outside it after 2004. Botswana's movement is also interesting, first moving in the (–,+) direction, and then completely reversing movement into the (+, –) direction, but moving away from the Quadrant overall.

Figure 4-13 is a world map where countries have been shaded according to their Medium-term Movement Towards the Quadrant; darker shades indicate significant movement towards it (i.e., good performance over the period), whereas lighter shades indicate that the country is moving away from it.

Figure 4-13: Medium-term (1990-2005) Movement Towards the Quadrant World Map (quintiles)



Source: Created by the author using ArcMap. Data from: Global Footprint Network, 2008; UNDP, 2008. World boundaries shapefile obtained from: DIVA-GIS, Thematic Mapping. *World Countries Boundary File, World, 2002*. Licensed under a Creative Commons Attribution 3.0 License. Downloaded from: http://finder.geocommons.com/overlays/5603

4.3.3.3. Short-term

The countries included in the short-term movement analysis are 121, which is the number of countries where both Ecological Footprint and Human Development Index figures are available for both 2000 and 2005. Thus, they constitute the only countries where it is now possible to estimate short-term movement towards the Global Sustainability Quadrant. Table 4-6 ranks these countries from largest overall Movement Towards the Quadrant to largest overall movement away from it. Numbers in **bold** font on the Overall Movement column indicate (+, +) movement.

Table 4-6: Short-term (2000 to 2005) Movement Towards the Quadrant – Country Rank List

Note: Numbers in **bold** font on the Overall Movement column indicate (+, +) movement. Numbers in parenthesis indicate negative movement.

Source: Created by the author. Data from: Global Footprint Network, 2008; UNDP, 2008.

Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
Singapore	0.189	0.009	**0.198**	1
Mongolia	0.115	0.038	**0.153**	2
Kyrgyzstan	0.099	0.013	**0.112**	3
Portugal	0.061	0.019	**0.080**	4
Argentina	0.072	0.005	**0.077**	5
Congo	0.017	0.052	**0.069**	6
Paraguay	0.053	0.015	**0.068**	7
Tunisia	(0.013)	0.079	0.066	8
Netherlands	0.057	0.007	**0.064**	9
Yemen	(0.002)	0.064	0.062	10
Nigeria	0.017	0.044	**0.061**	11
United Arab Emirates	0.009	0.049	**0.058**	12
Niger	(0.013)	0.070	0.057	13
Costa Rica	0.037	0.019	**0.056**	14
Laos	0.017	0.038	**0.055**	15
Indonesia	0.007	0.048	**0.055**	16
Cambodia	(0.001)	0.055	0.054	17
Tanzania	0.004	0.049	**0.053**	18
Brazil	0.040	0.013	**0.053**	19
Guinea-Bissau	0.017	0.035	**0.052**	20
Ethiopia	(0.006)	0.056	0.050	21
Rwanda	0.006	0.044	**0.050**	22
Madagascar	0.019	0.030	**0.049**	23
Mauritania	0.021	0.027	**0.048**	24

Table 4-6 (continued)

Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
France	0.035	0.013	**0.048**	25
Morocco	(0.012)	0.056	0.044	26
Uganda	0.011	0.033	**0.044**	27
Germany	0.036	0.007	**0.043**	28
Mali	0.000	0.041	**0.041**	29
India	0.002	0.039	**0.041**	30
Benin	0.012	0.028	**0.040**	31
Nicaragua	0.013	0.027	**0.040**	32
Switzerland	0.031	0.008	**0.039**	33
Turkey	0.002	0.037	**0.039**	34
Senegal	0.012	0.026	**0.038**	35
El Salvador	(0.002)	0.038	0.036	36
Zambia	(0.001)	0.037	0.036	37
Myanmar	0.006	0.030	**0.036**	38
Philippines	0.017	0.018	**0.035**	39
Honduras	0.003	0.031	**0.034**	40
Nepal	0.005	0.029	**0.034**	41
Guatemala	0.005	0.028	**0.033**	42
Venezuela	0.017	0.015	**0.032**	43
Malaysia	0.010	0.022	**0.032**	44
Congo (Democratic Rep.)	0.008	0.023	**0.031**	45
Bolivia	0.010	0.021	**0.031**	46
Dominican Republic	0.014	0.017	**0.031**	47
Chad	(0.002)	0.032	0.030	48
Bangladesh	0.002	0.028	**0.030**	49
Mauritius	0.002	0.028	**0.030**	49
Egypt	(0.017)	0.047	0.030	51
Tajikistan	(0.003)	0.032	0.029	52
Colombia	0.007	0.022	**0.029**	53
Uzbekistan	0.012	0.016	**0.028**	54
Malawi	0.022	0.003	**0.025**	55
New Zealand	0.009	0.016	**0.025**	56
Uruguay	0.006	0.018	**0.024**	57
Australia	0.011	0.012	**0.023**	58

Table 4-6 (continued)

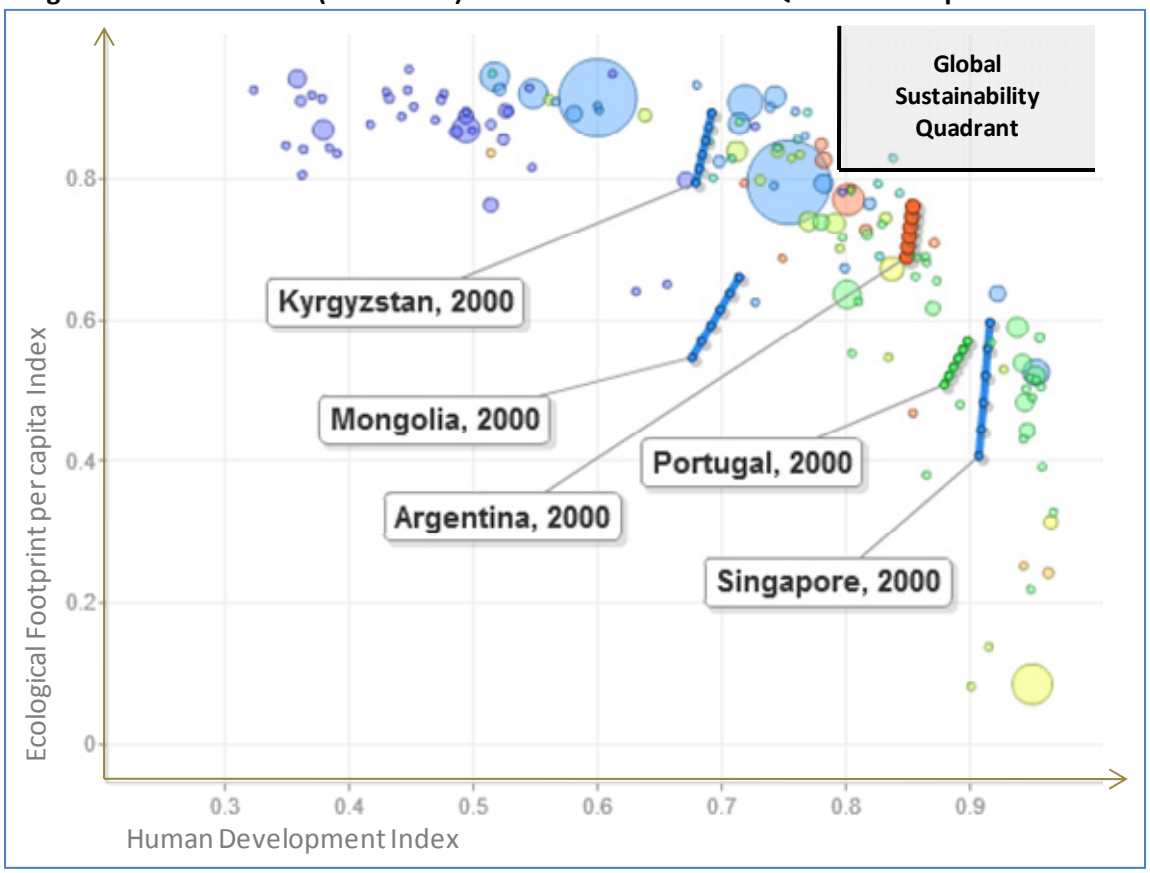
Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
Burkina Faso	(0.023)	0.045	0.022	59
Angola	(0.003)	0.024	0.021	60
Chile	(0.002)	0.023	0.021	61
Poland	0.000	0.018	**0.018**	62
Kenya	0.008	0.010	**0.018**	63
Spain	0.000	0.017	**0.017**	64
Côte d'Ivoire	0.016	(0.001)	0.015	65
Greece	(0.025)	0.038	0.013	66
Ireland	(0.014)	0.024	0.010	67
Burundi	(0.008)	0.018	0.010	68
Italy	(0.007)	0.017	0.010	69
Lithuania	(0.024)	0.034	0.010	70
Mozambique	(0.018)	0.028	0.010	71
Jamaica	(0.012)	0.020	0.008	72
Algeria	(0.025)	0.033	0.008	73
Bulgaria	(0.019)	0.027	0.008	74
Sri Lanka	(0.009)	0.016	0.007	75
Cameroon	0.000	0.006	**0.006**	76
Croatia	(0.021)	0.027	0.006	77
Latvia	(0.035)	0.039	0.004	78
Moldova	(0.031)	0.035	0.004	79
Belarus	(0.023)	0.025	0.002	80
Togo	0.002	(0.001)	0.001	81
Armenia	(0.031)	0.032	0.001	82
Ghana	(0.026)	0.027	0.001	83
Canada	(0.016)	0.015	(0.001)	84
Japan	(0.016)	0.012	(0.004)	85
South Africa	0.012	(0.016)	(0.004)	86
Sudan	(0.030)	0.025	(0.005)	87
Finland	(0.017)	0.012	(0.005)	88
Azerbaijan	(0.044)	0.037	(0.007)	89
China	(0.043)	0.036	(0.007)	90
Thailand	(0.040)	0.032	(0.008)	91
Central African Republic	0.007	(0.016)	(0.009)	92

Table 4-6 (continued)

Country	Eco Footprint Index Progress	HDI Progress	Overall Movement	Rank
Hungary	(0.040)	0.030	(0.010)	93
Viet Nam	(0.036)	0.026	(0.010)	94
Iran	(0.048)	0.035	(0.013)	95
Estonia	(0.046)	0.032	(0.014)	96
United Kingdom	(0.029)	0.015	(0.014)	97
United States	(0.021)	0.006	(0.015)	98
Austria	(0.024)	0.008	(0.016)	99
Denmark	(0.030)	0.013	(0.017)	100
Albania	(0.046)	0.027	(0.019)	101
Gabon	(0.039)	0.018	(0.021)	102
Belgium	(0.023)	0.002	(0.021)	103
Syrian Arab Republic	(0.039)	0.017	(0.022)	104
Georgia	(0.050)	0.026	(0.024)	105
Panama	(0.042)	0.018	(0.024)	106
Namibia	(0.025)	(0.005)	(0.030)	107
Swaziland	0.011	(0.048)	(0.037)	108
Ukraine	(0.068)	0.027	(0.041)	109
Czech Republic	(0.067)	0.025	(0.042)	110
Slovenia	(0.066)	0.024	(0.042)	111
Lesotho	(0.009)	(0.035)	(0.044)	112
Romania	(0.082)	0.035	(0.047)	113
Botswana	(0.086)	0.037	(0.049)	114
Slovakia	(0.076)	0.026	(0.050)	115
Norway	(0.076)	0.007	(0.069)	116
Trinidad and Tobago	(0.110)	0.022	(0.088)	117
Kazakhstan	(0.170)	0.053	(0.117)	118
Sweden	(0.133)	0.005	(0.128)	119
Kuwait	(0.171)	0.039	(0.132)	120
Macedonia (TFYR)	(0.200)	0.010	(0.190)	121

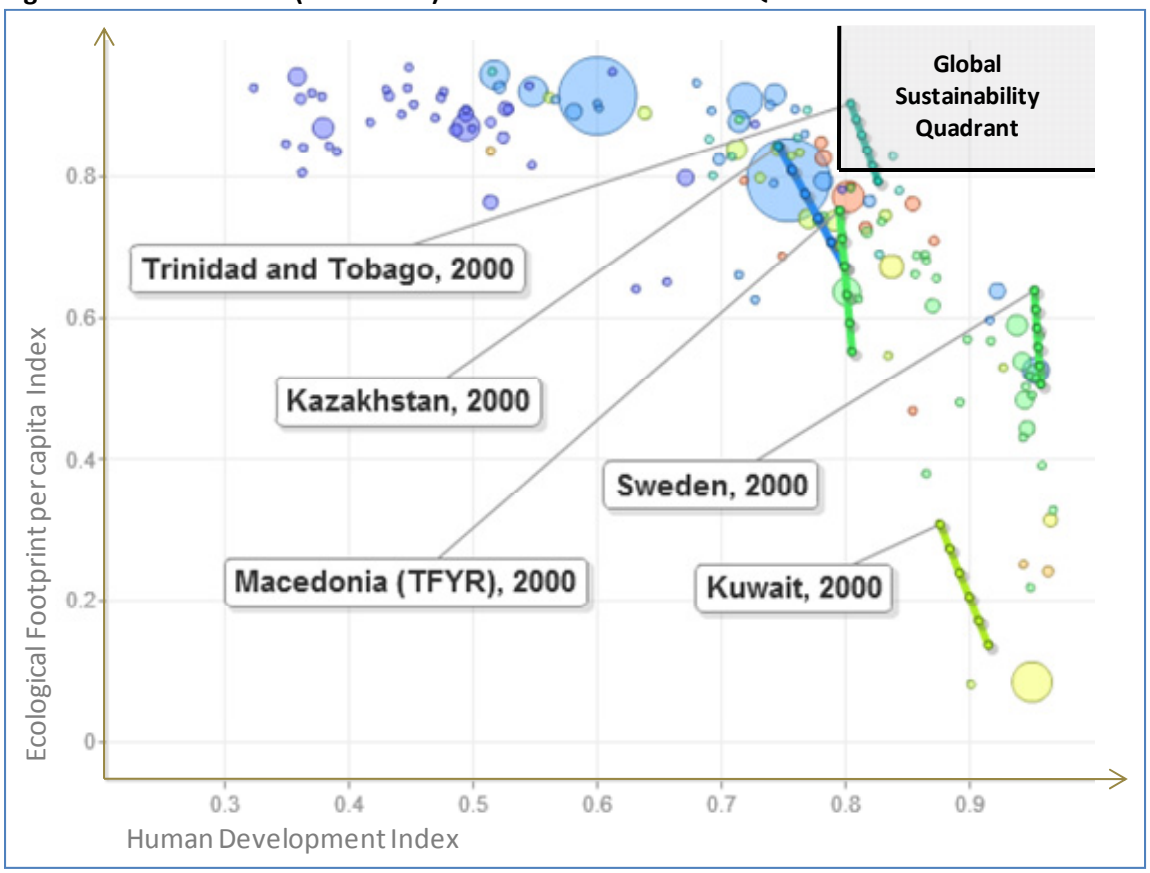
Figure 4-14 illustrates, on the EF vs. HDI plot, how the top 5 performers in the period have moved closer to the Quadrant. In turn, Figure 4-15 illustrates how the bottom 5 performers have moved away from the Quadrant during the same period (2000 to 2005).

Figure 4-14: Short-term (2000-2005) Movement Towards the Quadrant – Top 5 Performers



Note: The countries' labels point to the period's starting year; the last point along the progression represents the period's end year (2005).
Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008.

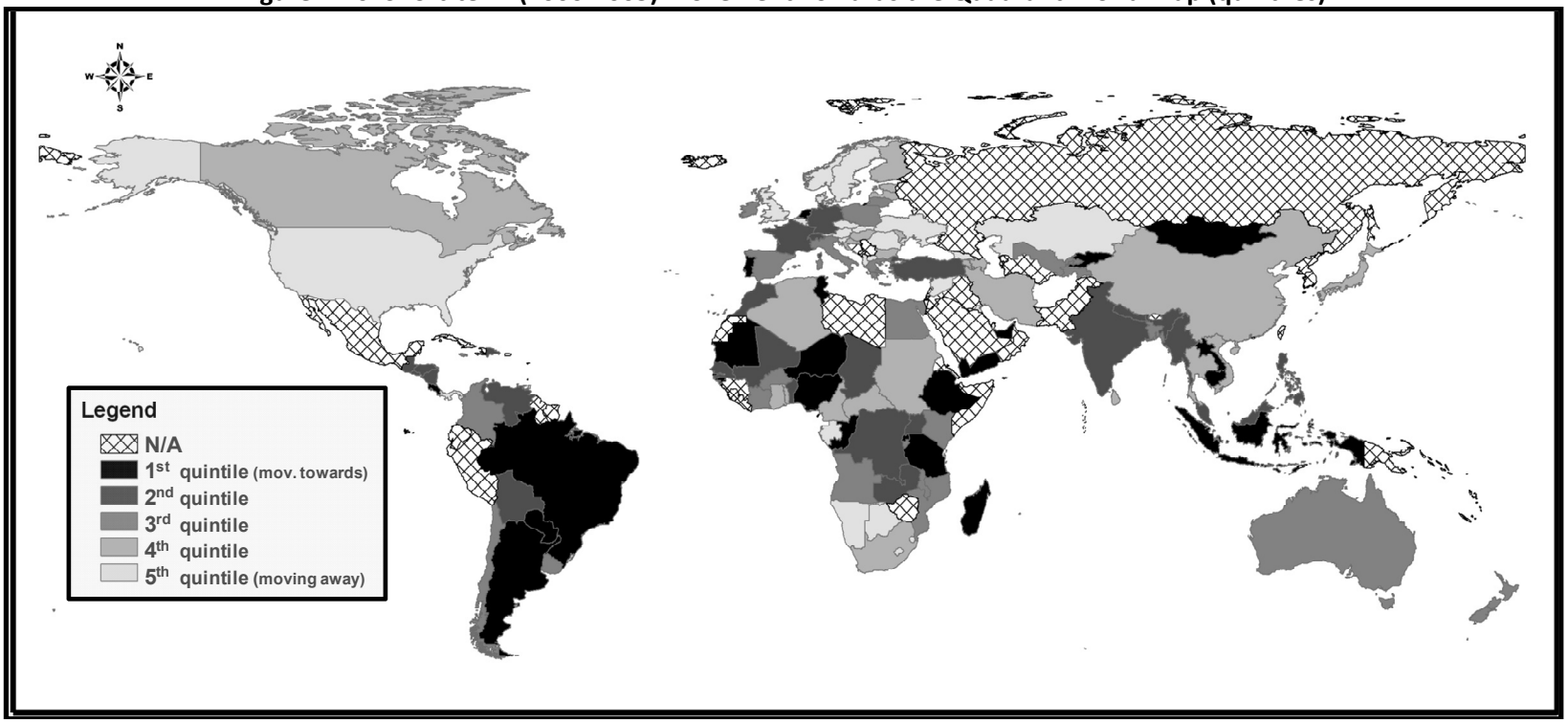
Figure 4-15: Short-term (2000-2005) Movement Towards the Quadrant – Bottom 5 Performers



Note: The countries' labels point to the period's starting year; the last point along the progression represents the period's end year (2005).
Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008.

Figure 4-16 is a world map where countries have been shaded according to their Short-term Movement Towards the Quadrant; darker shades indicate significant movement towards it (i.e., good performance over the period), whereas lighter shades indicate that the country is moving away from it.

Figure 4-16: Short-term (2000-2005) Movement Towards the Quadrant World Map (quintiles)



Source: Created by the author using ArcMap. Data from: Global Footprint Network, 2008; UNDP, 2008. World boundaries shapefile obtained from: DIVA-GIS, Thematic Mapping. *World Countries Boundary File, World, 2002*. Licensed under a Creative Commons Attribution 3.0 License. Downloaded from: http://finder.geocommons.com/overlays/5603

4.4. Analysis using Rank Lists and the Pearson Moment Correlation Function

A wide array of environmental, social, economic, and governance performance metrics – selected using the subsystems and elements listed in Table 2-3 as a guide – are tested for correlation with the rank lists obtained for Distance From the Quadrant and historical Movement Towards the Quadrant. This is done with the purpose of identifying the metrics that could be significantly associated with sustainable (or unsustainable) development, according to the Quadrant approach.

4.4.1. Creating Country Rank Lists for the Metrics to be Tested

For each individual metric selected, countries are ranked from the largest to the smallest value. For the historical movement analysis, the difference in value between the period's starting year and end year is calculated, and the countries are ranked according to overall progress. All gross measures were transformed to per capita values, or to percent of total land area where applicable, in order to make objective comparisons between nations (and so, to be able to rank the countries and create the lists for the analysis).

The purpose of using rank lists, instead of raw values, to test correlation, is to avoid errors caused by outliers. Nevertheless, it should be noted that using rank lists can somewhat alter the true distance that exists between different values.

The rank lists are created automatically by an Excel function; thus, for some metrics where a small value is 'good' (e.g., child mortality), the countries that figure in the top ranks are actually the ones that are worse off. This is why it is very important to examine the *Interpretation* column provided in the result tables (Chapter 5) before assuming that a correlation between a given metric and movement/distance relative to the Quadrant is positive or negative.

4.4.2. Finding Correlations Using Pearson's R

The relationship between each selected metric and movement/distance relative to the Quadrant is determined by calculating the **Pearson product–moment correlation coefficient (R)** between the two respective country rank lists. Pearson's R indicates "the degree to which a linear predictive relationship exists between two variables. If both variables increase together across countries, a positive correlation results in a value from 0 to +1.0. Conversely, an inverse relationship between the metrics would yield a negative correlation coefficient, between 0 and –1.0" (Wilson, et al., 2007).

The Pearson product-moment correlation coefficient is obtained using the following formula (3):

$$r = \frac{1}{n-1}\sum_{i=1}^{n}\left(\frac{X_i - \bar{X}}{s_X}\right)\left(\frac{Y_i - \bar{Y}}{s_Y}\right) \qquad (3)$$

Where:

X_i is the score (in our case, a given country's rank)

$\bar{X}$ is the sample mean

s_x is the sample's standard deviation

n is the number of countries in the sample

It should be noted that, for each specific metric, the analysis is performed considering only the countries where data are available for both the metric and distance/movement relative to the Quadrant. In other words, for each metric tested, the correlation considers only the countries present in both rank lists compared; these countries makes up the *sample*.

Figure 4-17 illustrates how the Pearson product-moment correlation is conducted using the rank lists for an individual metric and movement/distance relative to the Quadrant. This particular Figure describes how the correlation method is used to analyze the relationship between long-term (1980 to 2005) Movement Towards the Quadrant and the metric: meat consumption per capita. The correlation coefficient obtained (-0.4) indicates that countries that have increased their meat consumption per capita between 1980 and 2005, have tended to move *away* from the Quadrant.

Figure 4-17: Sample Analysis Using Pearson Moment Correlation and Rank Lists

	Eco Footprint Index	HDI	movement (1980 - 2005)	Rank
Norway	0.328	0.067	0.395	1
Argentina	0.231	0.064	0.295	2
Nepal	0.017	0.213	0.230	3
Uruguay	0.150	0.080	0.230	4
Germany	0.148	0.072	0.220	5
Hungary	0.145	0.072	0.217	6
United Arab Emirates	0.057	0.158	0.215	7
Indonesia	0.010	0.199	0.209	8
Trinidad and Tobago	0.177	0.027	0.204	9
Egypt	(0.026)	0.229	0.203	10

Correlation coefficient, R = -0.400

Meat Consumption per capita - Kg. per person				
	1980	2005	change	Rank
Denmark	84.9	145.9	61	1
Spain	71.5	118.6	47.1	2
Israel	51.6	97.1	45.5	3
Portugal	46.3	91.1	44.8	4
Brazil	41.7	82.4	40.7	5
China	14.6	52.4	37.8	6
Chile	32	66.4	34.4	7
Ireland	74.7	106.3	31.6	8
Malaysia	23.2	50.9	27.7	9
Ecuador	20.8	45	24.2	10

Note: The rank lists shown in the figure are incomplete. The complete lists contain the same set of countries.
Source: Created by the author. Data from: Global Footprint Network, 2008; UNDP, 2008; FAO, 2004.

4.4.3. Determining Statistical Significance for Pearson's R

"[T]he interpretation of a correlation coefficient depends on the context and purposes. A correlation of 0.9 may be very low if one is verifying a physical law using high-quality instruments, but may be regarded as very high in the social sciences where there may be a greater contribution from complicating factors…" (Cohen, 1988).

A full interpretation of any given metric's relationship with a concept as complex as global sustainability is a task beyond the scope of this work. Nevertheless, to determine the correlations' *statistical significance* is indeed a feasible task, and one that could serve as a stepping stone for more complete interpretations in the future.

Statistical significance for the Pearson moment correlation coefficient (R) is determined using a table of Critical Values for Pearson's R. Once the number of samples (n) and the correlation coefficient (R) are known, the desired alpha level, $P(H_0)$, has to be set. The alpha level indicates the "likelihood of being incorrect when we say the relationship we found in our sample reflects a relationship in the population." (Del Siegle, 2009). Explained in different terms, the alpha level determines the probability with which *the null hypothesis* (H_0) can be rejected. The null hypothesis suggests that the correlation coefficient (R) obtained for a number of samples (n) is actually a random occurrence (i.e., there is no actual correlation). If, for a given number of samples, R is greater than the corresponding critical value found in the table using an alpha level of 0.001, the null hypothesis can be rejected with 99.9% confidence.

The table of critical values for Pearson's R can be found in Appendix F.

4.5. Description of Data Sources

The Ecological Footprint (EF) and the Human Development Index (HDI) are the cornerstones of the analysis methodology proposed for this work. Present-day and historical data for both of these were obtained, respectively, from:

- Global Footprint Network. *National Footprint Accounts*. 2008 edition. (www.footprintnetwork.org.)
- United Nations Development Programme (UNDP). 2008. *Human Development Reports, 2008* (http://hdr.undp.org).

Aside from these measuring frameworks, a vast amount of metrics were selected to be tested for correlation with distance/movement relative to the Quadrant. This selection was made to include metrics that represent all of the subsystems and elements listed in Table 2-3 (Section 2.3.). Multiple metrics were found for most of the elements.

As indicated in Section 3.2.3., the number of countries that have both EF and HDI data for the latest available year (2005) is 142. The metrics were sourced for all the countries available within these 142.

4.5.1. Present-day Distance From the Quadrant – Metrics Tested

A total of 738 metrics were tested for correlation with present-day Distance From the Quadrant. Figures for the year 2005 were used in the analysis[22] whenever available; if not, the most recent available year was taken. The main data sources that were employed in the present-day analysis are:

- **The Compendium of Environmental Sustainability Indicator Collections compiled by Columbia University's Socioeconomic Data and Applications Center (SEDAC).** "The compendium includes several collections of national-level sustainability indicators," as well as 'raw' data/variables and aggregated indices." (SEDAC, 2007). This compendium includes a total of 411 metrics, which themselves were taken from the sources listed in Table 4-7.

[22] As of this publication, 2005 is the most recent year when complete country measures for both HDI and EF are available, so it has been taken to represent the 'present-day' in this work.

Table 4-7: Sources used in the SEDAC Compendium of Environmental Sustainability Indicator Collections

Source: Adapted from SEDAC, 2007.

Indicator Collection	Number of Metrics	Original Source
2006 Environmental Performance Index	39	Esty, D.C., M.A. Levy, T. Srebotnjak, A. de Sherbinin, C.H. Kim, and B. Anderson (2006). *Pilot 2006 Environmental Performance Index*. New Haven: Yale Center for Environmental Law & Policy.
2005 Environmental Sustainability Index	103	Esty, D.C., M. Levy, T. Srebotnjak, and Alexander de Sherbinin (2005). *2005 Environmental Sustainability Index: Benchmarking National Environmental Stewardship*. New Haven: Yale Center for Environmental Law & Policy.
2004 Environmental Vulnerability Index	111	Kaly, U.L., Pratt, C.R. and Mitchell, J. 2004. The Demonstration Environmental Vulnerability Index (EVI) 2004. SOPAC Technical Report 384.
Rio to Johannesburg Dashboard of Sustainability	35	O'Connor, J., and J. Jesinghaus. 2001. *Rio to Johannesburg Dashboard of Sustainability*, http://esl.jrc.it/envind/dashbrds.htm
The Wellbeing of Nations	123	Prescott-Allen, R. 2001. The Wellbeing of Nations: A Country-by-Country Index of Quality of Life and the Environment. Washington, DC: Island Press.

Among the indicators/metrics included in the compendium there are measures for: biodiversity, habitat and species conditions, wilderness protection, forest cover, forest resource use and management, land use, desertification, climate conditions, marine conditions, geographic conditions, energy sources, energy use, water resources, water use and access, air quality, soil quality, emissions to air, water, and soil, crops, livestock, agricultural inputs and outputs, subsidies, fishing, industry, mining, population, education, fertility, human health, mortality, disease, nutrition, sanitation, institutional capacity, environmental stewardship, governance, corruption, civil and political liberties, conflicts, violence, crime, poverty, gender issues, inequality, housing, development aid, international cooperation, eco-efficiency, recycling and waste, science and technology, transportation, urbanization, information technology, communications, natural hazards, markets, trade, investments, income, wealth, debt, and tourism.

To view the complete list of indicators/metrics obtained from this source, visit the SEDAC Compendium's website and download their Data Dictionary at: http://sedac.ciesin.columbia.edu/es/compendium.html

- **The World Resources Institute's Earth Trends Web Portal** (http://earthtrends.wri.org/). "Earth Trends is a comprehensive online database, maintained by the World Resources Institute, that focuses on the environmental, social, and economic trends that shape our world." (World

Resources Institute, 2009). Table 4-8 lists the 220 metrics used in this analysis that were sourced from Earth Trends' vast wealth of data.

Table 4-8: List of Present-Day Metrics Sourced from the Earth Trends Web Portal

Source: Compiled by the author.

#	Metric	Year
1	Total population, both sexes	2005
2	Land: Total area	2005
3	Civil liberties index	2005
4	Control of Corruption Index	2005
5	Level of freedom index	2005
6	Political rights index	2005
7	Political Stability and Absence of Violence Index	2005
8	Press freedom index	2005
9	Regulatory Quality Index	2005
10	Religious freedom index	2000
11	Rule of Law Index	2005
12	Foreign direct investment, net inflows	2005
13	Transnational Corporations: Number of foreign affiliates	1993-2005
14	Transnational Corporations: Number of parent enterprises	1993-2005
15	Investment in telecommunications	2005
16	Density of international non-governmental organizations with membership	2003
17	Corruption: Bribe Payer's Index	2006
18	Corruption perceptions index	2005
19	Present value of debt as a percent of GNI	2005
20	Total debt service	2005
21	Total debt service as a percent of export earnings	2005
22	Total external debt	2005
23	(External)Aid as a percent of government expenditure	2005
24	Aid (received) per capita	2005
25	Government cash deficit/surplus as a percent of GDP	2005
26	Government consumption expenditure as a percent of GDP	2005
27	Military expenditure as a percent of GDP	2005
28	Military expenditure as a percent of government expenditure	2005
29	Public education expenditure as a percent of GDP	2005
30	Public health expenditure as a percent of GDP	2005
31	Cost to register property	2005
32	Cost to start a new business	2005
33	Time required to register property	2005

Table 4-8 (continued)

#	Metric	Year
34	Time required to start a new business	2005
35	Water Poverty Index	2002
36	Organic water pollutant (BOD) emissions	2002
37	Internal Renewable Water Resources (IRWR): Dependency ratio	1960-2007
38	Access to an improved water source	2004
39	Access to improved sanitation	2004
40	Rural access to an improved water source	2004
41	Rural access to improved sanitation	2004
42	Urban access to an improved water source	2004
43	Urban access to improved sanitation	2004
44	Carbon monoxide emissions	2000
45	Nitrogen oxides emissions	2000
46	Non-methane VOC emissions	2000
47	Sulfur dioxide emissions	2000
48	Cumulative emissions from land use change	1950-2000
49	CO2 emissions per capita	2004
50	Residential CO2 emissions per capita	2003
51	CO2 emissions per GDP	2004
52	Non-CO2 Greenhouse Gas Emissions: Fluorinated gases	2000
53	Non-CO2 Greenhouse Gas Emissions: Methane	2000
54	Non-CO2 Greenhouse Gas Emissions: Nitrous oxide	2000
55	Cellular mobile telephone subscribers per 1000 people	2005
56	Homes with personal computers	2004
57	Homes with telephones	2004
58	Internet users per 1000 people	2005
59	Television sets per 1000 people	2005
60	AIDS/HIV: Antiretroviral therapy coverage	2005
61	AIDS/HIV: Adults and children living with HIV	2005
62	Average annual reduction in under-5 mortality	1990-2005
63	Infant mortality rate	2005
64	Stunting in children under 5--moderate and severe	1996-2005
65	Under-5 mortality rate	2005
66	Underweight children under 5--moderate and severe	1996-2005
67	Wasting in children under 5--moderate and severe	1996-2005
68	Crude birth rate	2005-2010
69	Crude death rate	2005-2010

Table 4-8 (continued)

#	Metric	Year
70	Life expectancy at birth, both sexes	2005-2010
71	Net number of migrants	2005-2010
72	Total fertility rate	2005-2010
73	Internally displaced persons	2006
74	Average length of schooling, both sexes	2004
75	Primary school net enrollment ratio	2004
76	Secondary school gender parity in gross enrollment	2004
77	Secondary school net enrollment ratio	2004
78	Tertiary school gross enrollment ratio, female	2004
79	Lack of Durability of Housing	2001
80	% Owner Occupied Housing Units, Rural	1984-1999
81	% Owner Occupied Housing Units, Urban	1984-1999
82	Lack of Sufficient Living Area	2001
83	Percent of urban population living in slums	2001
84	Women Headed Households, Percent of Total	1990-1999
85	Agricultural labor force as a percent of total labor force	2004
86	Female professional and technical workers, percent of total	1994-2005
87	Female literacy rate as a percentage of male literacy rate	2000-2004
88	Literacy rate, all adults	2000-2004
89	Literacy rate, youth (age 15 to 24)	2000-2004
90	Population above age 65, both sexes	2005
91	Population below age 15, both sexes	2005
92	Growth rate of total population	2005-2010
93	Population density	2005
94	Alcohol consumption per capita	2003
95	Contraceptive prevalence rate	1986-2004
96	Women with unmet need for family planning	1986-2004
97	Government expenditure on health as a percent of total expenditure on health	2003
98	Per capita total expenditure on health	2003
99	Solid fuel use	2004
100	Passenger cars per 1000 people	2003
101	Deaths due to road accidents	2000
102	Pump prices for diesel fuel	2002
103	Pump prices for super gasoline	2002
104	Road traffic, million vehicle-kilometers	2000
105	Total road network	2000

Table 4-8 (continued)

#	Metric	Year
106	Total vehicles per km road	2000
107	Volume of public road transport	2000
108	Growth rate of rural population	2005-2010
109	Growth rate of urban population	2005-2010
110	Total population in cities with more than 100,000 inhabitants	2002
111	Total population in cities with more than one million inhabitants	2002
112	Urban population as a percent of total population	2005
113	Share of total household expenditure, education	2005
114	Base of the Pyramid: Share of total household expenditure, energy	2005
115	Base of the Pyramid: Share of total household expenditure, food	2005
116	Base of the Pyramid: Share of total household expenditure, health	2005
117	Base of the Pyramid: Share of total household expenditure, household goods	2005
118	Base of the Pyramid: Share of total household expenditure, housing	2005
119	Base of the Pyramid: Share of total household expenditure, information and communication technology	2005
120	Base of the Pyramid: Share of total household expenditure, transportation	2005
121	Base of the Pyramid: Share of total household expenditure, water	2005
122	Aid as a percent of GNI	2005
123	Financial Flows: Net Inflows (sales - purchases) of Cross-Border Mergers and Acquisitions	2004
124	GDP per capita, annual growth rate	2005
125	GDP per capita, PPP, current international dollars	2005
126	GDP: Official exchange rate	2005
127	Percent GDP from agriculture	2005
128	Percent GDP from industry	2005
129	Percent GDP from manufacturing	2005
130	Percent GDP from services	2005
131	GNI: PPP, current international dollars	2005
132	Income Equality: Gini Index	1992-2005
133	Share of total income, highest 20% of population	1992-2005
134	Share of total income, fourth 20% of population	1992-2005
135	Share of total income, lowest 20% of population	1992-2005
136	Share of total income, second 20% of population	1992-2005
137	Share of total income, third 20% of population	1992-2005
138	Workers' remittances and compensation of employees, paid	2005

Table 4-8 (continued)

#	Metric	Year
139	Workers' remittances and compensation of employees, received	2005
140	Micro, Small, and Medium Enterprises: MSME employment, percent of total	1994-2005
141	Micro, Small, and Medium Enterprises: MSMEs per 1000 people	1994-2005
142	Adjusted Net Savings, percent of GNI	2005
143	National poverty rates	1987-2006
144	National poverty rates, rural population	1991-2006
145	National poverty rates, urban population	1991-2006
146	International tourism expenditures	2005
147	International tourism receipts	2005
148	Trade in Forest Products: Imports, value	2005
149	Trade in Goods and Services: Current account balance	2005
150	Trade in Fish and Fisheries Products: Exports, quantity	2005
151	Trade in Fish and Fisheries Products: Imports, quantity	2005
152	Trade in Goods and Services: Net trade in goods and services (balance of trade)	2005
153	Trade in Goods: Agricultural raw materials exports as a percent of merchandise exports	2005
154	Trade in Goods: Agricultural raw materials imports as a percent of merchandise imports	2005
155	Trade in Goods: Food exports as a percent of merchandise exports	2005
156	Trade in Goods: Food imports as a percent of merchandise imports	2005
157	Trade in Goods: Fuel exports as a percent of merchandise exports	2005
158	Trade in Goods: Fuel imports as a percent of merchandise imports	2005
159	Trade in Goods: Manufactures exports as a percent of merchandise exports	2005
160	Trade in Goods: Manufactures imports as a percent of merchandise imports	2005
161	Electricity consumption per capita	2005
162	Total electricity production	2005
163	Energy Consumption by Source: Biogas and liquid biomass	2003
164	Energy Consumption by Source: Coal and coal products	2005
165	Energy Consumption by Source: Hydroelectric	2005
166	Energy Consumption by Source: Natural gas	2005
167	Energy Consumption by Source: Oil and petroleum products	2005
168	Energy Consumption by Source: Solar, wind, and wave	2003
169	Energy Consumption by Source: Solid biomass (includes fuelwood)	2003

Table 4-8 (continued)

#	Metric	Year
170	Residential energy consumption per capita	2005
171	Total energy consumption per capita	2005
172	Total energy production	2005
173	Paper and paperboard consumption per capita	2005
174	Diesel oil consumption per capita	2003
175	Motor gasoline consumption per capita	2003
176	Protected Areas: IUCN categories I-V, percent of total land area	2006
177	Protected Areas: IUCN categories I-VI and Other, percent of total land area	2006
178	Protected Areas: Larger than 100,000 hectares, number	2006
179	Protected Areas: Marine and Littoral, number	2006
180	Fertilizer use intensity	2005
181	Pesticide use intensity	2000
182	Agricultural Inputs: Tractor use intensity	2003
183	Agricultural Inputs: Water use intensity	2000
184	Food production per capita index	2005
185	Agricultural Production Indices: Total production per capita index	2005
186	Agricultural Production: Cereals, yield	2005
187	Agricultural Production: Cereals, total production	2005
188	Agricultural Production: Roots and tubers, yield	2005
189	Food Aid: Cereals donated by country	2005
190	Food Aid: Cereals received by country	2005
191	Irrigated land as a percent of total agricultural area	2003
192	Cattle stocks	2005
193	Chicken stocks	2005
194	Equine (horses, mules, asses) stocks	2005
195	Goat stocks	2005
196	Sheep stocks	2005
197	Swine stocks	2005
198	Turkey stocks	2005
199	Meat Consumption: Per capita	2002
200	Meat production per capita	2005
201	Percentage of population that is undernourished	2002-2004
202	Calorie supply per capita	2003
203	Calorie supply per capita from animal products	2002
204	Grain fed to livestock as a percent of total grain consumed	2005

Table 4-8 (continued)

#	Metric	Year
205	Number of organic farms	2005-2006
206	Organic land area as a percent of total agricultural area	2005-2006
207	Food exports as a percent of merchandise exports	2005
208	Dryland area as a percent of total area, average	1999
209	Ecosystem Area: Barren or sparsely vegetated area	1992-1993
210	Urban and built-up areas	2000
211	Paper Production: Recovered paper	2005
212	Paper Production: Paper and paperboard	2005
213	Forest area (current) as a percent of original forest area	1996
214	Forest area (original) as a percent of total land area	1996
215	Forest plantations area, average annual percent change	2000-2005
216	Frontier forest area as a percent of original forest area	1996
217	Mangrove forest area	1997
218	Forest Extent: Natural forest area	2005
219	Total forest area	2005
220	Paper and paperboard consumption per capita	2005

The original sources for these metrics are listed in Appendix B. Visit http://earthtrends.wri.org/ for more information about these metrics, including complete definitions, technical notes, methodologies, and other relevant information.

- A large number of metrics were taken from the database compiled by the **United Nations Development Programme (UNDP) for their *Human Development Reports, 2008***. Table 4-9 lists the 62 metrics used in the present-day analysis that were sourced from this database.

Table 4-9: List of Metrics Sourced from the UNDP's Human Development Reports

Source: Compiled by the author.

#	Metric	Year
1	Adult literacy rate (% aged 15 and older)	1995-2005
2	Armed forces, index (1985=100)	2007
3	Biomass and waste used for power (% of total primary energy supply)	2005
4	Births attended by skilled health personnel (%)	1997-2005
5	Carbon intensity of energy (kt CO2 per kt of oil equivalent)	2004
6	Carbon intensity of growth (kt CO2 per million 2000 PPP US$)	2004
7	Carbon stocks in forests (living biomass) (Mt C)	2005
8	Cellular subscribers (per 1,000 people)	2005
9	CO2 emissions, average annual change (%)	1994-2004
10	CO2 emissions/sequestration from forests (Mt CO2 per year)	1990-2005

Table 4-9 (continued)

#	Metric	Year
11	Coal (% of total primary energy supply)	2005
12	Current public expenditure on education, pre-primary and primary (as % of all levels)	2002-2005
13	Current public expenditure on education, secondary (% of all levels)	2002-2005
14	Current public expenditure on education, tertiary (% of all levels)	2002-2005
15	Debt service, total (% of exports of goods, services and net income from abroad)	2005
16	Debt service, total (% of GDP)	2005
17	Electricity consumption per capita (% change)	2004
18	Employment in agriculture (% of total employment)	2005
19	Employment in industry (% of total employment)	2005
20	Employment in non-agricultural informal sector, both sexes (%)	1990-2004
21	Employment in services (% of total employment)	2005
22	Employment, total (thousands)	2005
23	Exports of goods and services (% of GDP)	2005
24	Fertility rate, total (births per woman)	2005
25	Foreign direct investment, net inflows (% of GDP)	2005
26	Forest area (% total land) 2005 Forest area, average annual change (%)	1990-2005
27	Gas (% of total primary energy supply)	2005
28	GDP per capita (PPP US$)	2005
29	GDP per unit of energy use (% change)	1990-2004
30	GDP per unit of energy use (2000 PPP US$ per kg of oil equivalent)	2004
31	Gender empowerment measure (GEM) value	2005
32	Gender-related development index (GDI) rank	2005
33	Gender-related development index (GDI) value	2005
34	Health expenditure per capita (PPP US$)	2006
35	Hydro, solar, wind and geothermal power (% of total primary energy supply)	2005
36	Imports of goods and services (% of GDP)	2005
37	Long-term unemployment (% of labor force)	2006
38	Manufactured exports (% of merchandise exports)	2005
39	Maternal mortality ratio, adjusted (per 100,000 live births)	2000
40	Official development assistance per capita of donor country (2005 US$)	2005
41	Official development assistance received (net disbursements) (% of GDP)	2005
42	Official development assistance received (net disbursements) per capita (US$)	2005

Table 4-9 (continued)

#	Metric	Year
43	Oil (% of total primary energy supply)	2005
44	Patents granted to residents (per million people)	2005
45	Physicians (per 100,000 people)	2004
46	Population aged 65 and older (% of total population)	2005
47	Population under age 15 (% of total population)	2005
48	Population undernourished (% of total population)	2004
49	Population using an improved water source (%)	2004
50	Population using improved sanitation (%)	2004
51	Population without electricity (millions)	2005
52	Private expenditure on health (% of GDP)	2004
53	Public expenditure on education (% of total government expenditure)	2002-2005
54	Refugees by country of asylum (thousands)	2006
55	Refugees by country of origin (thousands)	2006
56	Research and development expenditure (% of GDP)	2005
57	Researchers in R&D (per million people)	2005
58	Telephone mainlines (per 1,000 people)	2005
59	Tertiary students in science, engineering, manufacturing, and construction (%)	1999-2005
60	Total primary energy supply (TPES) (Mt of oil equivalent)	2005
61	Unemployment rate Total (% of labor force)	2006
62	Unemployment rate Total (% of labor force)	2005

Complete information about these metrics, including original sources and measuring methods, can be viewed on the statistics section of the Human Development Report's website: http://hdr.undp.org/en/statistics/data/

- The individual components of the 2005 Ecological Footprint were also tested for correlation with present-day Distance From the Quadrant. They were taken from the **Global Footprint Network, *National Footprint Accounts*, 2008 edition**. Table 4-10 lists these 30 individual components.

Table 4-10: List of Individual Components of the 2005 Ecological Footprint

Source: Compiled by the author.

#	Ecological Footprint or Biocapacity Component
1	Footprint of local production per capita
2	Footprint of imports per capita
3	Footprint of exports per capita
4	Footprint of local production - % of total ecological footprint
5	Footprint of imports - % of total ecological footprint
6	Footprint of exports - % of total ecological footprint
7	Cropland footprint per capita
8	Grazing footprint per capita
9	Forest footprint per capita
10	Fishing footprint per capita
11	Carbon footprint per capita
12	Built-up land footprint per capita
13	Cropland footprint - % of total ecological footprint
14	Grazing footprint - % of total ecological footprint
15	Forest footprint - % of total ecological footprint
16	Fishing footprint - % of total ecological footprint
17	Carbon footprint - % of total ecological footprint
18	Built-up land footprint - % of total ecological footprint
19	Cropland biocapacity per capita
20	Grazing biocapacity per capita
21	Forest biocapacity per capita
22	Fishing biocapacity per capita
23	Carbon biocapacity per capita
24	Built-up land biocapacity per capita
25	Cropland biocapacity - % of total biocapacity
26	Grazing biocapacity - % of total biocapacity
27	Forest biocapacity - % of total biocapacity
28	Fishing biocapacity - % of total biocapacity
29	Carbon biocapacity - % of total biocapacity
30	Built-up land biocapacity - % of total biocapacity

- Data from the National Water Footprints were employed in the analysis as well. These data were taken from **Hoekstra, A.Y. and Chapagain, A.K. (2008)** ***Globalization of water: Sharing the planet's freshwater resources*****, Blackwell Publishing, Oxford, UK**. The Water Footprint and its components are measured in units of water volume per capita. Table 4-11 lists the 11 individual components of the Water Footprint tested for correlation with Distance from

the Quadrant. For more information on the Water Footprint, visit: http://www.waterfootprint.org.

Table 4-11: List of Individual Components of the Water Footprint (years 1997-2001)

Source: Compiled by the author.

#	Water Footprint Components
1	Total water footprint per capita
2	Total renewable water resources per capita
3	Water Scarcity (renewable water resources minus water footprint)
4	Water import dependency
5	Water self-sufficiency
6	% of total water footprint used for agricultural production
7	% of total water footprint used for industrial production
8	% of internal water footprint used for agricultural production (water embodied in local production minus exports)
9	% of internal water footprint used for industrial production (water embodied in local production minus exports)
10	% of external water footprint used for agricultural production (water embodied in imports)
11	% of external water footprint used for industrial production (water embodied in imports)

- National ethnic, religious, and linguistic fractionalization scores were tested for correlation with Distance From the Quadrant as well. Fractionalization is "a measure of diversity among individuals" (Bossert, et al., 2006). Countries are given a score between 0 and 1, with higher scores indicating greater diversity. The data were taken from **Alesina, Alberto, et al, 2003. "Fractionalization," *Journal of Economic Growth*, Springer, vol. 8(2), pages 155-94, June**. In turn, Alesina, et al's work used the following sources for their analysis: Encyclopedia Britanica, the CIA World Factbook, the Minority Rights Group International, local census data, and previously published work by Scarrit and Mozaffar.

- Countries' average latitude was also tested for correlation in the present-day analysis. This data were taken from **Mobilgistix Ltd. Average Latitude & Longitude of Countries, 2009**, available at http://www.mobilgistix.com/Resources/GIS/Locations/average-latitude-longitude-countries.aspx.

4.5.2. Historical Movement Towards the Quadrant – Metrics Tested

A total of 140 metrics were tested for correlation with historical Movement Towards the Quadrant. The bulk of these were sourced from **The World Resources Institute's Earth Trends Web Portal** (http://earthtrends.wri.org/), they are listed in Table 4-12. Note that the number of metrics available decreases as the time period considered goes further back in time; for the short-term analysis, data was available for 127 metrics; as opposed to 119 for the medium-term,

and 86 for the long-term. A list of the original sources for these metrics can be found in Appendix B.

Table 4-12: Complete List of Metrics Analyzed for Historical Movement Sourced from the Earth Trends Portal

Source: Compiled by the author.

#	Metric	Period		
		Long-term	Medium-term	Short-term
1	Total population, both sexes	1980 to 2005	1990 to 2005	2000 to 2005
2	Civil liberties index	1980 to 2005	1990 to 2005	2000 to 2005
3	Control of Corruption Index	N/A	N/A	2000 to 2005
4	Level of freedom index	1980 to 2005	1990 to 2005	2000 to 2005
5	Political rights index	1980 to 2005	1989-90 to 2005	2000 to 2005
6	Political Stability and Absence of Violence Index	N/A	N/A	2000 to 2005
7	Press freedom index	N/A	N/A	2000 to 2005
8	Regulatory Quality Index	N/A	N/A	2000 to 2005
9	Rule of Law Index	N/A	N/A	2000 to 2005
10	Transnational Corporations: Foreign direct investment, net inflows	1980 to 2005	1990 to 2005	2000 to 2005
11	Investment in telecommunications	1980 to 2005	1990 to 2005	2000 to 2005
12	Density of international non-governmental organizations with membership	N/A	1990 to 2003	2000 to 2003
13	Corruption perceptions index	1980-85 to 2005	1988-92 to 2005	2000 to 2005
14	Total debt service	1980 to 2005	1990 to 2005	2000 to 2005
15	Total debt service as a percent of export earnings	1980 to 2005	1990 to 2005	2000 to 2005
16	Total external debt	1980 to 2005	1990 to 2005	2000 to 2005
17	(External)Aid as a percent of government expenditure	N/A	1990 to 2005	2000 to 2005

Table 4-12 (continued)

#	Metric	Period		
		Long-term	Medium-term	Short-term
18	Aid (received) per capita	1980 to 2005	1990 to 2005	2000 to 2005
19	Government cash deficit/surplus as a percent of GDP	N/A	1990 to 2005	2000 to 2005
20	Government consumption expenditure as a percent of GDP	1980 to 2005	1990 to 2005	2000 to 2005
21	Military expenditure as a percent of GDP	N/A	1990 to 2005	2000 to 2005
22	Military expenditure as a percent of government expenditure	N/A	1990 to 2005	2000 to 2005
23	Public education expenditure as a percent of GDP	N/A	1991 to 2005	2000 to 2005
24	Public health expenditure as a percent of GDP	N/A	N/A	2001 to 2005
25	Organic water pollutant (BOD) emissions	1980 to 2002	1990 to 2002	2000 to 2002
26	Access to an improved water source	N/A	1990 to 2004	N/A
27	Access to improved sanitation	N/A	1990 to 2004	N/A
28	Rural access to an improved water source	N/A	1990 to 2004	N/A
29	Rural access to improved sanitation	N/A	1990 to 2004	N/A
30	Urban access to an improved water source	N/A	1990 to 2004	N/A
31	Urban access to improved sanitation	N/A	1990 to 2004	N/A
32	CO2 emissions per capita	1980 to 2004	1990 to 2004	2000 to 2004
33	Residential CO2 emissions per capita	N/A	1990 to 2003	N/A
34	CO2 emissions per GDP	1980 to 2004	1990 to 2004	2000 to 2004
35	Cellular mobile telephone subscribers per 1000 people	1980 to 2005	1990 to 2005	2000 to 2005
36	Homes with personal computers	N/A	1990 to 2004	2000 to 2004
37	Homes with telephones	1980 to	1990 to	2000 to

Table 4-12 (continued)

#	Metric	Period		
		Long-term	Medium-term	Short-term
		2004	2004	2004
38	Internet users per 1000 people	N/A	1990 to 2005	2000 to 2005
39	Television sets per 1000 people	1980 to 2005	1990 to 2005	2000 to 2005
40	Infant mortality rate	1980 to 2005	1990 to 2005	2000 to 2005
41	Under-5 mortality rate	1980 to 2005	1990 to 2005	2000 to 2005
42	Crude birth rate	1980-85 to 2005-10	1990-95 to 2005-10	2000-05 to 2005-10
43	Crude death rate	1980-85 to 2005-10	1990-95 to 2005-10	2000-05 to 2005-10
44	Life expectancy at birth, both sexes	1980-85 to 2005-10	1990-95 to 2005-10	2000-05 to 2005-10
45	Net number of migrants	1980-85 to 2005-10	1990-95 to 2005-10	2000-05 to 2005-10
46	Total fertility rate	1980-85 to 2005-10	1990-95 to 2005-10	2000-05 to 2005-10
47	Average length of schooling, both sexes	N/A	N/A	2000 to 2004
48	Primary school net enrollment ratio	N/A	N/A	2000 to 2004
49	Secondary school gender parity in gross enrollment	N/A	N/A	2000 to 2004
50	Secondary school net enrollment ratio	N/A	N/A	2000 to 2004
51	Tertiary school gross enrollment ratio, female	N/A	N/A	2000 to 2004
52	Agricultural labor force as a percent of total labor force	1980 to 2004	1990 to 2004	2000 to 2004
53	Population above age 65, both sexes	1980 to 2005	1990 to 2005	2000 to 2005
54	Population below age 15, both sexes	1980 to 2005	1990 to 2005	2000 to 2005
55	Growth rate of total population	1980-85 to 2005-10	1990-95 to 2005-10	2000-05 to 2005-10
56	Population density	1980 to 2005	1990 to 2005	2000 to 2005
57	Alcohol consumption per capita	1980 to	1990 to	2000 to

Table 4-12 (continued)

#	Metric	Period		
		Long-term	Medium-term	Short-term
		2003	2003	2003
58	Government expenditure on health as a percent of total expenditure on health	N/A	N/A	2000 to 2003
59	Per capita total expenditure on health	N/A	N/A	2000 to 2003
60	Passenger cars per 1000 people	1980 to 2003	1990 to 2003	2000 to 2003
61	Growth rate of rural population	1980-85 to 2005-10	1990-95 to 2005-10	2000-05 to 2005-10
62	Growth rate of urban population	1980-85 to 2005-10	1990-95 to 2005-10	2000-05 to 2005-10
63	Urban population as a percent of total population	1980 to 2005	1990 to 2005	2000 to 2005
64	Aid as a percent of GNI	1980 to 2005	1990 to 2005	2000 to 2005
65	Financial Flows: Net Inflows (sales - purchases) of Cross-Border Mergers and Acquisitions	N/A	1990 to 2004-05	2000 to 2004-05
66	GDP per capita, annual growth rate	1980 to 2005	1990 to 2005	2000 to 2005
67	GDP per capita, PPP, current international dollars	1980 to 2005	1990 to 2005	2000 to 2005
68	GDP: Official exchange rate	1980 to 2005	1990 to 2005	2000 to 2005
69	Percent GDP from agriculture	1980 to 2005	1990 to 2005	2000 to 2005
70	Percent GDP from industry	1980 to 2005	1990 to 2005	2000 to 2005
71	Percent GDP from manufacturing	1980 to 2005	1990 to 2005	2000 to 2005
72	Percent GDP from services	1980 to 2005	1990 to 2005	2000 to 2005
73	GNI: PPP, current international dollars	1980 to 2005	1990 to 2005	2000 to 2005
74	Workers' remittances and compensation of employees, paid	1980 to 2005	1990 to 2005	2000 to 2005
75	Workers' remittances and compensation of employees, received	1980 to 2005	1990 to 2005	2000 to 2005
76	Adjusted Net Savings, percent of GNI	N/A	1990 to 2005	2000 to 2005

Table 4-12 (continued)

#	Metric	Period		
		Long-term	Medium-term	Short-term
77	International tourism expenditures	N/A	N/A	2000 to 2005
78	International tourism receipts	N/A	N/A	2000 to 2005
79	Trade in Forest Products: Imports, value	1980 to 2005	1990 to 2005	2000 to 2005
80	Trade in Goods and Services: Current account balance	1980 to 2005	1990 to 2005	2000 to 2005
81	Trade in Fish and Fisheries Products: Exports, quantity	1980 to 2005	1990 to 2005	2000 to 2005
82	Trade in Fish and Fisheries Products: Imports, quantity	1980 to 2005	1990 to 2005	2000 to 2005
83	Trade in Goods and Services: Net trade in goods and services (balance of trade)	1980 to 2005	1990 to 2005	2000 to 2005
84	Trade in Goods: Agricultural raw materials exports as a percent of merchandise exports	1980 to 2005	1990 to 2005	2000 to 2005
85	Trade in Goods: Agricultural raw materials imports as a percent of merchandise imports	1980 to 2005	1990 to 2005	2000 to 2005
86	Trade in Goods: Food exports as a percent of merchandise exports	1980 to 2005	1990 to 2005	2000 to 2005
87	Trade in Goods: Food imports as a percent of merchandise imports	1980 to 2005	1990 to 2005	2000 to 2005
88	Trade in Goods: Fuel exports as a percent of merchandise exports	1980 to 2005	1990 to 2005	2000 to 2005
89	Trade in Goods: Fuel imports as a percent of merchandise imports	1980 to 2005	1990 to 2005	2000 to 2005
90	Trade in Goods: Manufactures exports as a percent of merchandise exports	1980 to 2005	1990 to 2005	2000 to 2005
91	Trade in Goods: Manufactures imports as a percent of merchandise imports	1980 to 2005	1990 to 2005	2000 to 2005
92	Electricity consumption per capita	N/A	1990 to 2005	2000 to 2005
93	Total electricity production	N/A	1990 to 2005	2000 to 2005
94	Energy Consumption by Source: Biogas and liquid biomass	N/A	1990 to 2003	2000 to 2003
95	Energy Consumption by Source: Coal and coal products	N/A	1990 to 2005	2000 to 2005

Table 4-12 (continued)

#	Metric	Period		
		Long-term	Medium-term	Short-term
96	Energy Consumption by Source: Hydroelectric	N/A	1990 to 2005	2000 to 2005
97	Energy Consumption by Source: Natural gas	N/A	1990 to 2005	2000 to 2005
98	Energy Consumption by Source: Oil and petroleum products	N/A	1990 to 2005	2000 to 2005
99	Energy Consumption by Source: Solar, wind, and wave	N/A	1990 to 2003	2000 to 2003
100	Energy Consumption by Source: Solid biomass (includes fuelwood)	N/A	1990 to 2003	2000 to 2003
101	Residential energy consumption per capita	N/A	1990 to 2005	2000 to 2005
102	Total energy consumption per capita	N/A	1990 to 2005	2000 to 2005
103	Total energy production	N/A	1990 to 2005	2000 to 2005
104	Paper and paperboard consumption per capita	1980 to 2005	1990 to 2005	2000 to 2005
105	Diesel oil consumption per capita	N/A	1990 to 2003	2000 to 2003
106	Motor gasoline consumption per capita	N/A	1990 to 2003	2000 to 2003
107	Agricultural Inputs: Tractor use intensity	1980 to 2003	1990 to 2003	2000 to 2003
108	Food production per capita index	1980 to 2005	1990 to 2005	2000 to 2005
109	Agricultural Production Indices: Total production per capita index	1980 to 2005	1990 to 2005	2000 to 2005
110	Agricultural Production: Cereals, yield	1980 to 2005	1990 to 2005	2000 to 2005
111	Agricultural Production: Cereals, total production	1980 to 2005	1990 to 2005	2000 to 2005
112	Agricultural Production: Roots and tubers, total production	1980 to 2005	1990 to 2005	2000 to 2005
113	Agricultural Production: Roots and tubers, yield	1980 to 2005	1990 to 2005	2000 to 2005
114	Food Aid: Cereals received by country	1980 to 2005	1990 to 2005	2000 to 2005
115	Irrigated land as a percent of total agricultural area	1980 to 2003	1990 to 2003	2000 to 2003

Table 4-12 (continued)

#	Metric	Period		
		Long-term	Medium-term	Short-term
116	Cattle stocks	1980 to 2005	1990 to 2005	2000 to 2005
117	Chicken stocks	1980 to 2005	1990 to 2005	2000 to 2005
118	Equine (horses, mules, asses) stocks	1980 to 2005	1990 to 2005	2000 to 2005
119	Goat stocks	1980 to 2005	1990 to 2005	2000 to 2005
120	Sheep stocks	1980 to 2005	1990 to 2005	2000 to 2005
121	Swine stocks	1980 to 2005	1990 to 2005	2000 to 2005
122	Meat Consumption: Per capita	1980 to 2002	1990 to 2002	2000 to 2002
123	Meat production per capita	1980 to 2005	1990 to 2005	2000 to 2005
124	Percentage of population that is undernourished	1979-81 to 2002-04	1990-92 to 2002-04	2001-03 to 2002-04
125	Calorie supply per capita	1980 to 2003	1990 to 2003	2000 to 2003
126	Calorie supply per capita from animal products	1980 to 2002	1990 to 2002	2000 to 2002
127	Grain fed to livestock as a percent of total grain consumed	1980 to 2005	1990 to 2005	2000 to 2005
128	Food exports as a percent of merchandise exports	1980 to 2005	1990 to 2005	2000 to 2005
129	Food imports as a percent of merchandise imports	1980 to 2005	1990 to 2005	2000 to 2005
130	Paper Production: Recovered paper	1980 to 2005	1990 to 2005	2000 to 2005
131	Paper Production: Paper and paperboard	1980 to 2005	1990 to 2005	2000 to 2005
132	Forest Extent: Natural forest area	N/A	1990 to 2005	2000 to 2005
133	Total forest area	N/A	1990 to 2005	2000 to 2005
134	Paper and paperboard consumption per capita	1980 to 2005	1990 to 2005	2000 to 2005

The other set of data used from the historical movement analysis comes from the **Ecological Footprint time series** (Global Footprint Network, *National Footprint Accounts*, 2008 edition). The EF time series has complete data from all the Ecological Footprint and Biocapacity components from 1961 to 2005, which allows for an analysis of the change in time for each of the component's share in the total footprint. The EF components selected for the historical movement analysis (on all – long, medium, and short – terms considered) are listed in Table 4-13.

Table 4-13: List of Ecological Footprint Components Analyzed for Historical Movement

Source: Compiled by the author.

#	Metric
1	Ecological Footprint of Cropland - % of total
2	Ecological Footprint of Grazing land - % of total
3	Ecological Footprint of Forest land - % of total
4	Ecological Footprint of Fishing ground - % of total
5	Ecological Footprint of Carbon - % of total
6	Ecological Footprint of Built-up land - % of total

5. Results of the Analysis

The present-day Distance From the Quadrant analysis yielded a much larger number of metrics with statistically significant correlations than the historical Movement Towards the Quadrant analysis; this is not unexpected, since data availability was much greater for the present-day. A total of 738 metrics were tested for the present-day analysis, as opposed to 127 metrics for the short-term movement analysis (2000 to 2005); 119 for the medium-term analysis (1990 to 2005), and 86 for the long-term analysis (1980 to 2005).

As was indicated in Section 3.3., the purpose of the analysis was to identify metrics that correlate with some degree of *statistical significance* with proximity/movement relative to the Global Sustainability Quadrant.

5.1. Metric Correlations with Highest Statistical Significance

This section lists *only* those metrics identified in the analysis that show correlation with the highest possible statistical significance. Statistical significance was determined using the table of critical values for Pearson's R described in Section 4.4.3. (Table 4-7). A rejection of the null hypothesis[23] with 99.9% confidence ($P(H_0) = <0.001$) is the highest possible confidence allowed by the table.

Appendix C lists *all* the metrics that showed some degree of statistical significance – rejection of the null hypothesis with at least 90% confidence ($P(H_0) = 0.1$). See Appendix D for a list of complete definitions and original sources for these statistically significant metrics.

5.1.1. Present-Day Correlations with the Highest Statistical Significance

Before arriving at any conclusion about sustainability based on the present-day[24] results, a fact that should not be overlooked is that, even though the approach provides a good snapshot of *where* in relation to the Sustainability Quadrant countries are positioned today, it reveals nothing about the direction they are moving in – which ultimately should be more relevant to researchers and policy-makers alike.

Table 5-1 lists those metrics that showed the highest statistical significance, $P(H_0) = <0.001$, in the present-day Distance From the Quadrant analysis. The total number of present-day metrics that meet this criterion is 58, but only those with a Pearson correlation coefficient (R) value above absolute 0.5 are included in Table 5-1 (for the complete list, see Appendix C). They are ranked according to their R value, from strongest to weakest correlation. The *Interpretation*

[23] The null hypothesis, H_0, indicates that there is no correlation between the variables analyzed. The probability for the null hypothesis, $P(H_0)$, is the probability that a correlation coefficient obtained for a number of samples *n* is actually a random occurrence.

[24] As of this publication, 2005 is the most recent year when complete country measures for both HDI and EF are available, so it has been taken to represent the 'present-day' in this work.

column explains the meaning of the correlation, and occasionally offers a *merely speculative explanation* for it. Arriving at more concrete and reliable explanations for the correlations is out of the scope of this work, but it does constitute an interesting opportunity for further research.

Table 5-1: Present-Day Correlations with the Highest Statistical Significance, $P(H_0) = <0.001$, and $R > |0.5|$

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
Source: Created by the author. See Section 4.5 for data sources.

Rank	Metric	n	R	Interpretation
1	Corruption: Bribe Payer's Index (score from 0 to 10, with 10 being the "best" or less corrupt)	29	(0.724)	"The Bribe Payer's Index (BPI) measures the tendency of firms from top exporting countries to pay bribes or make undocumented payments while conducting business abroad." *Quoted from the Earth Trends portal.* The negative correlation indicates that more "corrupt" countries tend to be closer to the Quadrant. Note that this metric includes only 29 top exporting countries. Thus, no assumptions should be made about corruption and its relationship with sustainability, but most certainly it is not cause-effect.
2	Contraceptive Prevalence Rate (% of married women aged 15-49 practicing contraception)	87	0.686	Countries where contraception is more widespread tend to be closer to the Quadrant.
3	Development Assistance: Aid received as a percent of GNI	103	(0.660)	Countries that receive more official development assistance (ODA) relative to their GNI tend to be farther away from the Quadrant. Perhaps this is a sign that ODA is being assigned where it is needed the most, or that it is usually very ineffective in fostering sustainable development.
4	Population without electricity (% of the population)	77	(0.657)	Countries where larger parts of the population do not have electricity tend to be farther away from the Quadrant.
5	Official development asst. received (net disbursements) (% of GDP)	96	(0.654)	Countries that receive more official development assistance (ODA) relative to their GDP tend to be farther away from the Quadrant. Perhaps this is a sign that ODA is being assigned where it is needed the most, or that it is usually very ineffective in fostering sustainable development.

Table 5-1 (continued)

Rank	Metric	n	R	Interpretation
6	Debt: Total debt service (current US$ per person)	109	0.641	Countries with higher debts tend to be closer to the Quadrant. Perhaps this explains how they got there (by borrowing money)...
7	Children's Health: Stunting in children under 5--moderate and severe (%)	107	(0.579)	"Stunting in children under 5-- moderate and severe, an indicator of child malnutrition, refers to the proportion of children under 5 whose height-for-age is below minus 2 standard deviations (for moderate stunting) or below minus 3 standard deviations (for severe stunting) from the median height-for-age of an international reference population recognized by the World Health Organization (WHO)." *Quoted from the Earth Trends portal*. Countries where stunting is more widespread tend to be farther away from the Quadrant.
8	Death rate from intestinal infectious diseases (deaths per 100,000 population)	70	0.574	It should be noted that this sample of 70 does not include any African nation, so among those that are included, the ones with higher death rates from intestinal infectious diseases tend to be closer to the Quadrant.
9	Total external debt (current US$ per person)	109	0.570	Countries with higher debts tend to be closer to the Quadrant. Perhaps this explains how they got there (by borrowing money)...
10	Children's Health: Underweight children under 5--moderate and severe (%)	108	(0.569)	Countries where the percentage of children considered underweight (which is an indicator of malnutrition) is higher tend to be farther away from the Quadrant.
11	Percentage of the population with insufficient food	89	(0.567)	Countries where the percentage of the population with insufficient food is higher tend to be farther away from the Quadrant.
12	Literacy: Female literacy rate as a percentage of male literacy rate (%)	97	0.552	Countries where the percentage of literate females, in relation to the percentage of literate males, is higher tend to be closer to the Quadrant.

Table 5-1 (continued)

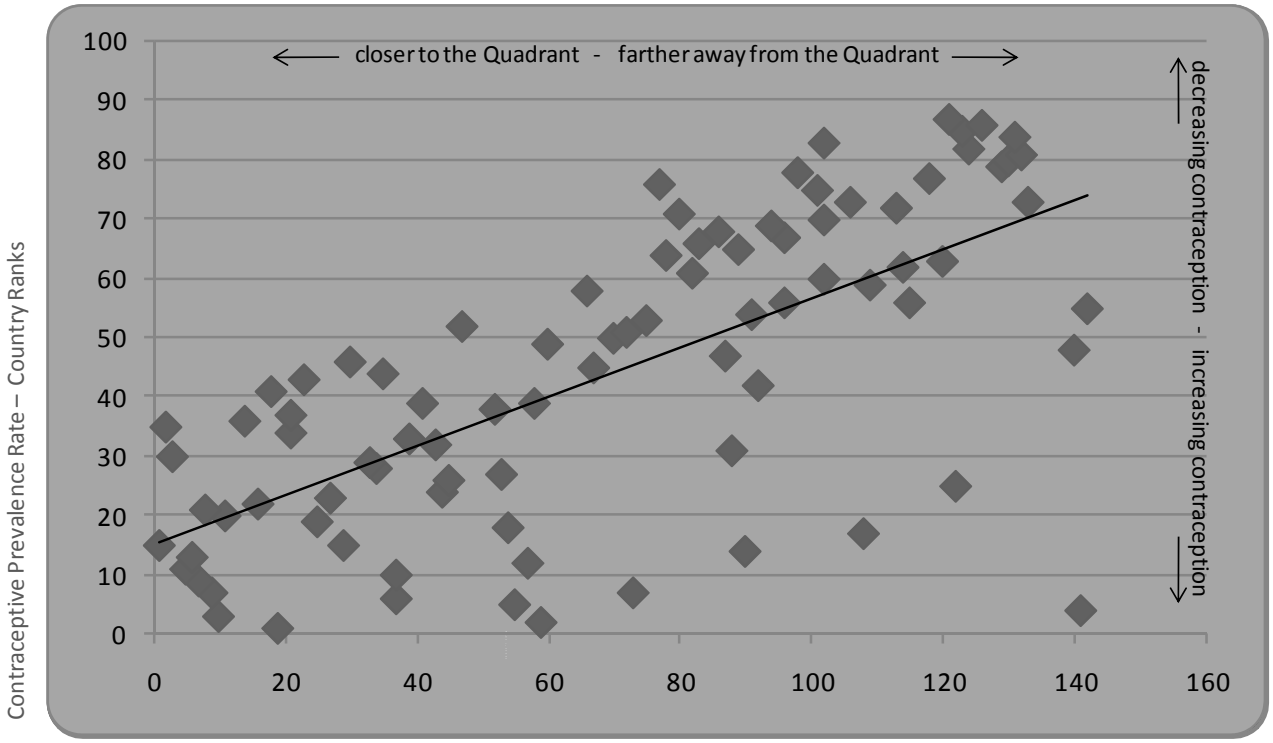
Rank	Metric	n	R	Interpretation
13	Literacy: Literacy rate, all adults (%)	97	0.550	Countries where the percentage of literate adults is higher tend to be closer to the Quadrant.
14	Literacy: Literacy rate, youth (age 15 to 24) (%)	93	0.549	Countries where the percentage of literate youths is higher tend to be closer to the Quadrant.
15	Adult literacy rate (% aged 15 or older)	113	0.549	Countries where the percentage of literate people over 15 is higher tend to be closer to the Quadrant.
16	Transportation: Passenger cars per 1000 people	48	(0.547)	"These numbers exclude buses, freight vehicles, and two-wheelers such as mopeds and motorcycles." *Quoted from the Earth Trends portal.* Nevertheless, they do include taxis, so the metric is not restricted to private vehicles. Countries where passenger cars are more widespread tend to be farther away from the Quadrant.
17	Children's Health: Wasting in children under 5--moderate and severe (%)	105	(0.529)	Wasting in children under 5--moderate and severe, an indicator of child malnutrition, refers to the proportion of children under 5 whose weight-for-height is below minus 2 standard deviations (for moderate wasting) or below minus 3 standard deviations (for severe wasting) from the median weight-for-height of an international reference population recognized by the World Health Organization (WHO). *Quoted from the Earth Trends portal*. Countries where wasting is more widespread tend to be farther away from the Quadrant.

Appendix C lists *all* the metrics that showed *some* statistical significance – rejection of the null hypothesis with at least 90% confidence ($P(H_0) = 0.1$). See Appendix D for a list of complete definitions and original sources for these statistically significant metrics.

Figures 5-1 and 5-2 and serve to better illustrate the correlation between present-day Distance From the Quadrant a given metric:

- Figure 5-1 is a plot of Distance From the Quadrant vs. Contraceptive Prevalence Rate, using the country ranks as units on both axes. Note that the two dimensions of the Global Sustainability Quadrant – HDI and EF Index – are combined into one dimension: distance, represented on the horizontal axis.

Figure 5-1: Contraceptive Prevalence Rate (CPR) vs. Present-day Distance From the Quadrant (country ranks)



n = 87 countries

R= 0.686

$P(H_0) < 0.001$

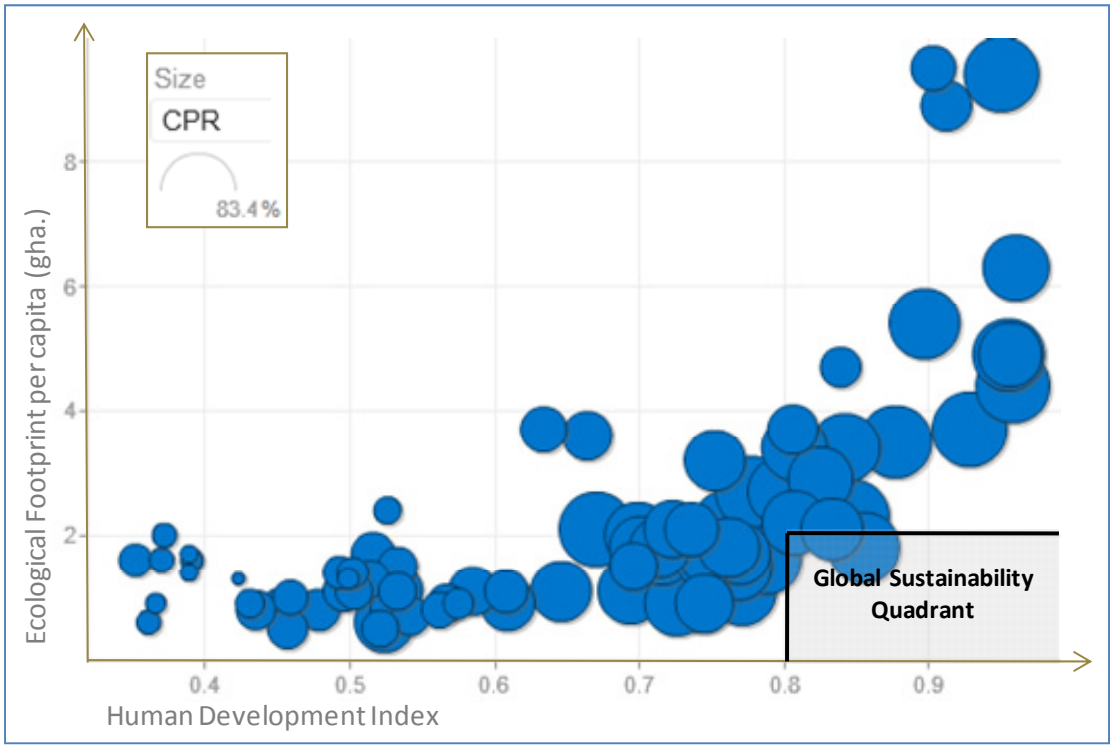
Countries where the % of married women aged 15-49 practicing contraception is greater tend to be closer to the Quadrant.

Note: The most recent available measures for Contraceptive Prevalence Rate come from the late 1990s.

Source: Created by the author. Data from: Global Footprint Network, 2008; UNDP, 2008; World Bank SIMA and WDI online.

- Figure 5-2 actually uses the three dimensions separately – with HDI and EF per capita as the horizontal and vertical axes, respectively, and CPR represented with circle size (small circles = low CPR %). Each circle represents a country; note that countries that appear closer to the Quadrant tend to be larger (higher CPR %).

Figure 5-2: Contraceptive Prevalence Rate (CPR) – Present-day Distance From the Quadrant



Note: The Figure does not use ranks, but the actual HDI, EF per capita, and CPR values as units.
Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008; World Bank SIMA and WDI online.

5.1.2. Long-Term Correlations with the Highest Statistical Significance

Table 5-2 lists those metrics that showed the highest statistical significance, $P(H_0) = <0.001$, in the long-term (1980 to 2005) Movement Towards the Quadrant analysis. They are ranked according to their Pearson correlation coefficient (R) value, from strongest to weakest correlation. The *Interpretation* column explains the meaning of the correlation, and occasionally offers a merely speculative possible explanation for it. Arriving at more concrete and reliable explanations for the correlations is out of the scope of this work, but it does constitute an interesting opportunity for further research.

Table 5-2: Long-Term (1980 to 2005) Correlations with the Highest Statistical Significance, $P(H_0) = <0.001$

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
Source: Created by the author. See Section 4.5 for data sources.

Rank	Metric	n	R	Interpretation
1	Meat Consumption: Per capita (Kg. per person)	67	(0.401)	As meat consumption increases in time, the country tends to move away from the Quadrant. This can be explained by the high footprint associated with meat production.
2	EF: Built-up land footprint - % of total ecological footprint	69	0.398	As the area defined as built-up land increases its share in a country's total ecological footprint, the country tends to move towards the Quadrant. This could be viewed as a sign of urbanization, which could be associated with resource efficiency; or it could also mean that other components of the ecological footprint are decreasing their share in the total – most likely the carbon footprint, which shows an inverse correlation with Movement Towards the Quadrant.

Appendix C lists *all* the metrics that showed *some* statistical significance – rejection of the null hypothesis with at least 90% confidence ($P(H_0) = 0.1$). See Appendix D for a list of complete definitions and original sources for these statistically significant metrics.

Figures 5-3 and 5-4 serve to better illustrate the correlation between long-term (1980 to 2005) Movement Towards the Quadrant and a given metric:

- Figure 5-3 is a plot of Movement Towards the Quadrant vs. change in Meat Consumption per capita, using the country ranks as units on both axes. Note that the

two dimensions of the Quadrant – HDI and EF Index – are combined into one dimension: movement, represented on the horizontal axis.

- Figure 5-4 actually uses the three dimensions separately – with HDI and EF per capita as the horizontal and vertical axes, respectively, and change in meat consumption per capita represented with circle size. Each circle represents a country; countries that increased their meat consumption per capita in the period are larger in size, whereas those which decreased their consumption are smaller. The trajectory through time for the top and bottom movers (for meat consumption) is highlighted. The Figure does not use ranks but actual values as units.

  Notice that, of the 10 countries highlighted in Figure 5-4, only 3 (Kuwait, Denmark, and Brazil) exhibit behavior contrary to the tendency described by the correlation.

Figure 5-3: Meat Consumption per capita – Long-term Movement (1980 to 2005)

Movement towards the Sustainability Quadrant – Country Ranks (1980 – 2005)

Period: 1980 – 2005*

n = 67 countries

R= -0.400

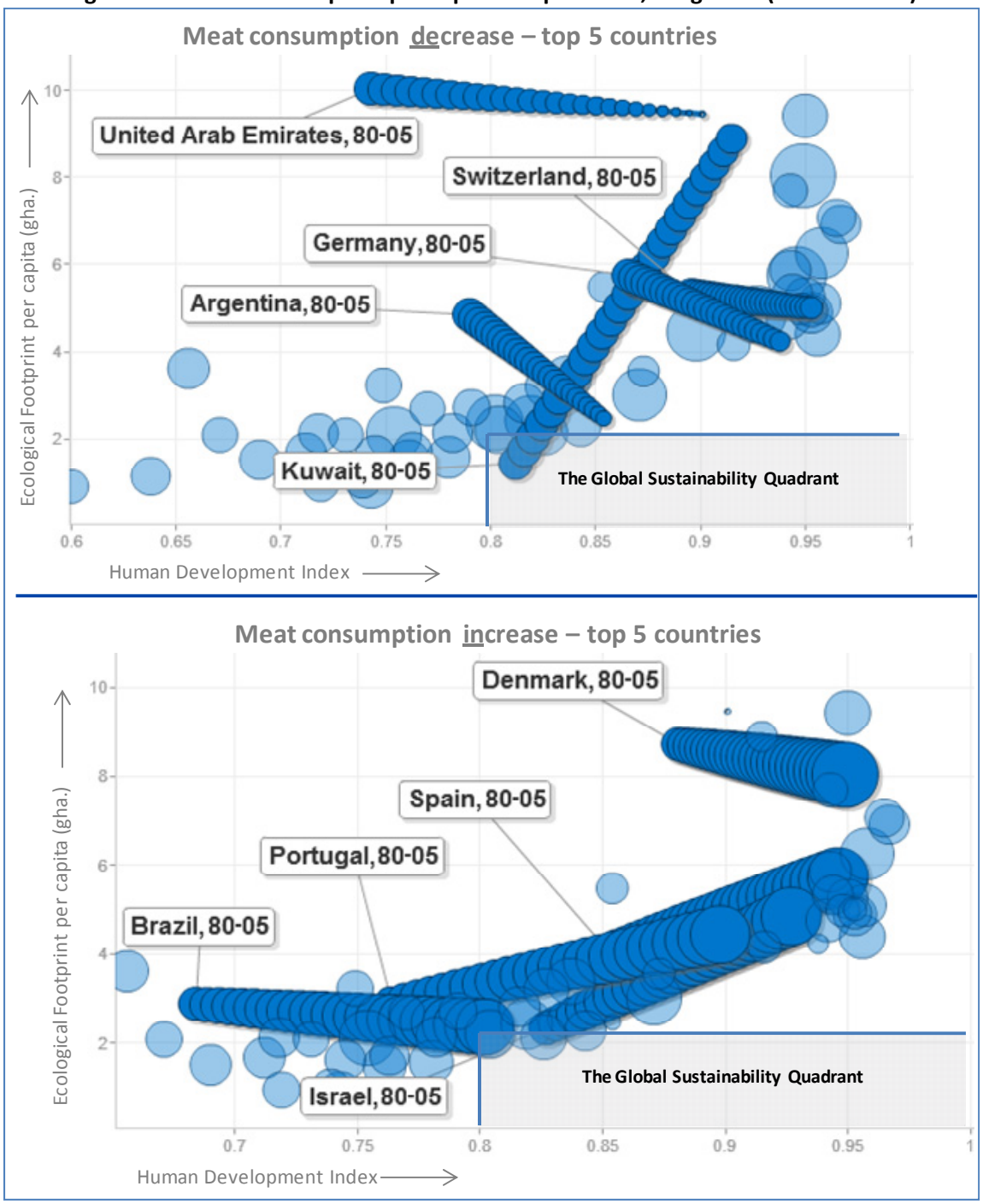
$P(H_0) < 0.001$

As meat consumption increases, countries tend to move away from the Sustainability Quadrant.

***The latest available data for meat consumption comes from 2002.**

Source: Created by the author. Data from: Global Footprint Network, 2008; UNDP, 2008; FAO, 2004.

Figure 5-4: Meat Consumption per capita – Top Movers, Long-term (1980 to 2005)



Notes: Period: 1980 – 2005 (the most recent data available for meat consumption comes from 2002)
Countries that decrease their meat consumption tend to move towards the Quadrant.
Countries that increase their meat consumption tend to move away from the Quadrant.

Source: Created by the author using Google Motion Chart and MS Power Point. Data from: Global Footprint Network, 2008; UNDP, 2008; FAO, 2004.

5.1.3. Medium-Term Correlations with the Highest Statistical Significance

Table 5-3 lists the only metric that showed the highest possible statistical significance, $P(H_0)$ = <0.001, in the medium-term (1990 to 2005) Movement Towards the Quadrant analysis. The *Interpretation* column explains the meaning of the correlation, and offers a merely speculative possible explanation for it. Arriving at a more concrete and reliable explanation for the correlation is out of the scope of this work, but it does constitute an interesting opportunity for further research.

Table 5-3: Medium-Term (1990 to 2005) Correlations with the Highest Statistical Significance, $P(H_0)$ = <0.001

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
Source: Created by the author. See Section 4.5 for data sources.

Metric	n	R	Interpretation
Demographics: Life expectancy at birth, both sexes (years)	83	0.372	As a country's average life expectancy increases, it tends to move towards the Quadrant. This is one of the components of the HDI, so the correlation is not surprising.

Appendix C lists *all* the metrics that showed *some* statistical significance – rejection of the null hypothesis with at least 90% confidence ($P(H_0)$ = 0.1). See Appendix D for a list of complete definitions and original sources for these statistically significant metrics.

5.1.4. Short-Term Correlations with the Highest Statistical Significance

Table 5-4 lists those metrics that showed the highest statistical significance, $P(H_0)$ = <0.001, in the short-term (2000 to 2005) Movement Towards the Quadrant analysis. They are ranked according to their Pearson correlation coefficient (R) value, from strongest to weakest correlation. The *Interpretation* column explains the meaning of the correlation, and occasionally offers a merely speculative possible explanation for it. Arriving at more concrete and reliable explanations for the correlations is out of the scope of this work, but it does constitute an interesting opportunity for further research.

Table 5-4: Short-Term (2000 to 2005) Correlations with the Highest Statistical Significance, $P(H_0) = <0.001$

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
Source: Created by the author. See Section 4.5 for data sources.

Rank	Metric	n	R	Interpretation
1	Forest Extent: Natural forest area (percent of total area)	137	(0.423)	As the natural forest area increases its share in a country's total land area, the country tends to move away from the Quadrant. This relationship contradicts common conceptions about sustainable development. Possible explanations include: countries that are reforesting are doing so precisely because they are acknowledging their unsustainable ways; others who are deforesting are achieving "development" at the expense of the natural capital – like incurring in debt, this practice eventually will catch up with them.
2	EF: Built-up land footprint - % of total ecological footprint	121	0.409	As the area defined as built-up land increases its share in a country's total ecological footprint, the country tends to move towards the Quadrant. This could be viewed as a sign of resource efficiency associated with urbanization; or it could also mean that other components of the ecological footprint are decreasing their share in the total more rapidly – most likely the carbon footprint, which shows an inverse correlation with Movement Towards the Quadrant.

Table 5-4 (continued)

Rank	Metric	n	R	Interpretation
3	GDP per capita, PPP, current international dollars	121	(0.403)	As GDP Per capita increases, the country tends to move away from the Quadrant. This could be related to an increased consumption of resources brought upon by the population's growing purchasing power. It would be worth to explore where the GDP stops impacting quality of life; a plot of GDP vs. Life Expectancy would show that this relationship is one of "diminishing returns." Furthermore, the link between economic development and environmental quality has been thoroughly explored by the proponents of the *Environmental Kuznets Curve* hypothesis;[25] however, the relationship between economic development and ecological footprint does not appear to fit that hypothesis.
4	Demographics: Life expectancy at birth, both sexes (years)	121	0.373	As a country's average life expectancy increases, it tends to move towards the Quadrant. This is one of the components of the HDI, so the correlation is not surprising.
5	Demographics: Total fertility rate (children per woman)	121	(0.364)	As more people are being born within a country, it tends to move away from the Quadrant. This may indicate increased pressure on resources, associated with overpopulation, which may lead to their unsustainable use; it could also be attributed to the fertility rate's negative association with the other components of the HDI.
6	Public Health: Per capita total expenditure on health (international dollars per person)	121	(0.356)	As average expenses in health care increase, the country tends to move away from the Quadrant. This is not surprising, as an unhealthy population is likely in no good position to achieve sustainable development.

[25] The theory behind the Environmental Kuznets curve is that an inverted-U relationship can be made between environmental degradation and economic development. This means that as a society moves toward economic development, its environmental quality diminishes, but after a certain point, it begins to improve, as a sign that greater development brings upon environmental stewardship.

Table 5-4 (continued)

Rank	Metric	n	R	Interpretation
7	Access to Information: Cellular mobile telephone subscribers per 1000 people	121	(0.341)	As cellular phones become more widespread in a country, it tends to move away from the Quadrant. This could be a sign of a population's growing purchasing power, related in turn to increased consumption of resources.
8	Total external debt (current US$ per person)	92	(0.339)	As its external debt grows in time, a country tends to move away from the Quadrant. A debt-free country should be better positioned to achieve sustainable development.
9	Population density (people per square km^2)	119	0.339	As population density increases in a country, the country tends to move towards the Quadrant. This correlation is puzzling; one possible explanation could lie in the population-imposed constraints on the available resources, which can force their more efficient use.
10	Civil Society: Density of international non-governmental organizations with membership (INGOs with membership per million population)	121	(0.337)	As INGOs proliferate within a country, it tends to move away from the Quadrant. Such proliferation may reflect a response to the country's need to reverse its path and start moving towards sustainability.
11	Demographics: Crude birth rate (births per 1,000 people)	121	(0.333)	As more people are being born within a country, it tends to move away from the Quadrant. This may indicate increased pressure on resources, associated with overpopulation, which may lead to their unsustainable use; it could also be attributed to the fertility rate's negative association with the other components of the HDI.
12	Trade in Forest Products: Imports, value (US dollars per person)	120	(0.323)	As a country imports more forest products, the country tends to move away from the Quadrant. This could reflect a need for resources that surpasses the country's own production capacity - either high consumption, low local stocks, or both.

Table 5-4 (continued)

Rank	Metric	n	R	Interpretation
13	Energy Consumption: Total energy consumption per capita (kgoe per person)	105	(0.323)	As energy consumption increases, the country tends to move away from the Quadrant. Note that this metric does not distinguish between different sources of electricity.
14	EF: Cropland footprint - % of total ecological footprint	121	0.318	As the cropland area increases its share in a country's total ecological footprint, the country tends to move towards the Quadrant. This could be associated with a reduction in the share of other components of the ecological footprint – most likely the carbon footprint, which shows an inverse correlation with Movement Towards the Quadrant.
15	Children's Health: Infant mortality rate (deaths per 1,000 live births)	121	(0.314)	As infant mortality increases, the country tends to move away from the Quadrant. Obviously, high infant mortality means that the human requirements of sustainable development are not being met.
16	GDP: Official exchange rate (local currency / US dollars)	120	0.310	A country's official exchange rate "is calculated as an annual average based on monthly averages and is expressed as the number of local currency units equivalent to a U.S. dollar." *Quoted from the Earth Trends portal*. As a country's currency decreases its value respective to the US dollar, it tends to move towards the Quadrant. Perhaps this could be explained by constraints in the population's spending power, which could lower their consumption patterns.

Table 5-4 (continued)

Rank	Metric	n	R	Interpretation
17	Forest Extent: Total forest area (percent of total area)	142	(0.310)	As the total forest area increases its share in a country's total land area, the country tends to move away from the Quadrant. This relationship contradicts common conceptions about sustainable development. Possible explanations include: countries that are reforesting are doing so precisely because they are acknowledging their unsustainable ways; others who are deforesting are achieving "development" at the expense of the natural capital – like incurring in debt, this practice eventually will catch up with them.
18	Politics and Freedom: Regulatory Quality Index (Index: -2.5 worst governance, 0 average, 2.5 best governance)	121	(0.306)	The Regulatory Quality Index is a measure of "the incidence of market unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the burdens imposed by excessive regulation in areas such as foreign trade and business development." It attempts to describe the degree to which governments create an atmosphere that encourages trade and foreign investment. *Quoted from the Earth Trends portal*. As a country encourages trade and foreign investment, it tends to move away from the Quadrant. A possible explanation for this is the overexploitation of local resources that unregulated markets can sometimes foster.
19	EF: Carbon footprint - % of total ecological footprint	121	(0.303)	As the carbon footprint increases its share in a country's total ecological footprint, the country tends to move away from the Quadrant.
20	Children's Health: Under-5 mortality rate (deaths per 1,000 live births)	121	(0.295)	As infant mortality increases, the country tends to move away from the Quadrant. Obviously, high infant mortality means that the human requirements of sustainable development are not being met.

Table 5-4 (continued)

Rank	Metric	n	R	Interpretation
21	Agricultural Production Indices: Food production per capita index (% of 1999-2001 avg. food production per capita)	121	(0.292)	As a country increases its food production, it tends to move away from the Quadrant. On the contrary, countries that are high food producers tend to be close to the Quadrant in the present-day.

Appendix C lists *all* the metrics that showed *some* statistical significance – rejection of the null hypothesis with at least 90% confidence ($P(H_0) = 0.1$). See Appendix D for a list of complete definitions and original sources for these statistically significant metrics.

5.2. Metrics with Statistical Significance in Multiple Periods

Some metrics show correlations not of the highest statistical significance, but significant nevertheless. Table 5-5 lists those metrics that were found to have *some degree* of statistical significance – rejection of the null hypothesis with at least 90% confidence ($P(H_0) = 0.1$) – on more than one term analyzed, be it long, medium, short-term Movement, or present-day Distance.

Especially noteworthy are those metrics that exhibit opposite types of correlation between historical movement and present-day distance (e.g., negative correlation in the long-term, and positive correlation in the present-day); these metrics are highlighted on the Table. The *Interpretation* column explains the meaning of the correlation, and occasionally offers a merely speculative possible explanation for it. Arriving at more concrete and reliable explanations for the correlations is out of the scope of this work, but it does constitute an interesting opportunity for further research.

Table 5-5: Metrics with Statistical Significance on more than One Term

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
$P(H_0)$ = Probability for the Null Hypothesis (i.e., no correlation).
Highlighted metrics exhibit opposite types of correlation between historical movement and present-day distance.
Source: Created by the author. See Section 4.5 for data sources.

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Access to Information: Cellular mobile telephone subscribers per 1000 people	67	(0.313)	0.01	Not statistically significant			121	(0.341)	<0.001	Not statistically significant			As cellular phones become more widespread in a country, especially in the last few years, it tends to move away from the Quadrant. This could be a sign of a population's growing purchasing power, related in turn to increased consumption of resources.
Agricultural Production Indices: Food production per capita index (% of 1999-2001 avg. food production per capita)	Not statistically significant			Not statistically significant			121	(0.292)	0.001	142	0.375	<0.001	As a country increases its food production, it tends to move away from the Quadrant, whereas countries that are high food producers tend to be closer to the Quadrant in the present-day (this later correlation is a bit stronger). When examining the causes for this, issues such as population growth and food security should not be overlooked.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Children's Health: Infant mortality rate (deaths per 1,000 live births)	69	(0.251)	<0.05	83	(0.310)	<0.01	121	(0.314)	0.001	Not statistically significant			As infant mortality increases, the country tends to move away from the Quadrant. Obviously, high infant mortality means that the human requirements of sustainable development are not being met. The correlation is consistent on all three time periods analyzed for historical movement.
Children's Health: Under-5 mortality rate (deaths per 1,000 live births)	69	(0.254)	<0.05	83	(0.304)	<0.01	121	(0.295)	0.001	Not statistically significant			As infant mortality increases, the country tends to move away from the Quadrant. Obviously, high infant mortality means that the human requirements of sustainable development are not being met. The correlation is consistent on all three time periods analyzed for historical movement.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
CO2 Emissions per capita (metric tons per capita)	69	(0.234)	<0.1	82	(0.220)	<0.05	121	(0.165)	<0.1	Not statistically significant			As CO_2 emissions increase, the country tends to move away from the Quadrant. The correlation is consistent on all three time periods analyzed for historical movement.
Debt: Total debt service (current US$ per person)	Not statistically significant			Not statistically significant			92	(0.284)	<0.01	109	0.641	<0.001	As its debt grows in the short-term, a country tends to move away from the Quadrant. A debt-free country should be better positioned to achieve sustainable development. Nevertheless, countries with higher debts tend to be closer to the Quadrant in the present-day - perhaps this explains how they got there (by borrowing money). The trend seems to make perfect sense: borrowing money can solve problems today, but eventually turns into a burden.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Demographics: Crude birth rate (births per 1,000 people)	Not statistically significant			Not statistically significant			121	(0.333)	<0.001	142	(0.275)	<0.01	As more people are being born in a country, it tends to move away from the Quadrant, as well as to be farther away from it in the present-day. This may indicate increased pressure on resources, associated with overpopulation, which may lead to their unsustainable use; it could also be attributed to the fertility rate's negative association with the other components of the HDI.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Demographics: Crude death rate (deaths per 1,000 people)	69	(0.268)	<0.05	83	(0.339)	<0.01	121	(0.224)	<0.05	142	(0.482)	<0.001	As the crude death rate increases, the country tends to move away from the Quadrant. Also, countries that are closer to the Quadrant in the present-day tend to have a lower death rate. This is not surprising, since a high death rate indicates that the human requirements of sustainable development are not being met.
Demographics: Life expectancy at birth, both sexes (years)	Not statistically significant			83	0.372	<0.001	121	0.373	<0.001	Not statistically significant			As a country's average life expectancy increases, it tends to move towards the Quadrant. This is one of the components of the HDI, so the correlation is expected.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Demographics: Net number of migrants (thousands of people)	69	(0.375)	<0.01	Not statistically significant			Not statistically significant			142	(0.342)	<0.001	Countries with positive figures on this metric have net immigration; negative figures indicate net emigration. Thus, net *emigration* is here correlated with Movement Towards the Quadrant, as well as with present-day proximity to it.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Demographics: Total fertility rate (children per woman)	Not statistically significant			Not statistically significant			121	(0.364)	<0.001	142	(0.324)	<0.001	As more people are being born within a country, it tends to move away from the Quadrant, as well as to be farther away from it in the present-day. This may indicate increased pressure on resources, associated with overpopulation, which may lead to their unsustainable use; it could also be attributed to the fertility rate's negative association with the other components of the HDI. The fact that this metric shows correlation only in the last few years may indicate that we are at the point in history where humanity has finally reached its limits to growth.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
EF: Built-up land footprint - % of total ecological footprint	69	0.398	<0.001	83	0.255	<0.05	121	0.409	<0.001	Not statistically significant			As the area defined as built-up land increases its share in a country's total ecological footprint, the country tends to move towards the Quadrant. This could be viewed as a sign of urbanization, which could be associated with resource efficiency; or it could also mean that other components of the ecological footprint are decreasing their share in the total – most likely the carbon footprint, which shows an inverse correlation with the movement towards Quadrant. The correlation is consistent on all three time periods analyzed for historical movement.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
EF: Carbon footprint - % of total ecological footprint	69	(0.338)	<0.01	83	(0.322)	<0.01	121	(0.303)	0.001	142	0.209	<0.05	As the carbon footprint increases its share in a country's total ecological footprint, the country tends to move away from the Quadrant. Nevertheless, countries with a high share of carbon footprint tend to be closer to the Quadrant in the present-day (although this correlation is less significant than the ones observed historically). This could be associated with a particular moment in a nation's path towards development (see *Environmental Kuznet's Curve* hypothesis[26]). The correlation is consistent on all three time periods analyzed for historical movement.

[26] See footnote 25.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
EF: Cropland footprint - % of total ecological footprint	69	0.365	<0.01	Not statistically significant			121	0.318	<0.001	Not statistically significant			As the cropland footprint increases its share in a country's total ecological footprint, the country tends to move towards the Quadrant. This could be associated with a reduction in the share of other components of the ecological footprint – most likely the carbon footprint, which shows an inverse correlation with the Movement Towards the Quadrant.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
EF: Grazing footprint - % of total ecological footprint	Not statistically significant			83	0.320	<0.01	121	0.159	<0.1	Not statistically significant			As the grazing footprint increases its share in a country's total ecological footprint, the country tends to move towards the Quadrant. This could be associated with a reduction in the share of other components of the ecological footprint – most likely the carbon footprint, which shows an inverse correlation with the Movement Towards the Quadrant. Note that the significance of this correlation is lower than for the other component's which showed positive correlation as their share of the total footprint changed (i.e., cropland and built-up land).

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Education: Secondary school gender parity in gross enrollment (Index value; 100 = enrollment equality)	N/A			N/A			86	0.260	<0.05	115	0.276	<0.01	Observed in the last few years, as a country increases its secondary school gender equality, it tends to move towards the Quadrant. In the present-day it also seems that countries that have higher gender equality in secondary school are closer to the quadrant.
Electricity consumption per capita (kWh per person)	N/A			74	(0.226)	<0.1	105	(0.280)	<0.01	Not statistically significant			As electricity consumption increases, the country tends to move away from the Quadrant. Note that this metric does not distinguish between different sources of electricity.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Energy Consumption by Source: Biogas and liquid biomass (ktoe per million persons)	N/A			73	(0.210)	<0.1	103	(0.173)	<0.1	119	(0.433)	<0.001	As consumption of biogas and liquid biomass increases, the country tends to move away from the Quadrant, although the correlation is not as strong as with total energy consumption per capita. Also, countries that are closer to the Quadrant in the present-day tend to have lower biogas and biomass consumption.
Energy Consumption : Residential energy consumption per capita (kgoe per person)	N/A			72	(0.307)	<0.01	Not statistically significant			119	(0.432)	<0.001	As happens with total energy and total electricity consumption per capita, when residential electricity consumption increases, the country tends to move away from the Quadrant. Nevertheless, the other two metrics show no correlation in the present-day. Note that this metric does not distinguish between different sources of electricity.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Energy Consumption : Total energy consumption per capita (kgoe per person)	N/A			74	(0.232)	<0.05	105	(0.323)	0.001	Not statistically significant			As energy consumption increases, the country tends to move away from the Quadrant. Note that this metric does not distinguish between different sources of electricity. The fact total energy consumption shows significant correlations, but all of the individual sources tested (including renewables) do not (except for biogas and liquid biomass), may indicate that reducing consumption has more incidence on sustainable development than finding cleaner sources.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Forest (Paper) Production: Recovered paper (metric tons per thousand persons)	Not statistically significant			Not statistically significant			80	(0.324)	<0.01	93	(0.417)	<0.001	As the amount of recovered paper increases, the country tends to move away from the Quadrant. Also, countries that in the present-day are closer to the Quadrant tend to recover less paper. Perhaps this could be explained by the idea that the *need* to recover and recycle paper arises when the effects of un-sustainability start to be felt.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
GDP per capita, PPP, current international dollars	69	(0.269)	<0.05	Not statistically significant			121	(0.403)	<0.001	Not statistically significant			As GDP Per capita increases, the country tends to move away from the Quadrant. This could be related to an increased consumption of resources brought upon by the population's growing purchasing power. It would be worth to explore where the GDP stops impacting quality of life; a plot of GDP vs. Life Expectancy would show that this relationship is one of "diminishing returns." This also could be associated with a particular moment in a nation's path towards development (see *Environmental Kuznet's Curve* hypothesis[27]).

[27] See footnote 25.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
GDP: Official exchange rate (local currency / US dollars)	69	0.272	<0.05	Not statistically significant			120	0.310	0.001	Not statistically significant			A country's official exchange rate "is calculated as an annual average based on monthly averages and is expressed as the number of local currency units equivalent to a U.S. dollar." *Quoted from the Earth Trends portal*. As a country's currency decreases its value respective to the US dollar, it tends to move towards the Quadrant. Perhaps this could be explained by constraints in the population's spending power, which could lower their consumption patterns.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Labor: Workers' remittances and compensation of employees, received (million US$ per capita)	Not statistically significant			62	0.236	<0.1	107	(0.199)	<0.05	128	0.283	<0.001	A reversal of the trend between the medium and the short-term is puzzling. The short-term correlation is more significant, and it tells us that as a country receives more remittance money, it tends to move away from the Quadrant - perhaps because it needs it most. To complicate matters further, the correlation is reversed again between the short-term and the present-day, so countries that receive more remittance money tend to be closer to the Quadrant.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Meat Consumption : Per capita (Kg. per person)	67	(0.401)	<0.001	80	(0.298)	<0.01	119	(0.278)	<0.01	Not statistically significant			As meat consumption increases in time, the country tends to move away from the Quadrant. This can be explained by the high footprint associated with meat production. The correlation is consistent on all three time periods analyzed for historical movement.
Nutrition: Calorie supply per capita from animal products (kilocalories/ person/day)	68	(0.323)	<0.01	Not statistically significant			120	(0.223)	<0.05	Not statistically significant			As a person's calorie supply from animal products increases in time, the country tends to move away from the Quadrant. This can be explained by the high footprint associated with meat production.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Population: Above age 65, both sexes (% of the population)	Not statistically significant			Not statistically significant			121	(0.205)	<0.05	142	0.232	<0.01	In the last few years, as the population above 65 increases, the country tends to move away from the Quadrant. Nevertheless, in the present-day it seems that countries that have greater populations above 65 are closer to the Quadrant.
Total external debt (current US$ per person)	Not statistically significant			Not statistically significant			92	(0.339)	0.001	109	0.570	<0.001	As its debt grows in the short-term, a country tends to move away from the Quadrant. A debt-free country should be better positioned to achieve sustainable development. Nevertheless, countries with higher debts tend to be closer to the Quadrant in the present-day - perhaps this explains how they got there (by borrowing money). The trend seems to make perfect sense: borrowing money can solve problems today, but eventually turns into a burden.

Table 5-5 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant			Interpretation
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)						
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	
Transportation: Motor gasoline consumption per capita (Liters per person)	N/A			73	(0.294)	<0.05	103	(0.211)	<0.05	Not statistically significant			As gasoline consumption increases, the country tends to move away from the Quadrant.
Urban and Rural Areas: Growth rate of rural population (%)	Not statistically significant			83	0.262	<0.05	Not statistically significant			142	(0.337)	<0.001	The medium-term trend shows that, as rural population grows, countries tend to move towards the Quadrant. Statistics show that the global human population is moving to the city, so perhaps the city-dweller's higher average footprint is the cause of this correlation. However, in the present-day, countries that are closer to the Quadrant tend to have smaller rates of growth for their rural populations.

5.3. Other Metrics Worth Mentioning

Either for their uniqueness, or for the *absence* of statistical significance, some metrics are worth mentioning in this section. They pose interesting questions for those studying sustainable development.

5.3.1. The Water Footprint

Today, water footprints are generally below the available renewable water resources in the world – every nation is still within their fair water Earth-share per capita. Although some countries – all desert nations – are in fact relying on imported water resources (directly and indirectly), the water footprint metrics analyzed (and listed in table 4-12) did not show any significant correlation with Distance From the Sustainability Quadrant (historical data were not available). Water scarcity, however, is a problem that can and should urgently be tackled by decision-makers. Recent estimates indicate that the global average of freshwater available per capita in the year 2000 was a mere 40% of what it was in 1950.[28]

5.3.2. Ethnic, Language, and Religious Fractionalization

National ethnic, religious, and linguistic fractionalization[29] scores were tested for correlation with present-day Distance From the Quadrant (historical data were not available). As Table 5-6 shows, ethnic diversity does not seem to be a factor that influences proximity to the Sustainability Quadrant. However, it does appear that having many different religions, and even more so, many different languages spoken, has a negative impact – countries with high language and religious fractionalization tend to be farther away from the Quadrant.

Table 5-6: Fractionalization – Present-day Distance from Quadrant Correlation Results

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
$P(H_0)$ = Probability for the Null Hypothesis (i.e., no correlation).
Source: Created by the author. See Section 4.5 for data sources.

Metric	n	R	$P(H_0)$
Ethnic Fractionalization	140	(0.196)	Not significant
Language Fractionalization	137	**(0.357)**	<0.001
Religious Fractionalization	141	**(0.252)**	<0.01

[28] UNDP et al., 2000.

[29] Fractionalization is "a measure of diversity among individuals" (Bossert, et al., 2006). Countries are given a score between 0 and 1 for ethnic, religious, and linguistic fractionalization, with higher scores indicating greater diversity.

5.3.3. Biodiversity and Forest Cover

The National Biodiversity Index (NBI),[30] which was only available for the present-day analysis, did show correlation with Distance From the Quadrant – countries with more biodiversity tend to be closer to the Quadrant –, although not of the highest significance ($P(H_0)$ <0.01), as Table 5-7 indicates).

Nevertheless, this relatively lower significance may be attributed to the fact that the Ecological Footprint methods do not allow for direct assignment of 'value' to biodiversity (see Section 3.1.2.). It should also be noted that measuring biodiversity – and in the process, distinguishing between keystone species and others – is no easy task, so obtaining reliable metrics is a challenge.

Another important consideration when dealing with this issue relates to biological corridors. It has been demonstrated that continuous areas of natural habitats can do greater good for species preservation than a larger – but fragmented – area.

Table 5-7: NBI – Present-day Distance from Quadrant Correlation Results

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
$P(H_0)$ = Probability for the Null Hypothesis (i.e., no correlation).
Source: Created by the author. See Section 4.5 for data sources.

Metric	n	R	$P(H_0)$
NBI (National Biodiversity Index)	140	0.238	<0.01

In turn, the metrics Natural Forest Area and Total Forest Area percentages – available indeed for the historical analysis – showed correlations of the highest significance (in the short-term only), but in a 'negative' way: as forest cover has increased its share in a country's total land area between 2000 and 2005, the country has moved away from the Quadrant. Perhaps countries that are reforesting are doing so precisely because they are acknowledging their unsustainable ways (see *Environmental Kuznet's Curve* hypothesis).[31]

Nevertheless, other metrics that indicate a positive relationship between forest cover and sustainability for the present-day (greater cover: closer to the Quadrant) were identified. These metrics are listed in table 5-8.

Overall, the relationship between sustainable development and biodiversity/forest cover appears to indicate that countries who are deforesting are achieving 'development' at the expense of the natural capital, but after a while the negative effects of such losses start to be felt.

[30] The NBI is scored between 0 and 1, "with large values corresponding to high levels of species abundance and small values reflecting low levels of species abundance." *Quoted from Earth Trends*.
[31] See footnote 25.

Table 5-8: Forest Cover – Present-day Distance from Quadrant Correlation Results

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
$P(H_0)$ = Probability for the Null Hypothesis (i.e., no correlation).
Source: Created by the author. See Section 4.5 for data sources.

Metric	n	R	$P(H_0)$
Forest Extent: Forest area (current) as a percent of original forest area	134	0.216	<0.05
Forest Extent: Frontier forest area as a percent of original forest area	134	0.225	0.01

5.3.4. Energy

Several metrics tested deal with energy consumption by source (coal, oil, gas, solar, hydro, wind, biomass, etc.). The fact that total energy consumption shows significant correlations with Movement Towards the Quadrant, but the individual sources (except biogas and liquid biomass) do not, may indicate that reducing consumption has more incidence on sustainable development than finding cleaner sources of energy.

5.3.5. Urbanization

Some urbanization metrics showed significant correlation in the present-day analysis. They indicate that (1) countries with higher % of their populations in cities, and (2) countries with lower growth rates of their rural populations tend to be closer to the Quadrant. Table 5-9 lists these metrics.

Table 5-9: Urbanization– Present-day Distance from Quadrant Correlation Results

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
$P(H_0)$ = Probability for the Null Hypothesis (i.e., no correlation).
Source: Created by the author. See Section 4.5 for data sources.

Metric	n	R	$P(H_0)$
Urban and Rural Areas: Total population in cities with more than 100,000 inhabitants (% of population in 2000)	119	0.408	<0.001
Urban and Rural Areas: Growth rate of rural population (%)	142	(0.337)	<0.001

6. Conclusions

The review and analysis presented in Chapter 2 found that most of the usual measuring approaches used to assess global sustainable development overlook human consumption patterns in relation to the planet's carrying capacity. As long as these measures continue to receive credibility, development within the ecological limits imposed by the planet's carrying capacity is unlikely to become a priority for policy makers.

The Global Sustainability Quadrant approach offers a new standard for assessing sustainable development, one that is more in tune with the physical requirements of sustainability. The top ranking countries according to this approach are not the ones that usually top the "M*ost Developed*" lists published in the literature, so it is expected that some will find all this difficult to digest.

The analysis of metrics that was based on the Quadrant approach yielded results that could serve as solid stepping stones for developing better indicators and indices, and perhaps aid policy-makers and other researchers in future endeavors. However, as with any analysis that deals with such (unimaginably) complex matters as global sustainable development, a great degree of caution is required when interpreting the meaning of such results. Without further research, it would be unwise to make concrete statements about a given metric's influence on a given country – surely in many instances, their benefits to sustainability will be less than marginal, or even counterproductive.

Ultimately, the value a reader might assign to this work depends mainly on whether s/he considers the Ecological Footprint and the Human Development Index as valid and reliable measurements or not.

With this in mind, the following general conclusions can be inferred from the analysis:

Access to information, research, and technology: Society tends to place great hopes in new technologies to reduce the environmental impact of human activities. Sustainability-related issues also seem to be gaining exposure in the media, and there is no doubt that the power of the internet and modern telecommunications plays a major role in this. Nevertheless, many metrics that pertain to these issues (e.g., cellular phone use, telephone mainlines, homes with internet connections, number of researchers per thousand persons, recovered paper for recycling, renewable energies, etc .), show negative correlations (or no correlation, in the case of renewables) with proximity and/or movement to the Quadrant.

All this could mean that the societal benefits of increased information, research, and technology – which are also associated with affluence – are being overshadowed by increased consumption of resources. Or perhaps it could be explained by the idea that the *need* to recycle, use renewable energy, conduct research, etc., arises when the effects of un-sustainability start to be felt.

Another possible explanation for this can be related to the *Jevons Paradox*: "In 1865, the English economist William Stanley Jevons wrote a book called *The Coal Question*. In it, he observed that the consumption of coal had gone up in England even after more efficient technologies, like an improved steam engine, had been introduced." (Rocky Mountain Institute, 2008). Thus, the Jevons Paradox is used to describe what happens when technological advances that increase resource-use efficiency actually increase the rate at which that resource is consumed.

Biodiversity and forest cover: Overall, the relationship between sustainable development and biodiversity/forest cover appears to indicate that countries who are deforesting are achieving 'development' at the expense of the natural capital, but after a while the negative effects of such losses start to be felt.

Carbon footprint: As the carbon footprint increases its share in a country's total ecological footprint, the country tends to move away from the Quadrant. Nevertheless, countries with a high share of carbon footprint tend to be closer to the Quadrant in the present-day (although this correlation is less significant than the ones observed historically). The relationship between sustainable development and carbon emissions also appears to be analogous to the one that exists with debt: intensive use of carbon emitting technologies has put come countries in a 'good' position, but eventually, as the carbon footprint increases it becomes a burden. This could also be associated with a particular moment in a nation's path towards development (see *Environmental Kuznet's Curve* hypothesis).[32]

Components of the Human Development Index: As GDP Per capita increases, a country tends to move *away* from the Quadrant. This should be related to an increased consumption of resources brought upon by the population's growing purchasing power. Nevertheless, the other two components of the HDI (health and knowledge), show the *opposite* type of correlation – as they increase, countries tend to move towards the Quadrant. What makes all this more interesting is that these three components are strongly correlated between themselves – they tend to go hand in hand – so we must conclude that the analysis was able to isolate the impact of GDP. This also tells us that growth of health and knowledge are not necessarily conditioned by growth of income.

Contraception: Countries where contraception methods are more widespread tend to be closer to the Quadrant. It is very interesting to note that, even though the Distance From the Quadrant is determined by per capita figures – population growth rate is not factored in – contraception still shows up with a significant association to a country's sustainable development.

Debt: As its debt grows in time, a country tends to move away from the Quadrant. A debt-free country should be better positioned to achieve sustainable development. Nevertheless, countries with higher debts tend to be closer to the Quadrant in the present-day; perhaps this explains how they got there. The trend seems to make perfect sense: borrowing money can solve problems today, but eventually can turn into a burden.

[32] See footnote 25.

Development aid: Countries that receive more official development assistance, as well as those who have a larger number of International NGOs, tend to be farther away from the Quadrant. This could indicate that development initiatives are being directed to where they are needed the most, or that they are ultimately ineffective in fostering sustainable development.

Diversity: Ethnic diversity does not seem to be a factor that influences proximity to the Sustainability Quadrant. However, it does appear that having many different religions, and even more so, many different languages spoken within a country, has a negative impact – countries with high language and religious diversity tend to be farther away from the Quadrant.

Energy: The fact *total* energy consumption shows negative correlation with proximity and/or movement to the Quadrant, but most of the individual sources analyzed (including renewables) do not, may indicate that reducing overall consumption has more incidence on sustainable development than finding cleaner sources.

Population dynamics: The results of the analysis of metrics that pertain to human population dynamics are somewhat puzzling:

- As *fertility rate* increases within a country, it tends to move away from the Quadrant. This may indicate increased pressure on resources, associated with overpopulation, which may lead to their unsustainable use. The fact that this metric shows correlation only in the last few years (but not in the long and medium terms) may indicate that humanity is at the point in history where population has finally surpassed the planet's carrying capacity.
- Nevertheless, as *population density* increases, the country tends to move towards the Quadrant. A possible explanation could lie in the population-imposed constraints on the available resources, which can force their more efficient use (e.g., in cities).
- *Mortality rates* are clearly associated with movement away from the Quadrant.
- *Net emigration* is correlated with movement towards the Quadrant, as well as with present-day proximity to it, which contradicts the idea that countries that advancing sustainable development would attract people, not drive them away.

A more in depth analysis of these correlations is needed before any reliable interpretation can be made.

Governance and policies: The impacts of good governance and good policies are difficult to quantify and measure. That is why few governance/policy-related metrics could be included in the analysis. Nevertheless, their importance should not be overlooked; good governance and good policies are society's tools to drive the economy towards sustainable development.

Meat consumption: As a country's meat consumption per capita and its nutritional supply derived from animal products increase in time, it tends to move away from the Quadrant. This seems to indicate that the environmental impacts associated with meat production (mainly deforestation in the 'developing' world, and industrial pollution in the 'developed' world) have

more incidence on overall sustainability than the nutritional gains (protein content) provided by it.

Urbanization: A trend that shows positive correlation with sustainability, which may not be so obvious at first glance, is the growth of urban population in relation to rural population. It is widely known that the global human population is moving to the city. Rather than viewing cities as the large clusters of consumption and pollution that they sometimes are, they could be viewed as blessings in disguise. The reason is this: the concentration of human populations within a city offers unique opportunities to manage resources and control wastes more efficiently on a *per capita* basis; plus, it will leave room for nature to thrive with less human 'interference.' Even though there are many uncertainties surrounding the human condition in the years to come, there is little doubt that the future of humankind lies in the city.

7. Possibilities for Further Research[33]

As indicated in the previous chapters, the interpretations of the results of the analysis, although based on the correlation coefficients found, are merely speculative. The next logical question to address is: why is this happening? A look at the Conclusions (Chapter 6) could provide starting points for more in-depth studies.

Some approaches to further research include:

- Conducting a separate analysis of those countries that have an HDI below 0.8, and those that have one above 0.8. The latter part is particularly interesting because countries with high HDI that are also reducing their EF are going against the flow, and therein lies the key to achieving sustainability.

- Categorization of the results: Several indicator categorization frameworks exist that may help to better sort out the identified metrics. Jeon, et al., 2005, identifies four distinct types of framework:

  Linkages-based: These frameworks explore the relationship between causes, impacts, and actions associated with sustainability. The popular *Driving force-Pressure-State-Impact-Response (DPSIR)*[34] approach is an example of this type of framework, where indicators are placed within one of these five categories. For example, a driving force (e.g., growth of urban population) creates pressure (more cars that bring increased NO_2 emissions), which changes the state of the system (increased NO_2 concentration in the city), which in turn has an impact (higher incidence of respiratory illness) that originates a response (creation of carpool lanes) from the government.
  Impacts-based: They classify indicators according to the type of impact they generate (e.g., economic, environmental, or social), without focusing on their causes or corrective measures.
  Influence-oriented: This type of framework is institution-centered. It is "developed bearing in mind the relative levels of influence that the responsible agency or organization has on various actions and/or activities that influence progress toward sustainability" (Jeon, et al., 2005).
  Process-based: They rely on a predefined vision and monitor actions taken to fulfill that vision.

- Both the HDI and EF dimensions were given equal weight in the calculation of distance/movement relative to the Quadrant. In reality, it is unlikely that both would have the same degree of incidence on overall sustainable development. To combine both dimensions more accurately, we would need to answer this question: Is it easier to

[33] For access to the vast wealth of data compiled for this study, contact the author: abtarte@mtu.edu.
[34] The DPSIR model is an extension of the PSR (Pressure-State-Response) model, developed by Anthony Friend in the 1970s, and subsequently adopted by the OECD's State of the Environment (SOE) group.

improve health, knowledge, and standard of living for the world's population, or to lower its consumption patterns?

- Conducting a more thorough statistical analysis of the data (perhaps using non-linear analysis tools) could identify the relationships that are truly meaningful, as well as better describe their behavior, including when their benefits to sustainability start to become marginal. This includes determining if a specific metric identified in this analysis correlates with simultaneous progress on both dimensions (EF and HDI), or if it correlates with only on one of them, so strongly, that it overshadows the other.

- Regional analyses of the data could determine if the correlations apply only to particular parts of the world.

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Appendix A: Overview of Composite Sustainability Indicator Frameworks Reviewed

The Ecological Footprint

Developed by: William Rees and Mathis Wackernagel, refined and presently carried forward by the Global Footprint Network.
http://www.footprintnetwork.org

> The Ecological Footprint puts human consumption in terms of the amount of 'biologically productive land and sea area' required to produce what we consume and assimilate what we discard. "The area of land or sea available to serve a particular use is called biocapacity, and represents the biosphere's ability to meet human demand for material consumption and waste disposal. The Ecological Footprint and biocapacity accounts cover six land use types: cropland, grazing land, fishing ground, forest land, built-up land and carbon uptake land (to accommodate the Carbon Footprint). For each component, the demand for ecological services is divided by the yield for those ecological services to arrive at the Footprint of each land use type. Ecological Footprint and biocapacity are scaled with yield factors and equivalence factors to convert this physical land demanded to world average biologically productive land called global hectares. This allows for comparisons between various land use types with differing productivities (Ewing, et al., 2008).

The following information has been copied from: Global Footprint Network website. *Ecological Footprint Methodology Overview*
http://www.footprintnetwork.org/en/index.php/GFN/page/methodology/ (accessed April, 2009).

> Global Footprint Network's core research calculates both the Ecological Footprint, the demand on nature, and biocapacity, the capacity to meet this demand, of more than 200 countries. The results, updated annually, as well as the calculations are shown in the National Footprint Accounts. The 2008 National Footprint Accounts use over 5,400 data points for each country, each year, derived from internationally recognized sources to determine the area required to produce the biological resources a country uses and to absorb its wastes, and to compare this with the area available. This area is reported in global hectares (global acres), hectares (acres) with world-average productivity, for each year from 1961 through 2005…
>
> The Ecological Footprint uses yields of primary products (from cropland, forest, grazing land and fisheries) to calculate the area necessary to support a given activity. Biocapacity is measured by calculating the amount of biologically productive land and sea area available to provide the resources a population consumes and to absorb its wastes, given current technology and management practices. Countries differ in the productivity of their ecosystems, and this is reflected in the accounts.
>
> A nation's consumption is calculated by adding imports to and subtracting exports from its national production. Results from this analysis shed light on a country's ecological impact. For example, the National Footprint Accounts identify whether or not a country's Ecological Footprint exceeds its biocapacity. A country has an ecological reserve if its Footprint is smaller than its biocapacity; otherwise it is operating with an ecological deficit. The former are often

referred to as ecological creditors, and the latter ecological debtors. Today, most countries, and the world as a whole, are running ecological deficits. The world's ecological deficit is referred to as global ecological overshoot."

The following information has been copied from: Ewing B., A. Reed, S.M. Rizk, A. Galli, M. Wackernagel, and J. Kitzes. 2008. *Calculation Methodology for the National Footprint Accounts, 2008 Edition.* Oakland: Global Footprint Network.

Ecological Footprint accounting is based on six fundamental assumptions (Wackernagel et al. 2002):

- The majority of the resources people consume and the wastes they generate can be tracked.
- Most of these resource and waste flows can be measured in terms of the biologically productive area necessary to maintain flows. Resource and waste flows that cannot be measured are excluded from the assessment, leading to a systematic underestimate of humanity's true Ecological Footprint.
- By weighting each area in proportion to its bioproductivity, different types of areas can be converted into the common unit of global hectares, hectares with world average bioproductivity.
- Because a single global hectare represents a single use, and all global hectares in any single year represent the same amount of bioproductivity, they can be added up to obtain an aggregate indicator of Ecological Footprint or biocapacity.
- Human demand, expressed as the Ecological Footprint, can be directly compared to nature's supply, biocapacity, when both are expressed in global hectares.
- Area demanded can exceed area supplied if demand on an ecosystem exceeds that ecosystems regenerative capacity (e.g., humans can temporarily demand more biocapacity from forests, or fisheries, than those ecosystems have available). This situation, where Ecological Footprint exceeds available biocapacity, is known as overshoot…

Limitations of the Ecological Fooptrint method

The Ecological Footprint is designed to answer a specific research question: How much of the biosphere's regenerative capacity is occupied by human activities? The method is limited in three ways: Some aspects of sustainability are excluded from its scope; some aspects of demand are hard to quantify; and like any method, errors can occur in the implementation. The Ecological Footprint Standards require that Footprint studies specify the limitations of the assessment. In particular, the Standards emphasize that the Footprint is not a complete indicator of sustainability, and needs to be complemented by other measures.

What the Footprint Does Not Measure

Non-ecological aspects of sustainability. The Footprint is, by design, not a complete sustainability measure. A single metric that includes all aspects of sustainability, even if possible, would produce results that would have little utilitarian value. Having a Footprint smaller than global biocapacity is a necessary minimum condition for humanity's sustainability, but is not sufficient. For instance, social well-being also needs to be tracked, but this is not measured by the Footprint. The Ecological Footprint also makes no attempt to evaluate the long-term viability of social structures, economies, or political systems. Neither does it identify the drivers – it simply

documents one particular ecological outcome: the demand on nature resulting from human activities that occurred at a given time.

-*Depletion of non-renewable resources.* The Footprint does not track the amount or the depletion of non-renewable resource stocks, such as oil, natural gas, coal or metal deposits. It focuses on regenerative capacity as the limiting factor, and captures the use of fossil fuels and minerals in as far as this makes a demand on the biosphere's regenerative capacity.

-*Inherently unsustainable activities.* Activities that are inherently unsustainable, such as the release of heavy metals, radioactive materials and persistent synthetic compounds (chlordane, PCBs, CFCs, PVCs, dioxins, etc.), do not enter into Footprint calculations. Nature does not have any significant capacity to break down and process these compounds, so the recycling of these materials cannot be the biosphere cannot assimilate any of these materials within human timescales, integration of these factors into Footprint calculations would result in infinitely large, and therefore meaningless, values.

-*Ecological degradation.* The Footprint does not directly measure ecological degradation, such as increased soil salinity from irrigation that could affect future productivity. However, if degradation leads to reductions in biological productivity, this loss is captured in future biocapacity accounts. The Footprint is not predictive in this sense, but documents effects as they occur. This avoids making Footprint assessments speculative.

-*Resilience of ecosystems.* Ecosystems have the capacity to tolerate some disturbance without collapsing. Excessive disturbance, leading to collapse, does not mean extermination of life, but rather a shift of the ecosystem into a qualitatively different state, with a new species composition.

What the Footprint does not measure well

-*Waste flows.* For many waste flows, inadequate data sets exist for Footprint calculations. For example, SOx emissions from fossil fuel-based power plants contribute to the acidification of rainwater, which has detrimental effects on forests, fish and wildlife. However, at this time, globally comparable data on the relationship between SOx concentration and biocapacity are lacking. Acid rain does not yet enter into Footprint calculations, but may in the future if better data become available.

-*Freshwater use.* Freshwater use is only indirectly included in the Footprint due to lack of data that link freshwater use with loss in bioproductivity. Some local Footprint assessments have included freshwater use, but national assessments do not yet do so. Freshwater shortages that do result in declining bioproductivity are reflected in biocapacity measurements. Making Ecological Footprint assessments more relevant to freshwater issues is a research task.

-*Nuclear power.* The challenges with nuclear power are poorly captured with the Ecological Footprint, and hence the Footprint is ill-suited to analyze the utility or risk of nuclear power. When analyzing nuclear power one needs to consider wider issues, such as costs, nuclear waste, military proliferation, and operational risks. The 2008 Edition no longer includes nuclear energy at par with fossil fuel.

-*Aspects of demand for which data are sparse.* Most of the underlying data sets used to calculate national Footprints and biocapacities come from the United Nations, namely from the UN Food

> and Agriculture Organization (UN FAO). These data sets do not include assessments of the uncertainty or reliability of included data. Accordingly, Footprint results must be interpreted with the provison that they assume the underlying data is correct. When there is doubt about data values, Footprint calculations generally exclude or use lower estimates for demand on nature, and use optimistic biocapacity accounts. This is done to avoid exaggerating ecological deficits. Results, therefore, most likely underestimate the extent of humanity's ecological overshoot.

The following information has been copied from : Anders Reed, Research Associate, Global Footprint Network, personal communication:

> [An observation about the EF's] incomplete source data, or reporting errors: our major datasets such as FAO, do not necessarily have data for all countries. Where data is missing, we try to still provide the best estimate we can based on what is available.
>
> [An observation about the EF's] trade assumptions: we assume that all imported and exported goods have world average footprint intensities [global hectares/tonne]. This assumption is sufficient in many cases, but leads to unlikely results where a country's actual production intensities differ substantially from the world average. Trade modeling is currently at the forefront of our research agenda, so look for significant improvements in this area within the next few years.

Human Development Index (HDI)

Developed by: United Nations Development Programme (UNDP).
http://hdr.undp.org

The following information has been copied from the Human Development Reports website:

> The first Human Development Report (1990) introduced a new way of measuring development by combining indicators of life expectancy, educational attainment and income into a composite human development index, the HDI. The breakthrough for the HDI was the creation of a single statistic which was to serve as a frame of reference for both social and economic development. The HDI sets a minimum and a maximum for each dimension, called goalposts, and then shows where each country stands in relation to these goalposts, expressed as a value between 0 and 1...
>
> The HDI – human development index – is a summary composite index that measures a country's average achievements in three basic aspects of human development: health, knowledge, and a decent standard of living. Health is measured by life expectancy at birth; knowledge is measured by a combination of the adult literacy rate and the combined primary, secondary, and tertiary gross enrolment ratio; and standard of living by GDP per capita (PPP US$).

The following dimensions and weighting factors are used to calculate the HDI:

Table A-1: Components of the HDI

Source: Adapted from UNDP, 2008.

Dimension	weight
Life Expectancy Index	**1/3**
Education Index	**1/3**
Adult Literacy Rate	2/3
Combined Gross Enrollment Ratio	1/3
GDP Index	**1/3**

Environmental Performance Index (EPI)

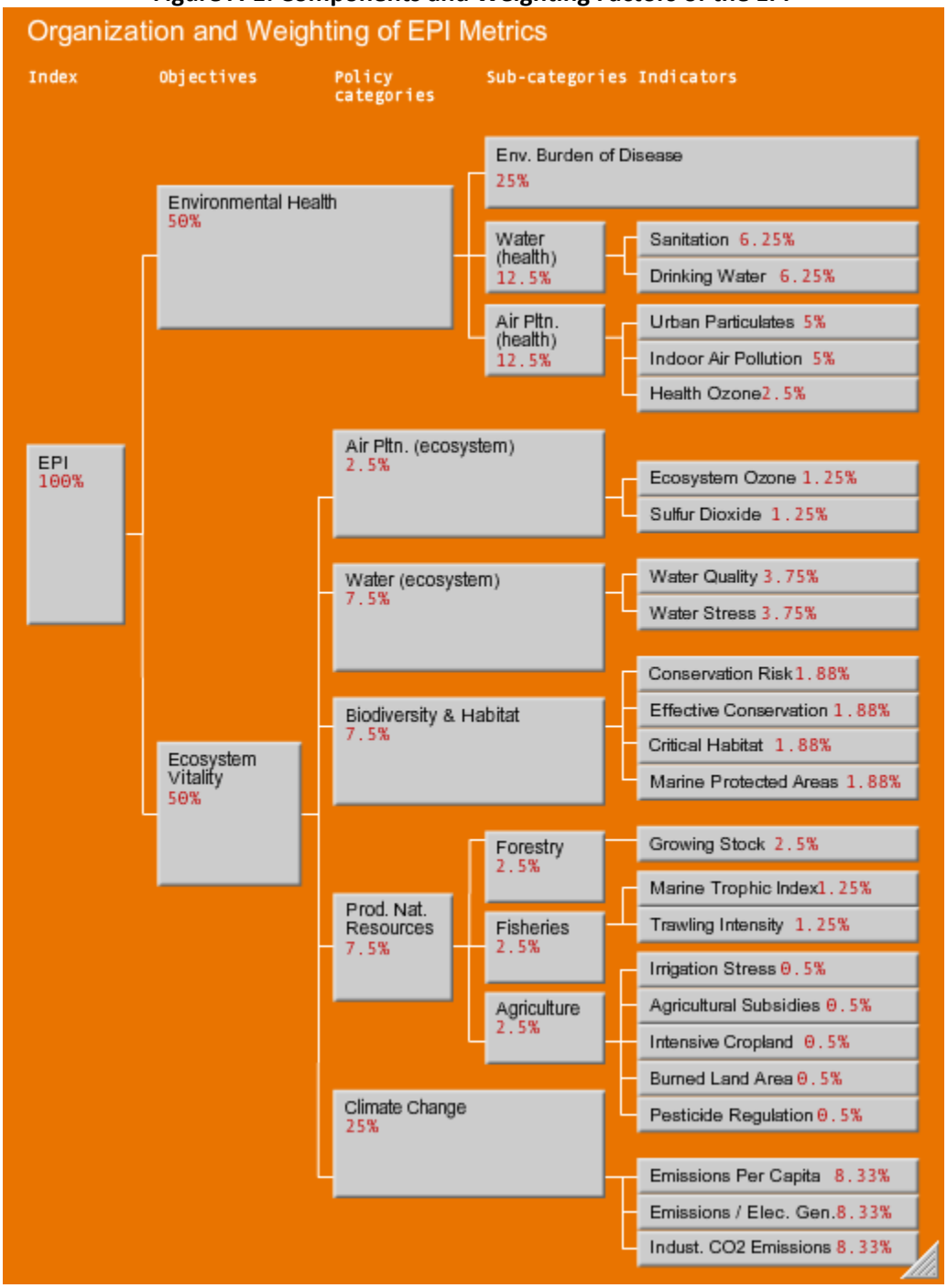
Developed by: Yale Center for Environmental law and Policy**,** Yale University.
http://www.yale.edu/envirocenter

The following information has been copied from: 2005 Environmental Sustainability Index – Benchmarking National Environmental Stewardship, available at: http://www.yale.edu/esi/f_comparing.pdf:

> The Environmental Sustainability Index was developed to evaluate environmental sustainability relative to the paths of other countries. Due to a shift in focus by the teams developing the ESI, a new index was developed, the Environmental Performance Index (EPI), that uses outcome-oriented indicators, then working as a benchmark index that can be more easily used by policy makers, environmental scientists, advocates and the general public.

The following diagram describes the components and weighting factors used in the calculation of the EPI:

Figure A-1: Components and Weighting Factors of the EPI



Source: EPI website (http://epi.yale.edu/Contents)

Environmental Sustainability Index (ESI)

Developed by: Yale Center for Environmental Law and Policy (YCELP) and the Center for International Earth Science Information Network (CIESIN) of Columbia University, in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission.
http://sedac.ciesin.columbia.edu/es/esi/

The following information has been copied from: Esty, Daniel C., Marc Levy, Tanja Srebotnjak, and Alexander de Sherbinin (2005). *2005 Environmental Sustainability Index: Benchmarking National Environmental Stewardship*. New Haven: Yale Center for Environmental Law & Policy:

> The Environmental Sustainability Index (ESI) benchmarks the ability of nations to protect the environment over the next several decades. It does so by integrating 76 data sets – tracking natural resource endowments, past and present pollution levels, environmental management efforts, and the capacity of a society to improve its environmental performance – into 21 indicators of environmental sustainability.
>
> These indicators permit comparison across a range of issues that fall into the following five broad categories:
>
> • Environmental Systems
> • Reducing Environmental Stresses
> • Reducing Human Vulnerability to Environmental Stresses
> • Societal and Institutional Capacity to Respond to Environmental Challenges
> • Global Stewardship
>
> The indicators and variables on which they are constructed build on the well-established 'Pressure-State-Response' environmental policy model. The issues incorporated and variables used were chosen through an extensive review of the environmental literature, assessment of available data, rigorous analysis, and broad-based consultation with policymakers, scientists, and indicator experts.
>
> While they do not provide a definitive vision of sustainability, the collection of indicators and variables that form the 2005 ESI provide: (1) a powerful tool for putting environmental decisionmaking on firmer analytical footing (2) an alternative to GDP and the Human Development Index for gauging country progress, and (3) a useful mechanism for benchmarking environmental performance.

The following table lists the five broad categories and the 22 sub-categories that compose the ESI:

Table A-2: Components of the ESI

Source: Adapted from Esty, et al., 2005.

Environmental Sustainability Index (ESI)	
Environmental Systems	Water quantity, including measures of the availability of surface freshwater as well as groundwater.
	Water quality, including measures of eutrophication, turbidity, dissolved oxygen, and other critical indicators.
	Air quality, including measures of pollutants such as sulfur dioxide, nitrogen oxides, particulates, volatile organic compounds (VOCs), and ozone.
	Landscape, including measures of urbanization, deforestation, agricultural conversion, and other anthropogenic alterations of the land.
	Biodiversity, including measures of both genetic and organismic diversity as well as of preservation of critical habitat and fragmentation of ecosystems.
Reducing Environmental Stresses	Air pollution emissions, including emissions of the criteria air pollutants sulfur dioxide, nitrogen oxides, and volatile organic compounds (VOC).
	Water pollution and consumption.
	Stresses on ecosystem functioning, including measures of anthropogenic disturbances to aquatic, terrestrial, and marine ecosystems.
	Waste and consumption, including measures of solid waste generation, landfill volume, hazardous waste generation, unsafe disposal of waste, and natural resource consumption relative to carrying capacities.
	Natural Resource management.
	Population, including measures of fertility and total growth.
Reducing Human Vulnerability to Environmental Stresses	Basic human substenance.
	Environmental health, including measures of morbidity and mortality stemming from waterborne vectors, such as intestinal infectious diseases; from poor air quality, such as respiratory diseases; and from exposure to toxins and mutagens, such as some cancers.
	Susceptibility to environmentally-related natural disasters, such as floods, droughts,landslides and hurricanes.

Table A-2 (continued)

Environmental Sustainability Index (ESI)	
Societal and Institutional Capacity to Respond to Environmental Challenges	Environmental governance, including measures of the effectiveness of the environmental regulatory apparatus, the flexibility and innovativeness of the regulatory regime, the strictness of enforcement of environmental laws as well as the extent of endemic problems such as corruption or deviation from rule of law, the use of best practices concerning monitoring, assessment, and implementation, the extent of public participation in environmental decisionmaking, and the availability of environmental information.
	Science and Technology, including measures of the level of environmental knowledge among the public, the capacity of a society to respond to technical challenges, and the ability of a society to innovate and generate less environmentally harmful products and production processes over time.
	Private Sector Responsiveness to Environmental Challenges, including measures of private sector compliance with laws, commitment to environmental stewardship, and capacity for environment-related innovation.
	Eco-Efficiency.
Global Stewardship	Greenhouse Gas Emissions.
	Participation in international collaboration.
	Transboundary environmental pressures.

Sustainable Society Index (SSI)

Developed by: Sustainable Society Foundation - SSF
http://www.sustainablesocietyindex.com/home.htm

The following information has been copied from: http://www.sustainablesocietyindex.com/ssi-description.htm:

> Over the years many indexes have been developed, among which some very good ones. However, until recently there was no index which:
>
> - comprises all aspects of a sustainable society,
> - is simple, clear and transparent,
> - is adequate for a comparison between countries,
> - and is regularly updated.

For this reason, a new index - the Sustainable Society Index (SSI) - has been developed by the Sustainable Society Foundation. The newly developed Sustainable Society Index, the SSI, integrates for the first time sustainability and quality of life in an understandable way. The SSI is based on public data from scientific research institutes and international organizations.

A detailed description can be read in 'A comprehensive index for a sustainable society: The SSI - the Sustainable Society Index,' published in *Ecological Economics*, Volume 66/2-3, pp 228-242.

The framework of the Index for a Sustainable Society consists of five categories, each built up from several indicators:

Personal Development [weight: 1/7]
- Healthy Life
- Sufficient Food
- Sufficient to Drink
- Safe Sanitation
- Education Opportunities
- Gender Equality

Healthy Environment [weight: 1/7]
- Air Quality
- Surface Water Quality
- Land Quality

Well-balanced Society [weight: 1/7]
- Good Governance
- Employment
- Population Growth
- Income Distribution
- Public Debt

Sustainable Use of Resources [weight: 2/7]
- Waste Recycling
- Use of Renewable Water Resources
- Consumption of Renewable Energy

Sustainable World [weight: 2/7]
- Forest Area
- Preservation of Biodiversity
- Emission of Greenhouse Gases
- Ecological Footprint
- International Cooperation"

Environmental Vulnerability Index (EVI)

Developed by: South Pacific Applied Geoscience Commission (SOPAC), the United Nations Environment Programme (UNEP) and their partners.
http://www.vulnerabilityindex.net

The following information has been copied from the EVI's website:
http://www.vulnerabilityindex.net/:

Environmental Vulnerability - The Issue

Healthy, productive and protective environments, social systems and economies are the basis of sustainable development and human welfare. The environment is the source of all our raw materials and absorbs the pollution from our activities. In turn, whilst going about our daily business (social and economic) we use the environment and convert its resources and natural services into those that directly support us. The problem is that all of these systems can be damaged, overloaded, or prevented from meeting our needs. By our own choices we can to a large extent determine our own quality of life, the condition of our lands and opportunities for future generations.

Vulnerability is a new way of looking at an age-old problem. Instead of focusing just on what has been going wrong in the past and the effects of hazards, vulnerability gives us the opportunity to focus on getting things right for the future. As a future-focused approach, vulnerability is a way of using strengths and strategically improving weaknesses.

Vulnerability refers to the tendency of something to be damaged. The opposite of this is resilience, or the ability to resist and/or recover from damage. When we talk about vulnerability, we are automatically also talking about resilience because the two are opposite sides of a single coin. That is, something is vulnerable to the extent that it is not resilient, and visa versa.

The idea of vulnerability/resilience applies equally well to physical entities (people, ecosystems, coastlines) and to abstract concepts (social systems, economic systems, countries). The factors that cause the damage are known as hazards, each of which will be associated with some level of risk, or likelihood of occurring.

Why focus on vulnerability?

The vulnerability of our environmental, social and economic systems is made up of more than just the risk of disasters and good or bad management. It is not just about climate change, or globalisation, or trade agreements. It must also include an understanding of how well any system (environmental, social and economic) can cope with any hazards that may come its way and that might harm it. It would be impossible to work towards good quality of life and growth for countries under a sustainable development model if no account were made of the damage that can occur from internal and outside influences.

For development to be sustainable, we clearly need to learn to manage our vulnerabilities. We need to be able to understand and/or manage hazards, natural resilience and acquired resilience. This understanding for the first time opens up opportunities for improving our overall vulnerability because it forces us to examine the problem from all angles, instead of just focusing on the risk of disasters. Vulnerability management is emerging as a critical part of any sustainable development strategy.

The interesting thing about vulnerability is that it can be examined at different levels for different issues. That is, it can be used to look at a single issue, or to assess a complex entity such as a country…

The underlying assumption is that the more degraded the ecosystems of a country (as a result of past natural and anthropogenic hazards), the more vulnerable it is likely to be to future hazards. Indicators were also selected to ensure a good spread of information across the different elements that comprise and/or affect ecosystems. Indicators on weather & climate (6 indicators), geology (4), geography (6), ecosystem resources & services (28) and human populations (6) were chosen to ensure a good cross-section of the ecological processes, including human interactions occurring in countries.

The EVI is calculated using a total of 50 indicators:

Table A-3: Components of the EVI

Source: Adapted from EVI website, 2009.

Environmental Vulnerability Index		
Weather and Climate	1	High Winds
	2	Dry Periods
	3	Wet Periods
	4	Hot Periods
	5	Cold Periods
	6	Sea Temperature
Geology	7	Volcanoes
	8	Earthquakes
	9	Tsunamis
	10	Slides
Geography	11	Land Area
	12	Country Dispersion
	13	Isolation
	14	Relief
	15	Lowlands
	16	Borders
Resources and Services	17	Ecosystem Imbalance
	18	Environmental Openness
	19	Migrations
	20	Endemics
	21	Introductions
	22	Endangered Species
	23	Extinctions
	24	Vegetation Cover
	25	Loss of Cover
	26	Habitat Fragmentation
	27	Degradation
	28	Terrestrial Reserves

Table A-3 (continued)

Environmental Vulnerability Index		
	29	Marine Reserves
	30	Intensive Farming
	31	Fertilizers
	32	Pesticides
	33	Biotechnology
	34	Productivity Overfishing
	35	Fishing Effort
	36	Renewable Water
	37	Sulphur Dioxide Emissions
	38	Waste Production
	39	Waste Treatment
	40	Industry
	41	Spills
	42	Mining
	43	Sanitation
	44	Vehicles
Human Population	45	Population
	46	Population Growth
	47	Tourists
	48	Coastal Settlements
	49	Environmental Agreements
	50	Conflicts

Sustainable Development Index (SDI)

Developed by: Consultative Group on Sustainable Development Indicators at the International Institute for Sustainable Development (IISD).
http://www.iisd.org/cgsdi/

The following information has been copied from: Pavel Nováček and Peter Mederly. *Global Partnership for Development.* American Council for United Nations University, May 2002:

> The index should cover the significant aspects of sustainable development. As the four UNCSD recommended areas of sustainable development (environmental, social, economic, institutional) do not cover all the aspects, seven major topics were selected:
>
> - Human rights, freedom, and equality
> - Demographic development and life expectancy
> - Health conditions and health care
> - Education, technologies, and information

- Economic development and foreign indebtedness
- Resource consumption, eco−efficiency
- Environmental quality, environmental problems

The variables were selected on the following criteria:

- relevance to the indicator, as well as coherence with sustainable development;
- long−term observation and evaluation of the variable, data available for the last several years, and the possibility to extrapolate trends;
- data available at least for 100 countries (with some exceptions); and
- minimization of the number of data sources used, because it is desirable to use one source of information for most of the variables.

Fifty−eight variables had been selected; the number of variables for one indicator varied from three to six (an average of four variables by indicator). The construction of sub−indices and the overall index is a key methodological problem. Advantages and disadvantages of individual variable weight was considered. But because the mutual relationships among the variables and their significance are not yet known at this stage of the study, it was decided to weight all variables equally. The final index is therefore an arithmetical average of all the variables. Determining the weight is a task for the next step in the evolution of the SD Index, based on multidimensional data analysis and finding correlation between individual variables.

The SDI is comprised of the following topics and sub-topics:

Table A-4: Components of the SDI

Source: Adapted from Nováček, et al.,, 2002.

Sustainable Development Index (SDI)	
1. Human rights, freedom and equality	A. Politics and human rights
	B. Equality
2. Demographic and life expectancy	C. Demography issues
	D. Life expectancy
3. Health and health care	E. Health care
	F. Diseases and nutrition
4. Education, technology, and information	G. Education
	H. Technologies and access to information
5. Economic development and foreign indebtedness	I. Economy
	K. Indebtedness
6. Resource consumption	L. Economy–genuine savings
	M. Economy–resource consumption
7. Environmental issues	N. Environment–natural resources, land use
	O. Environment–urban and rural problems

Wellbeing Index (WI)

Developed by: Robert Prescott-Allen

Prescott-Allen, R. 2001. The Wellbeing of Nations: A Country-by-Country Index of Quality of Life and the Environment. Washington, DC: Island Press.

The following information has been copied from a summary of the event: The Wellbeing of Nations: Developing Tools for Measuring Sustainable Development,. *Featuring Robert Prescott-Allen, PADATA and author of The Wellbeing of Nations; Thomas E. Lovejoy, Lead Environmental Specialist for Latin America and the Caribbean, The World Bank (introduction); and Melinda Kimble, Senior Vice-President for Programs, UN Foundation (discussant).* October 11, 2001. Available at: http://wilsoncenter.org/index.cfm?topic_id=1413&fuseaction=topics.event_summary&event_id=6852:

> While 'sustainability' and 'sustainable development' are two of the key concepts for 21st century national and global policymaking, the terms often evoke glazed eyes and lip service, according to researcher and consultant Robert Prescott-Allen. To reinvigorate and sharpen these concepts, Prescott-Allen has invented several indices of human and ecosystem well-being that he says are much broader (and more precise) yardsticks of progress and health than such well-known indicators as the Gross Domestic Product or the Human Development Index. Prescott-Allen introduced his findings and his new Island Press book, The Wellbeing of Nations: A Country-by-Country Index of Quality of Life and the Environment, to a Wilson Center audience of population, development aid, and environment experts…
>
> Prescott-Allen, who has founded and chaired several influential IUCN-The World Conservation Union projects and has 18 years experience evaluating and advising development strategies on four continents, said that every society should continually ask itself two questions: How sustainable are we? And how well are we? To answer these questions, Prescott-Allen said, we need a formal assessment method to provide clear numeric measurements that can be the basis for policy and can build public consensus for action.
>
> Prescott-Allen defined "sustainability" (which he said is just another way of saying "the good life") as a combination of (a) a high level of human well-being, and (b) the high level of ecosystem well-being that supports it. Much as the white of an egg surrounds and supports its yolk, Prescott-Allen said, an ecosystem surrounds and supports people. Any measure of well-being, therefore, must reflect this interdependence…
>
> But why aren't present indices adequate for measuring the state of the world? Prescott-Allen argued that human well-being is both more than the strength of a market economy (which is what GDP measures) or a society's distance from deprivation (as measured by the Human Development Index). Instead, he said, human well-being consists of five dimensions:
>
> - Long lives in good health and a stable population base;
> - Wealth to secure basic needs and livelihoods as well as to promote enterprise and prosperity;
> - Knowledge to live sustainably and fulfill potential as well as a vibrant culture;
> - A community that upholds the freedom of members, has an open and clean government, and which is safe from violence and crime;

- Benefits that are shared equally by males and females and shared equitably among all strata of society.

Similarly, Prescott-Allen said that ecosystem well-being is more than low resource consumption (so it cannot be adequately measured by The Ecological Footprint) as well as more than the sum of a nation's environmental policies and practices (as measured by the Environmental Sustainability Index). Ecosystem well-being, according to Prescott-Allen, also has five dimensions:

- Conserving the diversity and quality of the natural land ecosystem;
- Conserving the diversity and quality of water ecosystems;
- Restoring the chemical balance of global atmosphere and the quality of local air;
- Maintaining all wild species and the genes in domesticated species;
- Keeping resource use within the carrying-capacity of ecosystems.

How To Measure Well-Being

The Wellbeing of Nations contains an exhaustive breakdown of each of these dimensions into the indicators that Prescott-Allen uses to develop his indices. The problem for any such work, Prescott-Allen said, is to convert these 'apples and oranges' indicator measurements into common units.

Instead of using the inherently-limited options of physical units or money, Prescott-Allen opted for performance scores, which are the distance between a standard and the actual performance of a country. Using international targets, national standards, and expert opinions to set his myriad performance standards, Prescott-Allen then mapped each country's performances onto a 0-100 scale—making it 'readily comprehensible to a wide range of lay people,' he said. The numeric scale also allows each score to be summed—for example, water withdrawal, inland water quality, and river conversion can be added to give a cumulative inland waters index for each country. 'We can instantly see how any country is performing on any given indicator,' said Prescott-Allen.

Happy Planet Index (HPI)

Developed by: New Economics Foundation
http://www.neweconomics.org

The following information has been copied from: Happy Planet Index website (accessed in April 2009). http://www.happyplanetindex.org/about.htm:

The Happy Planet Index (HPI) is an innovative new measure that shows the ecological efficiency with which human well-being is delivered around the world. It is the first ever index to combine environmental impact with well-being to measure the environmental efficiency with which country by country, people live long and happy lives.

The Index doesn't reveal the 'happiest' country in the world. It shows the relative efficiency with which nations convert the planet's natural resources into long and happy lives for their citizens. The nations that top the Index aren't the happiest places in the world, but the nations that score well show that achieving, long, happy lives without over-stretching the planet's resources is

possible. The HPI shows that around the world, high levels of resource consumption do not reliably produce high levels of well-being (life-satisfaction), and that it is possible to produce high levels of well-being without excessive consumption of the Earth's resources. It also reveals that there are different routes to achieving comparable levels of well-being. The model followed by the West can provide widespread longevity and variable life satisfaction, but it does so only at a vast and ultimately counter-productive cost in terms of resource consumption…

How it is calculated

The HPI reflects the average years of happy life produced by a given society, nation or group of nations, per unit of planetary resources consumed. Put another way, it represents the efficiency with which countries convert the earth's finite resources into well-being experienced by their citizens.

The Global HPI incorporates three separate indicators: ecological footprint, life-satisfaction and life expectancy.

Conceptually, it is straight forward and intuitive:

$$HPI = \frac{\text{Life satisfaction x Life expectancy}}{\text{Ecological Footprint} + \alpha} x\ ß$$

(For details of how alpha and beta are calculated, see the appendix in the full Happy Planet Index report)

Life satisfaction

Extensive research has been conducted in psychology and the social sciences to understand the factors influencing well-being. Nevertheless, it is only relatively recently that subjective measures of well-being have begun to be taken seriously outside academia. In the UK there has been a groundswell of interest in the potential of subjective well-being measures both from within government and from those such as nef seeking to inform and influence policy from outside. However, just as there is controversy over whether IQ tests really measure intelligence, there is considerable debate over whether self-reports of life satisfaction have anything to do with real 'well-being'. Yet, self-reports of life satisfaction are considered valid if they correlate reliably with predicted objective indicators that are thought to be associated with well-being. Most academics working on well-being are satisfied that ratings of life satisfaction within a country or culture are acceptably valid. An individual's self-reported life satisfaction correlates with reports from loved ones, with how often they experience good moods, and even the likelihood they will commit suicide later on in their life. People with positive self-perceptions also tend to live longer than those who regard themselves more negatively. As well as being valid, self-reports of life satisfaction seem to be reliable. In other words, people tend to give the same patterns of response over time, and when slightly different question wordings are used.

Some researchers notably those from an economics background tend to see happiness, life satisfaction and well-being as synonymous and interchangeable. But there are important and clearly discernable differences. Satisfaction with life overall, tends to be generally stable since it reflects a summary of "judgements about feelings". Whilst on the individual level, day-to-day changes in happiness are of interest, at a policy level it is overall satisfaction that gives the best

indication of how groups of people are faring. If a majority of people in a country report dissatisfaction with their lives, this seems to be a reasonable indication that something is awry, either with government policy, with society, or with both.

International surveys tend to consider life satisfaction by asking respondents a question such as: 'If you consider your life overall, how satisfied would you say you are nowadays?' Responses are given on a 010 scale, from not at all satisfied to extremely satisfied. Clearly this is not a perfect measure. Ideally, subjective well-being would be assessed by asking a series of questions, perhaps probing different aspects of life and framing the issue in different ways so as to gain a more complete picture. As a general indicator of the state of well-being in a country, however, this single question performs surprisingly well, showing good validity when compared with other national-level statistics.

The Happy Planet Index: What it reveals

On a scale of 0 to 100 for the HPI, we have set a reasonable target for nations to aspire to of 83.5. This is based on attainable levels of life expectancy and well-being and a reasonably sized ecological footprint.

At this point in time, the highest HPI is only 68.2, scored by the Pacific archipelago of Vanuatu. The lowest, and perhaps less surprising than some other results, is Zimbabwe's at 16.6. No country achieves an overall high score and no country does well on all three indicators. Vanuatu, for example, has only a moderate level of life expectancy at 69 years.

The message is that when we measure the efficiency with which countries enable the fundamental inputs of natural resources to be turned into the ultimate ends of long and happy lives, all can do better.

This conclusion is less surprising in the light of our argument that governments have been concentrating on the wrong indicators for too long. If you have the wrong map, you are unlikely to reach your destination.

Some of the most unexpected findings of the HPI concern the marked differences between nations, and the similarities among some groups of nations:

Island nations score well above average in the Index**:** They have higher life satisfaction, higher life expectancy and marginally lower Footprints than other states. Yet incomes (by GDP per capita) are roughly equal to the world average. Even within regions, islands do well. Malta tops the Western world with Cyprus in seventh place (out of 24); the top five HPI nations in Africa are all islands; as well as two of the top four in Asia. Perhaps a more acute awareness of environmental limits has sometimes helped their societies to bond better and to adapt to get more from less. Combined with the enhanced well-being that stems from close contact with nature, the world as a whole stands to learn much from the experience of islands.

It is possible to live long, happy lives with a much smaller environmental impact**:** For example, in the United States and Germany people's sense of life satisfaction is almost identical and life expectancy is broadly similar. Yet Germany's Ecological footprint is only about half that of the USA. This means that Germany is around twice as efficient as the USA at generating happy long lives based on the resources that they consume. Ecological footprint is only about half that of the

USA. This means that Germany is around twice as efficient as the USA at generating happy long lives based on the resources that they consume.

Why do we need the Happy Planet Index?

In the Western world, economics is at the heart of our thinking about most issues. When we talk of growth or development, we are typically thinking about the distribution and flow of money. A nation's progress is also most commonly measured in terms of GDP. Defined as the total value of a country's annual output of goods and services. GDP is the standard measure of economic activity and the key headline indicator for government policy in the vast majority of countries.

GDP was never intended to function as an indicator of well-being. Even the economist Simon Küznets, a central figure in the development of GDP, in 1934 urged the US Congress to remember "The welfare of a nation can scarcely be inferred from a measurement of national income." Yet, until quite recently, it has routinely been assumed to be a reliable proxy for standard of living.

The logic underlying this was that- growth in GDP implies economic activity, which in turn implies that people are spending money and improving their quality of life. But GDP turns out to be a poor indicator of welfare in several key respects. For a start, interpreting it as a standard-of-living measure means assuming that income is strongly correlated with national well-being, such that - all else being equal general well-being will increase as the economy grows. It has been repeatedly proven in recent years that this is simply not true. Undoubtedly, a relationship exists between income and well-being, but after a certain, surprisingly low level of GDP is reached, the strength of this relationship declines markedly.

GDP is also insensitive to the distribution of income within countries. A country with high rates of poverty, a small but affluent elite, and high exports could have a similar GDP per capita to one with comparably little inequality and a thriving domestic economy. GDP also fails to distinguish money spent correcting or compensating for undesirable events. This can lead to some apparently perverse results. For example, it has been estimated that the Enron accounting scandal may have contributed up to $1 billion to US GDP. Natural disasters - hurricanes, floods and so on -also tend to boost GDP, because huge amounts of public money are typically spent in mitigating the resulting damage. From an environmental perspective this is a disastrous oversight - GDP counts resource consumption, but takes no account whatsoever of the extent to which it can be maintained, or its real cost.

Quality of Life Index (QOL)

Developed by: The Economist Intelligence Unit
http://www.eiu.com/

"The Economist Intelligence Unit has developed a new 'quality of life' index based on a unique methodology that links the results of subjective life-satisfaction surveys to the objective determinants of quality of life across countries." *Quoted from* 'The Economist Intelligence Unit's quality-of-life Index.' See the entire document at http://www.economist.com/media/pdf/QUALITY_OF_LIFE.PDF for a full overview.

The QOL uses the following factors/weights:

Table A-5: Components of the QLI

Source: Adapted from The Economist Intelligence Unit.

Quality of Life Index (QLI)	Weight %
Material wellbeing	18.8
Health	19
Family relations	11.3
Job security	7.7
Social and community activities	12.2
Political freedom and security	26.2
Gender equality	4.7

Appendix B: Original Sources for Metrics Taken from the Earth Trends Portal

Table B-1: Original Sources for Metrics Taken from the Earth Trends Portal

Source: Compiled by the author.

Metric	Original Source[35]
Total population, both sexes	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations.
Land: Total area	Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO.
Civil liberties index	Freedom House. 2007. Freedom in the World 2007: The Annual Survey of Political Rights and Civil Liberties. New York: Freedom House.
Control of Corruption Index	Governance Matters VII: Aggregate and Individual Governance Indicators, 1996-2007. D. Kaufmann, A. Kraay, and M. Mastruzzi (2008). World Bank Policy Research Working Paper 4654.
Level of freedom index	Freedom House. 2007. Freedom in the World 2007: The Annual Survey of Political Rights and Civil Liberties. New York: Freedom House.
Political rights index	Freedom House. 2007. Freedom in the World 2007: The Annual Survey of Political Rights and Civil Liberties . New York: Freedom House.
Political Stability and Absence of Violence Index	Governance Matters VII: Aggregate and Individual Governance Indicators, 1996-2007. D. Kaufmann, A. Kraay, and M. Mastruzzi (2008). World Bank Policy Research Working Paper 4654.
Press freedom index	Freedom House. 2007. Freedom of the Press 2007: A Global Survey of Media Independence. New York: Freedom House.
Regulatory Quality Index	Governance Matters VII: Aggregate and Individual Governance Indicators, 1996-2007. D. Kaufmann, A. Kraay, and M. Mastruzzi (2008). World Bank Policy Research Working Paper 4654.
Religious freedom index	Freedom House, Center for Religious Freedom. 2000. Religious Freedom in the World: A Global Survey of Religious Freedom and Persecution. Washington: Freedom House.

[35] "*TRANSFORMED TO PER CAPITA*" indicates that the metric has been divided by population using figures from: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations. "*TRANSFORMED TO PER LAND AREA*" indicates that the metric has been divided by land area using figures from: Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO.

Table B-1 (continued)

Metric	Original Source
Rule of Law Index	Governance Matters VII: Aggregate and Individual Governance Indicators, 1996-2007. D. Kaufmann, A. Kraay, and M. Mastruzzi (2008). World Bank Policy Research Working Paper 4654.
Transnational Corporations: Foreign direct investment, net inflows	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. *TRANSFORMED TO PER CAPITA.*
Transnational Corporations: Number of foreign affiliates	United Nations Conference on Trade and Development (UNCTAD). 2006. World Investment Report 2006 - FDI from Developing and Transition Economies: Implications for Development. Annex Table A.I.6. Number of parent corporations and foreign affiliates, by region and economy, latest available year.â€ New York and Geneva: UNCTAD. *TRANSFORMED TO PER CAPITA*.
Transnational Corporations: Number of parent enterprises	United Nations Conference on Trade and Development (UNCTAD). 2006. World Investment Report 2006 - FDI from Developing and Transition Economies: Implications for Development. Annex Table A.I.6. Number of parent corporations and foreign affiliates, by region and economy, latest available year.â€ New York and Geneva: UNCTAD. *TRANSFORMED TO PER CAPITA*.
Investment in telecommunications	International Telecommunication Union (ITU). 2007. World Telecommunication Indicators 2006. Geneva: ITU. *TRANSFORMED TO PER CAPITA*.
Density of international non-governmental organizations with membership	Center for the Study of Global Governance. 2004. Global Civil Society 2004/5. H. Anheier et al., eds. London: Sage.
Corruption: Bribe Payer's Index	Transparency International. 2006. 2006 Bribe Payer's Index. Berlin: Transparency International.
Corruption perceptions index	Internet Center for Corruption Research. 2006. Corruption Perceptions Index. Berlin: Internet Center for Corruption Research.
Present value of debt as a percent of GNI	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.

Table B-1 (continued)

Metric	Original Source
Total debt service	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. *TRANSFORMED TO PER CAPITA*.
Total debt service as a percent of export earnings	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. *TRANSFORMED TO PER CAPITA*.
Total external debt	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. TRANSFORMED TO PER CAPITA.
(External)Aid as a percent of government expenditure	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Aid (received) per capita	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Government cash deficit/surplus as a percent of GDP	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Government consumption expenditure as a percent of GDP	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Military expenditure as a percent of GDP	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Military expenditure as a percent of government expenditure	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.

Table B-1 (continued)

Metric	Original Source
Public education expenditure as a percent of GDP	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank
Public health expenditure as a percent of GDP	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Cost to register property	The World Bank Group. 2007. Doing Business Custom Datasets. Washington, DC: The World Bank
Cost to start a new business	The World Bank Group. 2007. Doing Business Custom Datasets. Washington, DC: The World Bank.
Time required to register property	The World Bank Group. 2007. Doing Business Custom Datasets. Washington, DC: The World Bank.
Time required to start a new business	The World Bank Group. 2007. Doing Business Custom Datasets. Washington, DC: The World Bank.
Water Poverty Index	Natural Environment Research Council, Centre for Ecology and Hydrology. 2002. The Water Poverty Index: International Comparisons. Wallingford: Centre for Ecology and Hydrology.
Organic water pollutant (BOD) emissions	Development Data Group, The World Bank. 2006. 2006 World Development Indicators Online. Washington, DC: The World Bank. *TRANSFORMED TO PER CAPITA*.
Internal Renewable Water Resources (IRWR): Dependency ratio	Food and Agriculture Organization of the United Nations (FAO) Land and Water Development Division. 2007. AQUASTAT Information System on Water and Agriculture: Online database. Rome: FAO.
Access to an improved water source	World Health Organization (WHO) and United Nation's Children's Fund (UNICEF). 2006. Meeting the MDG Drinking Water and Sanitation Target: The Urban and Rural Challenge of the Decade. Geneva: WHO and New York: UNICEF.

Table B-1 (continued)

Metric	Original Source
Access to improved sanitation	World Health Organization (WHO) and United Nation's Children's Fund (UNICEF). 2006. Meeting the MDG Drinking Water and Sanitation Target: The Urban and Rural Challenge of the Decade. Geneva: WHO and New York: UNICEF.
Rural access to an improved water source	World Helath Organization (WHO) and United Nation's Children's Fund (UNICEF). 2006. Meeting the MDG Drinking Water and Sanitation Target: The Urban and Rural Challenge of the Decade. Geneva: WHO and New York: UNICEF.
Rural access to improved sanitation	World Helath Organization (WHO) and United Nation's Children's Fund (UNICEF). 2006. Meeting the MDG Drinking Water and Sanitation Target: The Urban and Rural Challenge of the Decade. Geneva: WHO and New York: UNICEF.
Urban access to an improved water source	World Helath Organization (WHO) and United Nation's Children's Fund (UNICEF). 2006. Meeting the MDG Drinking Water and Sanitation Target: The Urban and Rural Challenge of the Decade. Geneva: WHO and New York: UNICEF.
Urban access to improved sanitation	World Health Organization (WHO) and United Nation's Children's Fund (UNICEF). 2006. Meeting the MDG Drinking Water and Sanitation Target: The Urban and Rural Challenge of the Decade. Geneva: WHO and New York: UNICEF.
Carbon monoxide emissions	The Netherlands National Institute for Public Health and the Environment/The Netherlands Environmental Assessment Agency (RIVM/MNP) and the Netherlands Organization for Applied Scientific Research (TNO). 2005 and 2001. The Emission Database for Global Atmospheric Research (EDGAR) 3.2 Fast Track 2000 and 3.2. Precursors: CO (Carbon Monoxide): Extended Emissions 2000 and Aggregated Emissions 1990/1995. The Netherlands: RIVM. *TRANSFORMED TO PER CAPITA*.
Nitrogen oxides emissions	The Netherlands National Institute for Public Health and the Environment/The Netherlands Environmental Assessment Agency (RIVM/MNP) and the Netherlands Organization for Applied Scientific Research (TNO). 2005 and 2001. The Emission Database for Global Atmospheric Research (EDGAR) 3.2 Fast Track 2000 and 3.2. Precursors: NOx (Nitrogen Oxides): Extended Emissions 2000 and Aggregated Emissions 1990/1995. The Netherlands: RIVM. TRANSFORMED TO PER CAPITA.

Table B-1 (continued)

Metric	Original Source
Non-methane VOC emissions	The Netherlands National Institute for Public Health and the Environment/The Netherlands Environmental Assessment Agency (RIVM/MNP) and the Netherlands Organization for Applied Scientific Research (TNO). 2005 and 2001. The Emission Database for Global Atmospheric Research (EDGAR) 3.2 Fast Track 2000 and 3.2. Precursors: NMVOC (Non-Methane Volatile Organic Compounds): Extended Emissions 2000 and Aggregated Emissions 1990/1995. The Netherlands: RIVM. TRANSFORMED TO PER CAPITA.
Sulfur dioxide emissions	The Netherlands National Institute for Public Health and the Environment/The Netherlands Environmental Assessment Agency (RIVM/MNP) and the Netherlands Organization for Applied Scientific Research (TNO). 2005 and 2001. The Emission Database for Global Atmospheric Research (EDGAR) 3.2 Fast Track 2000 and 3.2. Acidifying gases: SO2 (Sulfur Dioxide): Extended Emissions 2000 and Aggregated Emissions 1990/1995. The Netherlands: RIVM. TRANSFORMED TO PER CAPITA.
Cumulative emissions from land use change	Climate Analysis Indicators Tool (CAIT) version 3.0. (Washington, DC: World Resources Institute, 2005). TRANSFORMED TO PER CAPITA.
CO2 emissions per capita	Climate Analysis Indicators Tool (CAIT) version 3.0. (Washington, DC: World Resources Institute, 2005).
Residential CO2 emissions per capita	International Energy Agency (IEA) Statistics Division. 2006. CO2 Emissions from Fuel Combustion (2006 edition). Paris: IEA. / Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2005. World Population Prospects: The 2004 Revision. Dataset on CD-ROM. New York: United Nations.
CO2 emissions per GDP	Climate Analysis Indicators Tool (CAIT) version 5.0. (Washington, DC: World Resources Institute, 2005). / EIA. 2005. International Energy Annual 2005. / IEA. 2004. CO2 Emissions from Fuel Combustion (2004 edition). / Marland, G., T.A. Boden, and R. J. Andres. 2005. Global, Regional, and National Fossil Fuel CO2 Emissions. in Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. *TRANSFORMED TO PER CAPITA* USING GDP PER CAPITA.

Table B-1 (continued)

Metric	Original Source
Non-CO2 Greenhouse Gas Emissions: Fluorinated gases	Climate Analysis Indicators Tool (CAIT), version 3.0. (Washington, DC: World Resources Institute, 2005). / EPA. 2004. Personal communications based on Global Non-CO2 Greenhouse Gas Emissions: 1990 - 2020. / EDGAR 3.2 by RIVM/TNO. 2003. (Olivier, J.G.J. and Berdowski, J.J.M., 2001, Global emission sources and sinks. In: J. Berdowski, R. Guicherit and B.J. Heij, eds. The Climate System: 33-78. Lisse: Swets & Zeitlinger Publishers). *TRANSFORMED TO PER CAPITA.*
Non-CO2 Greenhouse Gas Emissions: Methane	Climate Analysis Indicators Tool (CAIT), version 3.0. (Washington, DC: World Resources Institute, 2005). / EPA. 2004. Personal communications based on Global Non-CO2 Greenhouse Gas Emissions: 1990 - 2020. / EDGAR 3.2 by RIVM/TNO. 2003. (Olivier, J.G.J. and Berdowski, J.J.M., 2001, Global emission sources and sinks. In: J. Berdowski, R. Guicherit and B.J. Heij, eds. The Climate System: 33-78. Lisse: Swets & Zeitlinger Publishers). *TRANSFORMED TO PER CAPITA.*
Non-CO2 Greenhouse Gas Emissions: Nitrous oxide	Climate Analysis Indicators Tool (CAIT), version 3.0. (Washington, DC: World Resources Institute, 2005). / EPA. 2004. Personal communications based on Global Non-CO2 Greenhouse Gas Emissions: 1990 – 2020. / EDGAR 3.2 by RIVM/TNO. 2003. (Olivier, J.G.J. and Berdowski, J.J.M., 2001, Global emission sources and sinks. In: J. Berdowski, R. Guicherit and B.J. Heij, eds. The Climate System: 33-78. Lisse: Swets & Zeitlinger Publishers). *TRANSFORMED TO PER CAPITA.*
Cellular mobile telephone subscribers per 1000 people	International Telecommunication Union (ITU). 2007. World Telecommunication Indicators 2006. Geneva: ITU.
Homes with personal computers	International Telecommunication Union (ITU). 2006. World Telecommunication Indicators 2005. Geneva: ITU.
Homes with telephones	International Telecommunication Union (ITU). 2006. World Telecommunication Indicators 2005. Geneva: ITU.
Internet users per 1000 people	International Telecommunication Union (ITU). 2007. World Telecommunication Indicators 2006. Geneva: ITU.
Television sets per 1000 people	International Telecommunication Union (ITU). 2007. World Telecommunication Indicators 2006. Geneva: ITU.

Table B-1 (continued)

Metric	Original Source
AIDS/HIV: Antiretroviral therapy coverage	World Health Organization (WHO) and Joint United Nations Programme on HIV/AIDS (UNAIDS). 2006. Progress on Global Access to HIV Antiretroviral Therapy: A Report on "3 by 5" and Beyond. Geneva: WHO/UNAIDS.
AIDS/HIV: Adults and children living with HIV	Joint United Nations Programme on HIV/AIDS (UNAIDS). 2006. Report on the global AIDS epidemic. Geneva: UNAIDS.
Average annual reduction in under-5 mortality	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Table 10. New York: UNICEF.
Infant mortality rate	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Table 1. New York: UNICEF. / United Nations Children's Fund (UNICEF). 2006. Childinfo.org: Monitoring the Situation of Children and Women. Child Mortality statistical database. New York: UNICEF.
Stunting in children under 5--moderate and severe	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Table 2. New York: UNICEF.
Under-5 mortality rate	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Tables 1 and 10. New York: UNICEF. / United Nations Children's Fund (UNICEF). 2006. Childinfo.org: Monitoring the Situation of Children and Women. Child Mortality statistical database. New York: UNICEF.
Underweight children under 5--moderate and severe	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Table 2. New York: UNICEF.
Wasting in children under 5--moderate and severe	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Table 2. New York: UNICEF.
Crude birth rate	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations.

Table B-1 (continued)

Metric	Original Source
Crude death rate	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations.
Life expectancy at birth, both sexes	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations.
Net number of migrants	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations.
Total fertility rate	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations
Internally displaced persons	Internal Displacement Monitoring Centre, Norwegian Refugee Council. 2006. Internal Displacement: Global Overview of Trends and Developments in 2005. Geneva: Norwegian Refugee Council. *TRANSFORMED TO PER CAPITA.*
Average length of schooling, both sexes	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators. Paris: UNESCO.
Primary school net enrollment ratio	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators. Paris: UNESCO.
Secondary school gender parity in gross enrollment	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators. Paris: UNESCO.
Secondary school net enrollment ratio	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators. Paris: UNESCO.
Tertiary school gross enrollment ratio, female	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators. Paris: UNESCO.
Lack of Durability of Housing	United Nations Human Settlements Programme (UN-HABITAT). 2003. Slums of the World: The face of urban poverty in the new millennium?.
% Owner Occupied Housing Units, Rural	United Nations Human Settlements Programme (UN-HABITAT). 2001. Global Report on Human Settlements: Statistical Annexes.

Table B-1 (continued)

Metric	Original Source
% Owner Occupied Housing Units, Urban	United Nations Human Settlements Programme (UN-HABITAT). 2001. Global Report on Human Settlements: Statistical Annexes.
Lack of Sufficient Living Area	United Nations Human Settlements Programme (UN-HABITAT). 2003. Slums of the World: The face of urban poverty in the new millennium?
Percent of urban population living in slums	United Nations Human Settlements Programme (UN-HABITAT). 2003. Slums of the World: The face of urban poverty in the new millennium?
Women Headed Households, Percent of Total	United Nations Human Settlements Programme (UN-HABITAT). 2001. Global Report on Human Settlements: Statistical Annexes.
Agricultural labor force as a percent of total labor force	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO.
Female professional and technical workers, percent of total	United Nations Development Programme (UNDP). 2007. Human Development Report 2007. New York: UNDP.
Female literacy rate as a percentage of male literacy rate	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators, Literacy Statistics. Paris: UNESCO
Literacy rate, all adults	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators, Literacy Statistics. Paris: UNESCO.
Literacy rate, youth (age 15 to 24)	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators, Literacy Statistics. Paris: UNESCO
Population above age 65, both sexes	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2005. World Population Prospects: The 2004 Revision. Dataset on CD-ROM. New York: United Nations. *TRANSFORMED TO PER CAPITA*.

Table B-1 (continued)

Metric	Original Source
Population below age 15, both sexes	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2005. World Population Prospects: The 2004 Revision. Dataset on CD-ROM. New York: United Nations. *TRANSFORMED TO PER CAPITA*.
Growth rate of total population	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations.
Population density	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations.
Alcohol consumption per capita	World Health Organization (WHO). 2005. Global Alcohol Database. Geneva: WHO.
Contraceptive prevalence rate	Department of Economic and Social Affairs, United Nations Population Division (UNPD). 2005. World Contraceptive Use. New York: UNPD.
Women with unmet need for family planning	Department of Economic and Social Affairs, United Nations Population Division (UNPD). 2005. World Contraceptive Use. New York: UNPD.
Government expenditure on health as a percent of total expenditure on health	World Health Organization (WHO). 2006. World Health Report 2006: Annex Table 2. Geneva: WHO.
Per capita total expenditure on health	World Health Organization (WHO). 2006. World Health Report 2006: Annex Table 3. Geneva: WHO.
Solid fuel use	World Health Organization (WHO). 2006. Global Health Atlas: World Health Statistics. Geneva: WHO.
Passenger cars per 1000 people	Development Data Group, The World Bank. 2006. 2006 World Development Indicators Online. Washington, DC: The World Bank.
Deaths due to road accidents	International Road Federation (IRF). 2002. World Road Statistics 2002 on CD-ROM, Table 7. Geneva: International Road Federation.
Pump prices for diesel fuel	The World Bank. 2004. World Development Indicators 2004 (The World Bank, Washington, D.C.)

Table B-1 (continued)

Metric	Original Source
Pump prices for super gasoline	The World Bank. 2004. World Development Indicators 2004. (The World Bank, Washington, D.C.)
Road traffic, million vehicle-kilometers	International Road Federation (IRF). 2002. World Road Statistics 2002 on CD-ROM, Table 5A. Geneva: International Road Federation.
Total road network	International Road Federation (IRF). 2002. World Road Statistics 2002 on CD-ROM, Table 1. Geneva: International Road Federation. *TRANSFORMED TO PER CAPITA*.
Total vehicles per km road	International Road Federation (IRF). 2002. World Road Statistics 2002 on CD-ROM, Table 4. Geneva: International Road Federation. *TRANSFORMED TO PER CAPITA*.
Volume of public road transport	International Road Federation (IRF). 2002. World Road Statistics 2002 on CD-ROM, Table 5B. Geneva: International Road Federation. *TRANSFORMED TO PER CAPITA*.
Growth rate of rural population	United Nations, Department of Economic and Social Affairs, Population Division. 2006. World Urbanization Prospects: The 2005 Revision. Urban and Rural Areas Dataset (POP/DB/WUP/Rev.2005/1/Table A.3), dataset in digital form.
Growth rate of urban population	United Nations, Department of Economic and Social Affairs, Population Division. 2006. World Urbanization Prospects: The 2005 Revision. Urban and Rural Areas Dataset (POP/DB/WUP/Rev.2005/1/Table A.6), dataset in digital form.
Total population in cities with more than 100,000 inhabitants	The World Bank Group. 2004. Urban Population in World Bank Regions by City Size. Washington, DC: World Bank. *TRANSFORMED TO PER CAPITA*.
Total population in cities with more than one million inhabitants	The World Bank Group. 2004. Urban Population in World Bank Regions by City Size. Washington, DC: World Bank. *TRANSFORMED TO PER CAPITA*.
Urban population as a percent of total population	United Nations, Department of Economic and Social Affairs, Population Division. 2006. World Urbanization Prospects: The 2005 Revision. Urban and Rural Areas Dataset (POP/DB/WUP/Rev.2005/1/Table A.2), dataset in digital form. New York: United Nations.

Table B-1 (continued)

Metric	Original Source
Share of total household expenditure, education	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI.
Base of the Pyramid: Share of total household expenditure, energy	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI.
Base of the Pyramid: Share of total household expenditure, food	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI.
Base of the Pyramid: Share of total household expenditure, health	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI.
Base of the Pyramid: Share of total household expenditure, household goods	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI.
Base of the Pyramid: Share of total household expenditure, housing	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI.

Table B-1 (continued)

Metric	Original Source
Base of the Pyramid: Share of total household expenditure, information and communication technology	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI.
Base of the Pyramid: Share of total household expenditure, transportation	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI.
Base of the Pyramid: Share of total household expenditure, water	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI.
Development Assistance: Aid received as a percent of GNI	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Financial Flows: Net Inflows (sales - purchases) of Cross-Border Mergers and Acquisitions	United Nations Conference on Trade and Development (UNCTAD). 2005. World Investment Report 2005: Transnational Corporations and the Internationalization of R&D. Annex Table "B.4. Cross-border M&As, by region/economy of seller/purchaser, 2002-2004.â€ New York and Geneva: UNCTAD. *TRANSFORMED TO PER CAPITA*.
GDP per capita, annual growth rate	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.

Table B-1 (continued)

Metric	Original Source
GDP per capita, PPP, current international dollars	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
GDP: Official exchange rate	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Percent GDP from agriculture	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Percent GDP from industry	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Percent GDP from manufacturing	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Percent GDP from services	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
GNI: PPP, current international dollars	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Income Equality: Gini Index	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Share of total income, highest 20% of population	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Share of total income, fourth 20% of population	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Share of total income, lowest 20% of population	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.

Table B-1 (continued)

Metric	Original Source
Share of total income, second 20% of population	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Share of total income, third 20% of population	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Workers' remittances and compensation of employees, paid	Development Data Group, The World Bank. 2007. 2007 World Development Indicators Online. Washington, DC: The World Bank.
Workers' remittances and compensation of employees, received	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Micro, Small, and Medium Enterprises: MSME employment, percent of total	Small and Medium Enterprise Department, International Finance Corporation (IFC). 2006. Micro, Small, and Medium Enterprises: A Collection of Published Data. Washington, DC: IFC.
Micro, Small, and Medium Enterprises: MSMEs per 1000 people	Small and Medium Enterprise Department, International Finance Corporation (IFC). 2006. Micro, Small, and Medium Enterprises: A Collection of Published Data. Washington, DC: IFC.
Adjusted Net Savings, percent of GNI	Development Data Group, The World Bank. 2007. 2007 World Development Indicators Online. Washington, DC: The World Bank.
National poverty rates	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
National poverty rates, rural population	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
National poverty rates, urban population	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.

Table B-1 (continued)

Metric	Original Source
International tourism expenditures	Development Data Group, The World Bank. 2007. 2007 World Development Indicators Online. Washington, DC: The World Bank.
International tourism receipts	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Trade in Forest Products: Imports, value	Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO. *TRANSFORMED TO PER CAPITA*.
Trade in Goods and Services: Current account balance	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. *TRANSFORMED TO PER CAPITA*.
Trade in Fish and Fisheries Products: Exports, quantity	Food and Agriculture Organization of the United Nations (FAO) Fishery Information, Data and Statistics Unit. 2007. Commodities production and trade 1976-2005. FISHSTAT Plus - Universal software for fishery statistical time series [online or CD-ROM]. Rome: FAO. *TRANSFORMED TO PER CAPITA*.
Trade in Fish and Fisheries Products: Imports, quantity	Food and Agriculture Organization of the United Nations (FAO) Fishery Information, Data and Statistics Unit. 2007. Commodities production and trade 1976-2005. FISHSTAT Plus - Universal software for fishery statistical time series [online or CD-ROM]. Rome: FAO. *TRANSFORMED TO PER CAPITA*.
Trade in Goods and Services: Net trade in goods and services (balance of trade)	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. *TRANSFORMED TO PER CAPITA*.
Trade in Goods: Agricultural raw materials exports as a percent of merchandise exports	Development Data Group, The World Bank. 2007. 2007 World Development Indicators Online. Washington, DC: The World Bank.

Table B-1 (continued)

Metric	Original Source
Trade in Goods: Agricultural raw materials imports as a percent of merchandise imports	Development Data Group, The World Bank. 2007. 2007 World Development Indicators Online. Washington, DC: The World Bank.
Trade in Goods: Food exports as a percent of merchandise exports	Development Data Group, The World Bank. 2007. 2007 World Development Indicators Online. Washington, DC: The World Bank.
Trade in Goods: Food imports as a percent of merchandise imports	Development Data Group, The World Bank. 2007. 2007 World Development Indicators Online. Washington, DC: The World Bank.
Trade in Goods: Fuel exports as a percent of merchandise exports	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Trade in Goods: Fuel imports as a percent of merchandise imports	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Trade in Goods: Manufactures exports as a percent of merchandise exports	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.
Trade in Goods: Manufactures imports as a percent of merchandise imports	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank.

Table B-1 (continued)

Metric	Original Source
Electricity consumption per capita	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition)--Economic Indicators and Energy Balances of Non-OECD Countries (2007 edition)--Economic Indicators. Paris: IEA.
Total electricity production	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. *TRANSFORMED TO PER CAPITA*.
Energy Consumption by Source: Biogas and liquid biomass	International Energy Agency (IEA) Statistics Division. 2008. Energy Balances of OECD Countries (2006 edition) and Energy Balances of Non-OECD Countries (2006 edition). Paris: IEA. *TRANSFORMED TO PER CAPITA*.
Energy Consumption by Source: Coal and coal products	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. *TRANSFORMED TO PER CAPITA*.
Energy Consumption by Source: Hydroelectric	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. *TRANSFORMED TO PER CAPITA*.
Energy Consumption by Source: Natural gas	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. *TRANSFORMED TO PER CAPITA*.
Energy Consumption by Source: Oil and petroleum products	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. *TRANSFORMED TO PER CAPITA*.
Energy Consumption by Source: Solar, wind, and wave	International Energy Agency (IEA) Statistics Division. 2006. Energy Balances of OECD Countries (2006 edition) and Energy Balances of Non-OECD Countries (2006 edition). Paris: IEA. *TRANSFORMED TO PER CAPITA*.

Table B-1 (continued)

Metric	Original Source
Energy Consumption by Source: Solid biomass (includes fuelwood)	International Energy Agency (IEA) Statistics Division. 2008. Energy Balances of OECD Countries (2006 edition) and Energy Balances of Non-OECD Countries (2006 edition). Paris: IEA. *TRANSFORMED TO PER CAPITA*.
Residential energy consumption per capita	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. / Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2005. World Population Prospects: The 2007 Revision. Dataset on CD-ROM. New York: United Nations.
Total energy consumption per capita	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA.
Total energy production	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. *TRANSFORMED TO PER CAPITA*.
Paper and paperboard consumption per capita	Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service.
Diesel oil consumption per capita	International Energy Agency (IEA) Statistics Division. 2006. Energy Balances of OECD Countries (2006 edition)--Extended Balances and Energy Balances of Non-OECD Countries (2006 edition)--Extended Balances. Paris: IEA.
Motor gasoline consumption per capita	International Energy Agency (IEA) Statistics Division. 2006. Energy Balances of OECD Countries (2008 edition)--Extended Balances and Energy Balances of Non-OECD Countries (2007 edition)--Extended Balances. Paris: IEA.
Protected Areas: IUCN categories I-V, percent of total land area	United Nations Environment Programme - World Conservation Monitoring Centre (UNEP-WCMC). 2006. World Database on Protected Areas (WDPA). *TRANSFORMED TO PER CAPITA.*

Table B-1 (continued)

Metric	Original Source
Protected Areas: IUCN categories I-VI and Other, percent of total land area	United Nations Environment Programme - World Conservation Monitoring Centre (UNEP-WCMC). 2006. World Database on Protected Areas (WDPA). *TRANSFORMED TO PER CAPITA.*
Protected Areas: Larger than 100,000 hectares, number	United Nations Environment Programme - World Conservation Monitoring Centre (UNEP-WCMC). 2006. World Database on Protected Areas (WDPA). *TRANSFORMED TO PER LAND AREA.*
Protected Areas: Marine and Littoral, number	United Nations Environment Programme - World Conservation Monitoring Centre (UNEP-WCMC). 2006. World Database on Protected Areas (WDPA). *TRANSFORMED TO PER COASTAL AREA*
Fertilizer use intensity	Food and Agriculture Organization of the United Nations (FAO). 2007. FAOSTAT Online Statistical Service. Rome: FAO.
Pesticide use intensity	Food and Agriculture Organization of the United Nations (FAO), 2004. FAOSTAT Online Statistical Service. Rome: FAO.
Agricultural Inputs: Tractor use intensity	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO.
Agricultural Inputs: Water use intensity	Food and Agriculture Organization of the United Nations (FAO) Land and Water Development Division. 2007. AQUASTAT Information System on Water and Agriculture: Online database. Rome: FAO. / Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO.
Food production per capita index	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO.
Agricultural Production Indices: Total production per capita index	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO.

Table B-1 (continued)

Metric	Original Source
Agricultural Production: Cereals, yield	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO.
Agricultural Production: Cereals, total production	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO. *TRANSFORMED TO PER CAPITA.*
Agricultural Production: Roots and tubers, total production	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO.
Agricultural Production: Roots and tubers, yield	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO.
Food Aid: Cereals donated by country	Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO. *TRANSFORMED TO PER CAPITA.*
Food Aid: Cereals received by country	Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO. *TRANSFORMED TO PER CAPITA.*
Irrigated land as a percent of total agricultural area	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO.
Cattle stocks	Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service. FAO: Rome. *TRANSFORMED TO PER CAPITA.*
Chicken stocks	Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service. FAO: Rome. *TRANSFORMED TO PER CAPITA.*
Equine (horses, mules, asses) stocks	Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service. FAO: Rome. *TRANSFORMED TO PER CAPITA.*

Table B-1 (continued)

Metric	Original Source
Goat stocks	Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service. FAO: Rome. *TRANSFORMED TO PER CAPITA.*
Sheep stocks	Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service. FAO: Rome. *TRANSFORMED TO PER CAPITA.*
Swine stocks	Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service. FAO: Rome. *TRANSFORMED TO PER CAPITA.*
Turkey stocks	Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service. FAO: Rome. *TRANSFORMED TO PER CAPITA.*
Meat Consumption: Per capita	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT on-line statistical service (FAO, Rome, 2004).
Meat production per capita	Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO.
Percentage of population that is undernourished	Food and Agriculture Organization of the United Nations (FAO), Statistics Division. Food Security Statistics, 2006.
Calorie supply per capita	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO.
Calorie supply per capita from animal products	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT on-line statistical service.
Grain fed to livestock as a percent of total grain consumed	United States Department of Agriculture (USDA) Foreign Agricultural Service (FAS). 2007. Production, Supply & Distribution Online Database. USDA: Washington, D.C.
Number of organic farms	Willer, Helga and Yussefi, Minou, Eds. 2006. The World of Organic Agriculture - Statistics and Emerging Trends 2006. International Federation of Organic Agriculture Movements (IFOAM). Bonn, Germany: IFOAM. *TRANSFORMED TO PER CAPITA.*

Table B-1 (continued)

Metric	Original Source
Organic land area as a percent of total agricultural area	Willer, Helga and Yussefi, Minou, Eds. 2006. The World of Organic Agriculture - Statistics and Emerging Trends 2006. International Federation of Organic Agriculture Movements (IFOAM). Bonn, Germany: IFOAM.
Food exports as a percent of merchandise exports	Development Data Group, The World Bank. 2007. 2007 World Development Indicators Online. Washington, DC: The World Bank.
Dryland area as a percent of total area, average	UNEP/GRID. United Nations Environment Program/Global Resource Information Database. 1991. Global digital data sets for land degradation studies: a GIS approach. Prepared by U. Deichmann and L. Eklundh. GRID Case Study Series No. 4. UNEP/GEMS and GRID. Nairobi, Kenya.
Ecosystem Area: Barren or sparsely vegetated area	Loveland, T.R., Reed, B.C., J.F., Brown, J.F., Ohlen, D.O., Zhu, Z., Yang, L. Merchant. J. 2000. Global Land Cover Characteristics Database (GLCCD) Version 2.0. *TRANSFORMED TO PER LAND AREA.*
Urban and built-up areas	Global Land Cover 2000 database. European Commission, Joint Research Centre, 2003. *TRANSFORMED TO PER LAND AREA.*
Paper Production: Recovered paper	Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO. *TRANSFORMED TO PER CAPITA.*
Paper Production: Paper and paperboard	Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO. *TRANSFORMED TO PER CAPITA.*
Forest area (current) as a percent of original forest area	Closed forest data: Bryant, D., D. Nielsen and L. Tangley, "The Last Frontier Forests: Ecosystems and Economies on the Edge", (World Resources Institute, Washington, DC, 1997). Land area is from Food and Agriculture Organization of the United Nations (FAO), FAOSTAT On-line Statistical Service.
Forest area (original) as a percent of total land area	Closed forest data: Bryant, D., D. Nielsen and L. Tangley, "The Last Frontier Forests: Ecosystems and Economies on the Edge", (World Resources Institute, Washington, DC, 1997). Land area is from Food and Agriculture Organization of the United Nations (FAO), FAOSTAT On-line Statistical Service,
Forest plantations area, average annual percent change	Food and Agriculture Organization of the United Nations (FAO). 2005. Global Forest Resources Assessment 2005: Progress towards sustainable forest management. FAO Forestry Paper 147. Rome: FAO.

Table B-1 (continued)

Metric	Original Source
Frontier forest area as a percent of original forest area	Closed forest data: Bryant, D., D. Nielsen and L. Tangley, "The Last Frontier Forests: Ecosystems and Economies on the Edge", (World Resources Institute, Washington, DC, 1997). Land area is from Food and Agriculture Organization of the United Nations (FAO), FAOSTAT On-line Statistical Service.
Mangrove forest area	Source: Spalding, M., F. Blasco, and C. Field (Eds.). "World Mangrove Atlas", The International Society for Mangrove Ecosystems (ISME), Okinawa, Japan, 1997. *TRANSFORMED TO PER CAPITA.*
Forest Extent: Natural forest area	Food and Agriculture Organization of the United Nations (FAO). 2005. Global Forest Resources Assessment 2005: Progress towards sustainable forest management. FAO Forestry Paper 147. Rome: FAO. *TRANSFORMED TO PER CAPITA.*
Total forest area	Food and Agriculture Organization of the United Nations (FAO). 2005. Global Forest Resources Assessment 2005: Progress towards sustainable forest management. FAO Forestry Paper 147. Rome: FAO. *TRANSFORMED TO PER CAPITA.*
Paper and paperboard consumption per capita	Trade in Paper: Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service.

Appendix C: Complete List of Statistically Significant Metrics Found in the Analysis

Table C-1: Complete List of Statistically Significant Metrics Found in the Analysis

Source: Created by the author.

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Access to Information: Cellular mobile telephone subscribers per 1000 people	67	(0.313)	0.01	Not statistically significant			121	(0.341)	<0.001	Not statistically significant		
Access to Information: Homes with personal computers (% of homes)	N/A			Not statistically significant			Not statistically significant			32	(0.419)	<0.05
Access to Information: Homes with telephones (% of homes)	Not statistically significant			Not statistically significant			Not statistically significant			21	(0.402)	<0.1
Access to Information: Internet users per 1000 people	N/A			Not statistically significant			106	(0.312)	<0.01	Not statistically significant		
Adequate solid waste disposal (% of total waste disposal)	N/A			N/A			N/A			27	(0.555)	<0.01
Adult literacy rate (% aged 15 or older)	N/A			N/A			N/A			113	0.549	<0.001
Agricultural Inputs: Water use intensity (m^3/ha/yr)	N/A			N/A			N/A			136	0.400	<0.001
Agricultural Production Indices: Food production per capita index (% of 1999-2001 avg. food production per capita)	Not statistically significant			Not statistically significant			121	(0.292)	0.001	142	0.375	<0.001
Base of the Pyramid: Share of total household expenditure, information and communication technology (% of total household expenditure among those earning less than $3,000 annually)	N/A			N/A			N/A			35	0.527	<0.01

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Children's Health: Infant mortality rate (deaths per 1,000 live births)	69	(0.251)	<0.05	83	(0.310)	<0.01	121	(0.314)	0.001	Not statistically significant		
Children's Health: Stunting in children under 5--moderate and severe (%)	N/A			N/A			N/A			107	(0.579)	<0.001
Children's Health: Under-5 mortality rate (deaths per 1,000 live births)	69	(0.254)	<0.05	83	(0.304)	<0.01	121	(0.295)	0.001	Not statistically significant		
Children's Health: Underweight children under 5--moderate and severe (%)	N/A			N/A			N/A			108	(0.569)	<0.001
Children's Health: Wasting in children under 5--moderate and severe (%)	N/A			N/A			N/A			105	(0.529)	<0.001
Civil Society: Density of international non-governmental organizations with membership (INGOs with membership per million population)	N/A			Not statistically significant			121	(0.337)	<0.001	Not statistically significant		
CO2 Emissions per capita (metric tons per capita)	69	(0.234)	<0.1	82	(0.220)	<0.05	121	(0.165)	<0.1	Not statistically significant		
Consumption of domestic water (internal footprint) (m3/cap/year)	N/A			N/A			N/A			123	0.375	<0.001
Contraceptive Prevalence Rate (% of married women aged 15-49 practicing contraception)	N/A			N/A			N/A			87	0.686	<0.001

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Corruption: Bribe Payer's Index (score from 0 to 10, with 10 being the "best")	N/A			N/A			N/A			29	(0.724)	<0.001
Death rate from intestinal infectious diseases (deaths per 100,000 population)	N/A			N/A			N/A			70	0.574	<0.001
Debt: Total debt service (current US$ per person)	Not statistically significant			Not statistically significant			92	(0.284)	<0.01	109	0.641	<0.001
Demographics: Crude birth rate (births per 1,000 people)	Not statistically significant			Not statistically significant			121	(0.333)	<0.001	142	(0.275)	<0.01
Demographics: Crude death rate (deaths per 1,000 people)	69	(0.268)	<0.05	83	(0.339)	<0.01	121	(0.224)	<0.05	142	(0.482)	<0.001
Demographics: Life expectancy at birth, both sexes (years)	Not statistically significant			83	0.372	<0.001	121	0.373	<0.001	Not statistically significant		
Demographics: Net number of migrants (thousands of people)	69	(0.375)	<0.01	Not statistically significant			Not statistically significant			142	(0.342)	<0.001
Demographics: Total fertility rate (children per woman)	Not statistically significant			Not statistically significant			121	(0.364)	<0.001	142	(0.324)	<0.001
Desertification Sub-Index (Standardized unit scale - from 1-7; with 1 as good and 7 as bad)	N/A			N/A			N/A			142	0.342	<0.001
Development Assistance: (external) Aid as a percent of government expenditure	N/A			Not statistically significant			Not statistically significant			48	(0.422)	<0.001

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Development Assistance: Aid received as a percent of GNI	Not statistically significant			Not statistically significant			Not statistically significant			103	(0.660)	<0.001
Dissolved oxygen concentration (mg. dissolved oxygen per liter water)	N/A			N/A			N/A			49	(0.469)	<0.001
EF: Built-up land footprint - % of total ecological footprint	69	0.398	<0.001	83	0.255	<0.05	121	0.409	<0.001	Not statistically significant		
EF: Carbon footprint - % of total ecological footprint	69	(0.338)	<0.01	83	(0.322)	<0.01	121	(0.303)	0.001	142	0.209	<0.05
EF: Cropland footprint - % of total ecological footprint	69	0.365	<0.01	Not statistically significant			121	0.318	<0.001	Not statistically significant		
EF: Grazing footprint - % of total ecological footprint	Not statistically significant			83	0.320	<0.01	121	0.159	<0.1	Not statistically significant		
Education: Primary school net enrollment ratio (%)	N/A			N/A			74	0.353	<0.01	Not statistically significant		
Education: Secondary school gender parity in gross enrollment (Index value; 100 = enrollment equality)	N/A			N/A			86	0.260	<0.05	115	0.276	<0.01
Electricity consumption per capita (kWh per person)	N/A			74	(0.226)	<0.1	105	(0.280)	<0.01	Not statistically significant		
Energy Consumption by Source: Biogas and liquid biomass (ktoe per million persons)	N/A			73	(0.210)	<0.1	103	(0.173)	<0.1	119	(0.433)	<0.001

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Energy Consumption by Source: Hydroelectric (ktoe per million persons)	N/A			74	0.356	<0.01	Not statistically significant			Not statistically significant		
Energy Consumption by Source: Solar, wind, and wave (ktoe per million persons)	N/A			Not statistically significant			Not statistically significant			119	(0.321)	<0.001
Energy Consumption: Residential energy consumption per capita (kgoe per person)	N/A			72	(0.307)	<0.01	Not statistically significant			119	(0.432)	<0.001
Energy Consumption: Total energy consumption per capita (kgoe per person)	N/A			74	(0.232)	<0.05	105	(0.323)	0.001	Not statistically significant		
Foreign Direct Investments, net inflows (% of GDP)	N/A			N/A			N/A			135	0.305	0.001
Forest (Paper) Production: Recovered paper (metric tons per thousand persons)	Not statistically significant			Not statistically significant			80	(0.324)	<0.01	93	(0.417)	<0.001
Forest Extent: Natural forest area (percent of total area)	N/A			Not statistically significant			137	(0.423)	<0.001	Not statistically significant		
Forest Extent: Total forest area (percent of total area)	N/A			Not statistically significant			142	(0.310)	<0.001	Not statistically significant		
Forest Extent: Forest area (current) as a percent of original forest area	N/A			N/A			N/A			134	0.216	<0.05
Forest Extent: Frontier forest area as a percent of original forest area	N/A			N/A			N/A			134	0.225	0.01

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
GDP per capita, annual growth rate (%)	Not statistically significant			Not statistically significant			Not statistically significant			140	0.325	<0.001
GDP per capita, PPP, current international dollars	69	(0.269)	<0.05	Not statistically significant			121	(0.403)	<0.001	Not statistically significant		
GDP: Official exchange rate (local currency / US dollars)	69	0.272	<0.05	Not statistically significant			120	0.310	0.001	Not statistically significant		
Gender Empowerment Measure (GEM) (score, from 0 to 1, with 1 being the total gender equality)	N/A			N/A			N/A			84	(0.458)	<0.001
Investment in telecommunications (U.S. dollars per person)	23	(0.405)	<0.1	Not statistically significant			Not statistically significant			Not statistically significant		
Irrigated land as a percent of total agricultural area (%)	Not statistically significant			Not statistically significant			Not statistically significant			137	0.348	<0.001
Labor: Workers' remittances and compensation of employees, received (million US$ per capita)	Not statistically significant			62	0.236	<0.1	107	(0.199)	<0.05	128	0.283	<0.001
Land Degradation (% of a country's land area considered severely and very severely degraded)	N/A			N/A			N/A			139	0.382	<0.001
Language Fractionalization Index (fractionalization score: higher means more diverse)	N/A			N/A			N/A			137	(0.351)	<0.001

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Literacy: Female literacy rate as a percentage of male literacy rate (%)	N/A			N/A			N/A			97	0.552	<0.001
Literacy: Literacy rate, all adults (%)	N/A			N/A			N/A			97	0.550	<0.001
Literacy: Literacy rate, youth (age 15 to 24) (%)	N/A			N/A			N/A			93	0.549	<0.001
Livestock: Goat stocks (8head per person)	Not statistically significant			71	0.315	<0.01	Not statistically significant			Not statistically significant		
Local Air Quality Score (unitless scale - 0 is the worst possible score and 100 is the best)	N/A			N/A			N/A			51	(0.494)	<0.001
Long term unemployment (% of labor force)	N/A			N/A			N/A			27	0.535	<0.01
Meat Consumption: Per capita (Kg. per person)	67	(0.401)	<0.001	80	(0.298)	<0.01	119	(0.278)	<0.01	Not statistically significant		
Micro, Small, and Medium Enterprises: MSMEs per 1000 people	N/A			N/A			N/A			85	(0.407)	<0.001
NBI (National Biodiversity Index) (score between 0 and 1 with large values corresponding to high levels of species abundance and small values reflecting low levels of species abundance)	N/A			N/A			N/A			140	0.238	<0.01

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Number of researchers in R&D per million inhabitants	N/A			N/A			N/A			78	(0.414)	<0.001
Nutrition: Calorie supply per capita from animal products (kilocalories/person/day)	68	(0.323)	<0.01	Not statistically significant			120	(0.223)	<0.05	Not statistically significant		
Nutrition: Grain fed to livestock as a percent of total grain consumed (%)	Not statistically significant			Not statistically significant			Not statistically significant			74	0.429	<0.001
Official development asst. received (net disbursements) (% of GDP)	N/A			N/A			N/A			96	(0.654)	<0.001
Organic Farming: Organic land area as a percent of total agricultural area	N/A			N/A			N/A			94	(0.360)	<0.001
Other Greenhouse Gases per capita (metric tons per capita)	N/A			N/A			N/A			32	(0.367)	<0.05
Patents granted to residents (# of patents per million people)	N/A			N/A			N/A			71	(0.457)	<0.001
Percent GDP from industry	Not statistically significant			Not statistically significant			Not statistically significant			129	0.358	<0.001
Percent GDP from manufacturing	Not statistically significant			Not statistically significant			Not statistically significant			123	0.300	0.001
Percentage of the population with insufficient food	N/A			N/A			N/A			89	(0.567)	<0.001

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Pesticide use (Kg. pesticides used per year per km^2 of total land area)	N/A			N/A			N/A			92	0.383	<0.001
Politics and Freedom: Regulatory Quality Index (Index: -2.5 worst governance, 0 average, 2.5 best governance)	N/A			N/A			121	(0.306)	0.001	Not statistically significant		
Population density (people per square km^2)	Not statistically significant			Not statistically significant			119	0.339	<0.001	Not statistically significant		
Population using improved sanitation (% of the population)	N/A			N/A			N/A			120	0.339	<0.001
Population without electricity (% of the population)	N/A			N/A			N/A			77	(0.657)	<0.001
Population: Above age 65, both sexes (% of the population)	Not statistically significant			Not statistically significant			121	(0.205)	<0.05	142	0.232	<0.01
Population: Below age 15, both sexes (% of the population)	Not statistically significant			Not statistically significant			121	0.257	<0.01	Not statistically significant		
Population: Growth rate of total population (%)	Not statistically significant			Not statistically significant			Not statistically significant			142	(0.326)	<0.001
Poverty: National poverty rates (% of national population)	N/A			N/A			N/A			89	(0.468)	<0.001
Public Health: Contraceptive prevalence rate (percent of married women age 15-49)	N/A			N/A			N/A			129	0.381	<0.001

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Public Health: Per capita total expenditure on health (international dollars per person)	N/A			N/A			121	(0.356)	<0.001	Not statistically significant		
Public Health: Solid fuel use (%)	N/A			N/A			N/A			141	(0.335)	<0.001
Religious Fractionalization Index (fractionalization score: higher means more diverse)	N/A			N/A			N/A			141	(0.255)	<0.01
Religious freedom index (Units: 1-3=Free; 4-5=Partly free; 6-7=Not free)	N/A			N/A			N/A			70	0.401	<0.001
Research and Development expenditure (% of GDP)	N/A			N/A			N/A			92	(0.433)	<0.001
Suspended solids per liter water (mg.)	N/A			N/A			N/A			27	0.439	<0.05
Total external debt (current US$ per person)	Not statistically significant			Not statistically significant			92	(0.339)	0.001	109	0.570	<0.001
Total fertility Rate (average number of births per woman based on current age-specific fertility rates)	N/A			N/A			N/A			142	(0.335)	<0.001
Trade in Forest Products: Imports, value (US dollars per person)	Not statistically significant			Not statistically significant			120	(0.323)	<0.001	Not statistically significant		
Transportation: Motor gasoline consumption per capita (Liters per person)	N/A			73	(0.294)	<0.05	103	(0.211)	<0.05	Not statistically significant		

Table C-1 (continued)

Metric	Movement Towards the Quadrant									Present-day Distance from Quadrant		
	Long –term (80-05)			Med.-term (90-05)			Short-term (00-05)					
	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$	n	R	$P(H_0)$
Transportation: Passenger cars per 1000 people	Not statistically significant			Not statistically significant			Not statistically significant			48	(0.547)	<0.001
Transportation: Pump prices for diesel fuel (US dollars per liter)	N/A			N/A			N/A			139	(0.393)	<0.001
Transportation: Volume of public road transport (passenger-km per person)	N/A			N/A			N/A			21	(0.541)	<0.05
Urban and Rural Areas: Growth rate of rural population (%)	Not statistically significant			83	0.262	<0.05	Not statistically significant			142	(0.337)	<0.001
Urban and Rural Areas: Total population in cities with more than 100,000 inhabitants (% of population in 2000)	N/A			N/A			N/A			119	0.408	<0.001
Urban and Rural Areas: Urban population as a percent of total population (%)	Not statistically significant			Not statistically significant			121	0.168	<0.1	Not statistically significant		
Urban population weighted TSP concentration (micrograms TSP per m^3)	N/A			N/A			N/A			60	0.402	<0.01

n = number of pairs of data (countries).
R = Pearson moment correlation coefficient.
$P(H_0)$ = Probability for the Null Hypothesis (i.e., no correlation).

See Appendix D for a list of complete definitions and original sources of these statistically significant metrics.

Appendix D: Definitions and Original Sources for Statistically Significant Metrics Found in the Analysis

Table D-1: Definitions and Sources for Statistically Significant Metrics Found in the Analysis

Source: Compiled by the author.

Metric	Definition	Original Source
Access to Information: Cellular mobile telephone subscribers per 1000 people	Cellular mobile telephone subscribers per 1000 people refers to the proportion of the population that subscribe to an automatic public mobile telephone service for portable telephones. Subscribers to public mobile data services, private trunked mobile radio, telepoint, or radio paging services are not included. *Quoted from the Earth Trends portal.*.	International Telecommunication Union (ITU). 2007. World Telecommunication Indicators 2006. Geneva: ITU. Available online at http://www.itu.int/ITU-D/ict/publications/world/world.html.
Access to Information: Homes with personal computers (% of homes)	Homes with personal computers is the percentage of households with one or more personal computers. *Quoted from the Earth Trends portal.*	International Telecommunication Union (ITU). 2006. World Telecommunication Indicators 2005. Geneva: ITU. Available online at http://www.itu.int/ITU-D/ict/publications/world/world.html.
Access to Information: Homes with telephones (% of homes)	Homes with telephones is the percentage of households with one or more private telephone lines.	International Telecommunication Union (ITU). 2006. World Telecommunication Indicators 2005. Geneva: ITU. Available online at http://www.itu.int/ITU-D/ict/publications/world/world.html.
Access to Information: Internet users per 1000 people	Internet users per 1000 people refers to the proportion of a country's population that have used the internet at any point in time during the specified year. *Quoted from the Earth Trends portal.*	International Telecommunication Union (ITU). 2007. World Telecommunication Indicators 2006. Geneva: ITU. Available online at http://www.itu.int/ITU-D/ict/publications/world/world.html.
Adequate solid waste disposal (% of total waste disposal)	Adequate solid waste disposal as a % of total waste disposal.	UN-Habitat database

Table D-1 (continued)

Metric	Definition	Original Source
Adult literacy rate (% aged 15 or older)	Adult literacy rate (% aged 15 or older)	UNESCO (United Nations Educational, Scientific and Cultural Organization) Institute for Statistics. 2007a. Correspondence on adult and youth literacy rates. May. Montreal.
Agricultural Inputs: Water use intensity (m^3/ha/yr)	Water use intensity is the amount of water used in the agricultural sector per hectare of temporary and permanent cropland in the year specified. This indicator shows a country's dependence on irrigation for agricultural production. Data are given in cubic meters per hectare per year. *Quoted from the Earth Trends portal.*	Food and Agriculture Organization of the United Nations (FAO) Land and Water Development Division. 2007. AQUASTAT Information System on Water and Agriculture: Online database. Rome: FAO. And: Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO.
Agricultural Production Indices: Food production per capita index (% of 1999-2001 avg. food production per capita)	The food production per capita index presents net food production (after deduction for feed and seed) of a country's agricultural sector per person relative to the base period 1999-2001. The food production per capita index covers all edible agricultural products that contain nutrients; coffee and tea are excluded. *Quoted from the Earth Trends portal.*	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO. Available online at: http://apps.fao.org.

Table D-1 (continued)

Metric	Definition	Original Source
Base of the Pyramid: Share of total household expenditure, information and communication technology (% of total household expenditure among those earning less than $3,000 annually)	Share of total household expenditure, information and communication technology (ICT) refers to the proportion of household spending that is dedicated to ICT among those earning less than $3,000 per year (the Base of the Pyramid). ICT includes telephone and telefax equipment and services and audio-visual, photographic and information processing equipment. Income cutoffs are given in 2002 international dollars, adjusted for purchasing power parity (PPP); when inflated to 2005 international dollars, the actual income cutoff is $3,260. The aim of this data is to generate poverty-specific purchasing power parities that take into account the spending patterns of the poor. *Quoted from the Earth Trends portal.*	World Resources Institute (WRI) and the International Finance Corporation (IFC), 2007. Next Four Billion: Market Size & Business Strategy at the Base of the Pyramid. Washington, D.C.: WRI. Available on-line at: http://www.nextbillion.net/thenext4billion and http://www.wri.org/thenext4billion.
Children's Health: Infant mortality rate (deaths per 1,000 live births)	Infant mortality rate (IMR) is the probability of a child dying between birth and the age of one, expressed per 1,000 live births. The indicator is used as a measure of children's well-being and the level of effort being made to maintain child health. Over three-quarters of child deaths in the developing world are caused by diseases that can be prevented or cured by low-cost interventions such as immunization, oral rehydration therapy (ORT), and antibiotics. *Quoted from the Earth Trends portal.*	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Table 1. New York: UNICEF. Available online at: http://www.unicef.org/sowc07/.

Table D-1 (continued)

Metric	Definition	Original Source
Children's Health: Stunting in children under 5--moderate and severe (%)	Stunting in children under 5â€"moderate and severe, an indicator of child malnutrition, refers to the proportion of children under 5 whose height-for-age is below minus 2 standard deviations (for moderate stunting) or below minus 3 standard deviations (for severe stunting) from the median height-for-age of an international reference population recognized by the World Health Organization (WHO). The values presented here, reported by the United Nations Childrenâ€™s Fund (UNICEF), include both moderate and severe stunting in children. *Quoted from the Earth Trends portal.*	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Table 2. New York: UNICEF. Available online at: http://www.unicef.org/sowc07/.
Children's Health: Under-5 mortality rate (deaths per 1,000 live births)	Under-5 mortality rate (U5MR) is the probability of a child dying between birth and the age of five, expressed per 1,000 live births. The indicator is used as a measure of children's well-being and the level of effort being made to maintain child health. Over three-quarters of child deaths in the developing world are caused by diseases that can be prevented or cured by low-cost interventions such as immunization, oral rehydration therapy (ORT), and antibiotics. *Quoted from the Earth Trends portal.*	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Tables 1 and 10. New York: UNICEF. Available online at: http://www.unicef.org/sowc07/.

Table D-1 (continued)

Metric	Definition	Original Source
Children's Health: Underweight children under 5--moderate and severe (%)	Underweight children under 5â€”moderate and severe, an indicator of child malnutrition, refers to the proportion of children under 5 whose weight-for-age is below minus 2 standard deviations (for moderate underweight) or below minus 3 standard deviations (for severe underweight) from the median weight-for-age of an international reference population recognized by the World Health Organization (WHO). The values presented here, reported by the United Nations Childrenâ€™s Fund (UNICEF), include both moderately and severely underweight children. *Quoted from the Earth Trends portal.*	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Table 2. New York: UNICEF. Available online at: http://www.unicef.org/sowc07/.
Children's Health: Wasting in children under 5--moderate and severe (%)	Wasting in children under 5â€”moderate and severe, an indicator of child malnutrition, refers to the proportion of children under 5 whose weight-for-height is below minus 2 standard deviations (for moderate wasting) or below minus 3 standard deviations (for severe wasting) from the median weight-for-height of an international reference population recognized by the World Health Organization (WHO). The values presented here, reported by the United Nations Childrenâ€™s Fund (UNICEF), include both moderate and severe wasting in children. *Quoted from the Earth Trends portal.*	United Nations Children's Fund (UNICEF). 2006. The State of the World's Children 2007: The Double Dividend of Gender Equality. Table 2. New York: UNICEF. Available online at: http://www.unicef.org/sowc07/.

Table D-1 (continued)

Metric	Definition	Original Source
Civil Society: Density of international non-governmental organizations with membership (INGOs with membership per million population)	Density of international non-governmental organizations with membership is the number of international non-governmental organizations that have either member organizations or individuals in each country per 1 million population. *Quoted from the Earth Trends portal.*	Center for the Study of Global Governance. 2004. Global Civil Society 2004/5. H. Anheier et al., eds. London: Sage. Available online at: http://www.lse.ac.uk/Depts/global/yearbook04chapters.htm.
CO2 Emissions per capita (metric tons per capita)	CO2 emissions per capita represents the mass of carbon dioxide (CO2) emitted per person for a country or region. Data are given in metric tons. *Quoted from the Earth Trends portal.*	Climate Analysis Indicators Tool (CAIT) version 3.0. (Washington, DC: World Resources Institute, 2005). Available at http://cait.wri.org.
Consumption of domestic water (internal footprint) (m3/cap/year)	"The water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business." Water Footprint Network Homepage http://www.waterfootprint.org/?page=files/home	Hoekstra, A.Y. and Chapagain, A.K. (2008) Globalization of water: Sharing the planet's freshwater resources, Blackwell Publishing, Oxford, UK.
Contracepitve Prevalence Rate (% of married women aged 15-49 practicing contraception)	“Contraceptive prevalence rate is the percentage of women who are practicing, or whose sexual partners are practicing, any form of contraception. It is usually measured for married women age 15-49 only." *Quoted from the SEDAC Data Dictionary.*	World Bank SIMA and WDI online
Corruption: Bribe Payer's Index (score from 0 to 10, with 10 being the "best")	The Bribe Payer's Index (BPI) measures the tendency of firms from top exporting countries to pay bribes or make undocumented payments while conducting business abroad. Ratings range in value from 10 (bribes never occur) to 0 (bribes occur often). *Quoted from the Earth Trends portal.*	Transparency International. 2006. 2006 Bribe Payer's Index. Berlin: Transparency International. Available online at: http://www.transparency.org/policy_research/surveys_indices/bpi/bpi_2006#pr.

Table D-1 (continued)

Metric	Definition	Original Source
Death rate from intestinal infectious diseases (deaths per 100,000 population)	"Indicator of the degree to which the population is affected by poor sanitation and water quality, which are related to environmental conditions." *Quoted from the SEDAC Data Dictionary.*	World Health Organization (WHO), Mortality databases for International Classification of Deaths (ICD) revisions 9 and 10, July 2004
Debt: Total debt service (current US$ per person)	Total debt service is the sum of principal repayments and interest actually paid in foreign currency, goods, or services on long-term debt, interest paid on short-term debt, and repayments (repurchases and charges) to the International Monetary Fund (IMF). Both long-term public and private debt are included. Private debt is an external obligation of a private debtor that is not guaranteed by a public entity. Data are in million current U.S. dollars. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.
Demographics: Crude birth rate (births per 1,000 people)	Crude birth rate refers to the average number of births in a year, expressed per 1,000 population. Crude birth rate provides a rough measure of fertility. The projections reported here assume medium fertility (the "medium-fertility assumption" of the United Nations Population Division). *Quoted from the Earth Trends portal.*	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations. Available on-line at http://www.un.org/esa/population/ordering.htm

Table D-1 (continued)

Metric	Definition	Original Source
Demographics: Crude death rate (deaths per 1,000 people)	Crude death rate refers to the average number of deaths in a year, expressed per 1,000 population. Crude death rate provides a rough measure of mortality. The projections reported here assume medium fertility (the "medium-fertility assumption" of the United Nations Population Division). *Quoted from the Earth Trends portal.*	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations. Available on-line at http://www.un.org/esa/population/ordering.htm
Demographics: Life expectancy at birth, both sexes (years)	Life expectancy at birth, both sexes is the average number of years that a newborn baby is expected to live if the age-specific mortality rates effective at the year of birth apply throughout his or her lifetime. The projections reported here assume medium fertility (the "medium-fertility assumption" of the United Nations Population Division). *Quoted from the Earth Trends portal.*	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations. Available on-line at http://www.un.org/esa/population/ordering.htm
Demographics: Net number of migrants (thousands of people)	Net number of migrants measures the number of people entering or leaving a country or region annually during each time period specified. It is calculated as the total number of immigrants (people entering the country) less the number of emigrants (people leaving the country) in a five-year period. The projections reported here assume medium fertility (the "medium-fertility assumption" of the United Nations Population Division). *Quoted from the Earth Trends portal.*	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations. Available on-line at http://www.un.org/esa/population/ordering.htm

Table D-1 (continued)

Metric	Definition	Original Source
Demographics: Total fertility rate (children per woman)	Total fertility rate is an estimate of the number of children an average woman would have if current age-specific fertility rates remained constant during her reproductive years. The projections reported here assume medium fertility (the "medium-fertility assumption" of the United Nations Population Division). *Quoted from the Earth Trends portal.*	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations. Available on-line at http://www.un.org/esa/population/ordering.htm
Desertification Sub-Index (Standardized unit scale - from 1-7; with 1 as good and 7 as bad)	This Sub-Index is an unweighted average of the scores for several EVI variables. *Quoted from the SEDAC Data Dictionary.*	Kaly, U.L., Pratt, C.R. and Mitchell, J. 2004. The Demonstration Environmental Vulnerability Inde (EVI) 2004. SOPAC Technical Report 384, 323 pp.
Development Assistance: (external) Aid as a percent of government expenditure	Aid as a percent of government expenditure is the amount of official development assistance (ODA) received by a country as a percentage of its central government expenditure. This indicator provides a measure of the recipient country's dependency on aid. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.
Development Assistance: Aid received as a percent of GNI	Aid as a percent of GNI is the amount of official development assistance (ODA) received by a country as a percentage of its Gross National Income (GNI), a measure of citizens' income. This indicator provides a measure of the recipient country's dependency on aid. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.
Dissolved oxygen concentration (mg. dissolved oxygen per liter water)	"A measure of eutrophication, which has an important impact on the health of aquatic resources and ecosystems. High levels correspond to low eutrophication." *Quoted from the SEDAC Data Dictionary.*	Socioeconomic Data and Applications Center (SEDAC), Center for International Earth Science Information Network (CIESIN), Columbia University

Table D-1 (continued)

Metric	Definition	Original Source
EF: Built-up land footprint - % of total ecological footprint	Use of use of built-up land as a % of total land used for consumption (footprint).	Global Footprint Network. National Footprint Accounts. 2008 Edition
EF: Carbon footprint - % of total ecological footprint	Use of carbon sinks as a % of total footprint.	Global Footprint Network. National Footprint Accounts. 2008 Edition
EF: Cropland footprint - % of total ecological footprint	Use of croplands as a % of total footprint.	Global Footprint Network. National Footprint Accounts. 2008 Edition
EF: Grazing footprint - % of total ecological footprint	Use of grazing land as a % of total footprint.	Global Footprint Network. National Footprint Accounts. 2008 Edition
Education: Primary school net enrollment ratio (%)	Primary school net enrollment ratio (NER) is the total primary school enrollment (both sexes) of the official primary school age group expressed as a percentage of the population from the same age group. The theoretical maximum value is 100%. A high NER denotes a high degree of participation of the official school-age population in education. If the NER is below 100%, users should not assume that the remaining school-aged population is not enrolled in any school; they could be enrolled in school at other grade levels.	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators. Paris: UNESCO. Available online at http://www.uis.unesco.org/ev.php?URL_ID=5263&URL_DO=DO_TOPIC&URL_SECTION=201.

Table D-1 (continued)

Metric	Definition	Original Source
Education: Secondary school gender parity in gross enrollment (Index value; 100 = enrollment equality)	Secondary school gender parity in gross enrollment represents the ratio of female to male gross enrollment in secondary schooling. A ratio of 100 indicates equality in representation. Values below (above) 100 indicate a higher (lower) ratio of male to female enrollment in secondary education. *Quoted from the Earth Trends portal.*	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators. Paris: UNESCO. Available online at http://www.uis.unesco.org/ev.php?URL_ID=5263&URL_DO=DO_TOPIC&URL_SECTION=201.
Electricity consumption per capita (kWh per person)	Electricity consumption per capita measures the average kilowatt-hours (kWh) of electrical power generated per person in a particular country or region. Public electricity plants, private electricity plants, and combined heat and power (CHP) plants as well as production by nuclear and hydro (excluding pumped storage production), geothermal, etc. Electricity produced by heat from chemical processes is not included here. Electricity consumption equals production + imports - exports - distribution losses. *Quoted from the Earth Trends portal.*	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition)--Economic Indicators and Energy Balances of Non-OECD Countries (2007 edition)--Economic Indicators. Paris: IEA. Available at http://data.iea.org/ieastore/default.asp.
Energy Consumption by Source: Biogas and liquid biomass (ktoe per million persons)	Energy Consumption by Source: Biogas and liquid biomass measures the amount of primary energy consumed from biogas and liquid biomass sources. Data are reported in thousand tonnes of oil equivalent (ktoe). *Quoted from the Earth Trends portal.* This metric was originally published as an absolute number, and was transformed into a per capita figure using the countries' total population.	International Energy Agency (IEA) Statistics Division. 2008. Energy Balances of OECD Countries (2006 edition) and Energy Balances of Non-OECD Countries (2006 edition). Paris: IEA. Available at http://data.iea.org/ieastore/default.asp.

Table D-1 (continued)

Metric	Definition	Original Source
Energy Consumption by Source: Hydroelectric (ktoe per million persons)	Energy Consumption by Source: Hydroelectric measures the amount of primary energy consumed from water power sources in a particular country or region. Data are reported in thousand tonnes of oil equivalent (ktoe). *Quoted from the Earth Trends portal.* This metric was originally published as an absolute number, and was transformed into a per capita figure using the countries' total population.	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. Available at http://data.iea.org/ieastore/default.asp.
Energy Consumption by Source: Solar, wind, and wave (ktoe per million persons)	Energy Consumption by Source: Solar, wind, and wave measures the amount of primary energy consumed from solar photovoltaic, solar thermal, wind, and ocean sources. Data are reported in thousand tonnes of oil equivalent (ktoe). *Quoted from the Earth Trends portal.*	International Energy Agency (IEA) Statistics Division. 2006. Energy Balances of OECD Countries (2006 edition) and Energy Balances of Non-OECD Countries (2006 edition). Paris: IEA. Available at http://data.iea.org/ieastore/default.asp.
Energy Consumption: Residential energy consumption per capita (kgoe per person)	Residential energy consumption per capita measures the amount of primary energy from all sources consumed by the residential sector in each country on a per person basis in the year specified. Data are reported in kilograms of oil equivalent (kgoe) per person. *Quoted from the Earth Trends portal.*	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. Available at http://data.iea.org/ieastore/default.asp.
Energy Consumption: Total energy consumption per capita (kgoe per person)	Total energy consumption per capita measures the amount of primary energy consumed, on average, by each person living in a particular country or region for the year indicated. All primary sources of energy, including coal and coal products, oil and petroleum products, natural gas, nuclear, hydroelectric, etc., are included here. Data are reported in kilograms of oil equivalent (kgoe) per person. *Quoted from the Earth Trends portal.*	International Energy Agency (IEA) Statistics Division. 2007. Energy Balances of OECD Countries (2008 edition) and Energy Balances of Non-OECD Countries (2007 edition). Paris: IEA. Available at http://data.iea.org/ieastore/default.asp.

Table D-1 (continued)

Metric	Definition	Original Source
Foreign Direct Investments, net inflows (% of GDP)	Foreign Direct Investments, net inflows as a % of GDP.	Calculated on the basis of data on foreign direct investment and GDP from World Bank. 2007b. World Development Indicators 2007. CD-ROM. Washington, D.C. (UNDP HDI 2008 Report)
Forest (Paper) Production: Recovered paper (metric tons per thousand persons)	Production of recovered paper describes the amount of waste and scrap of paper or paperboard used in the production of paper products in a given country in a given year. This commodity includes paper and paperboard which has been used for its original purpose and residues from paper conversion, including waste and scrap collected for re-use as a raw material for the manufacture of paper and related products. DIVIDED BY POP. *Quoted from the Earth Trends portal.*	Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO. Available online at: http://faostat.fao.org/.
GDP per capita, annual growth rate (%)	Gross Domestic Product (GDP) per capita, annual growth rate is the annual percentage change in total annual output of a country's economy in constant prices per person. GDP per capita is the total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment, and government spending, divided by the mid-year population. *Quoted from the Earth Trends portal.*	Adapted from the World Bank's World Development Indicators

Table D-1 (continued)

Metric	Definition	Original Source
GDP per capita, PPP, current international dollars	Gross Domestic Product (GDP) per capita, PPP is the total annual output of a country's economy, here in current international dollars, per person. GDP per capita is the total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment, and government spending, divided by the mid-year population. Here, it is converted into current international dollars using Purchasing Power Parity (PPP) rates. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.
GDP: Official exchange rate (local currency / US dollars)	Official exchange rate is the exchange rate determined by national authorities or the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages and is expressed as the number of local currency units equivalent to a U.S. dollar. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.
Gender Empowerment Measure (GEM) (score, from 0 to 1, with 1 being the total gender equality)	The Gender Empowerment Measure (GEM) is a measure of inequalities between men's and women's opportunities in a country. It combines inequalities in three areas: political participation and decision making, economic participation and decision making, and power over economic resources. *Quoted from the Wikipedia entry*.	UNDP HDI 2008 Report

Table D-1 (continued)

Metric	Definition	Original Source
Investment in telecommunications (U.S. dollars per person)	Investment in telecommunications refers to the annual expenditure associated with acquiring the ownership of telecommunication equipment infrastructure for use in a particular country. Totals include supporting land and buildings and intellectual and non-tangible property such as computer software. These include expenditure on initial installations and on additions to existing installations. Data are given in thousands of U.S. dollars. *Quoted from the Earth Trends portal.*	International Telecommunication Union (ITU). 2007. World Telecommunication Indicators 2006. Geneva: ITU. Available online at http://www.itu.int/ITU-D/ict/publications/world/world.html.
Irrigated land as a percent of total agricultural area (%)	Irrigated land as a percent of total agricultural area is the percentage of a country's total agricultural area which is equipped to provide water to crops. Types of irrigated land include full and partial control irrigation, spate irrigation areas, and equipped wetland or inland valley bottoms. The agricultural area is defined as the sum of arable and permanent cropland and permanent pasture. *Quoted from the Earth Trends portal.*	Food and Agriculture Organization of the United Nations (FAO). 2006. FAOSTAT Online Statistical Service. Rome: FAO. Available online at: http://faostat.fao.org.
Labor: Workers' remittances and compensation of employees, received (million US$ per capita)	Workers' remittances and compensation of employees, received comprise current transfers by migrant workers and wages and salaries earned by nonresident workers. Data are given in million U.S. dollars. DIVIDED BY POP. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.

Table D-1 (continued)

Metric	Definition	Original Source
Land Degradation (% of a country's land area considered severely and very severely degraded)	Percent of a country's total land area considered severely and very severely degraded.	Kaly, U.L., Pratt, C.R. and Mitchell, J. 2004. The Demonstration Environmental Vulnerability Inde (EVI) 2004. SOPAC Technical Report 384, 323 pp.
Language Fractionalization Index (fractionalization score: higher means more diverse)	Fractionalization is "a measure of diversity among individuals" (Bossert, et al., 2006)	Alesina, Alberto, et al, 2003. " Fractionalization," Journal of Economic Growth, Springer, vol. 8(2), pages 155-94, June.
Literacy: Female literacy rate as a percentage of male literacy rate (%)	WRI calculates female literacy rate as a percentage of male literacy rate to measure, in a single variable, gender parity in literacy. A value of 100% indicates that female and male literacy rates are the same. Values less than 100% indicate that the female literacy rate is less than the male literacy rate (e.g., 50% indicates that the female literacy rate is half that of male literacy rate). Values greater than 100% indicate that the female literacy rate is greater than the male literacy rate for that country. *Quoted from the Earth Trends portal.*	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators, Literacy Statistics. Paris: UNESCO. Available online at http://www.uis.unesco.org/ev.php?URL_ID=6401&URL_DO=DO_TOPIC&URL_SECTION=201.

Table D-1 (continued)

Metric	Definition	Original Source
Literacy: Literacy rate, all adults (%)	Though it varies across countries, the adult literacy rate is usually defined as the percentage of the population aged 15 years and over who can both read and write, with comprehension, a short, simple statement regarding their everyday life. Literacy data can be used to assess gender, age-group, and geographic patterns of illiteracy within each country, as well as the achievement of national literacy programs and policies. According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO), "These estimates reflect the performance of the national education system, as well as the quality of the human resources within a country in relation to their potential for growth, contribution to development, and quality of life." Adult literacy correlates with GNP per capita, life expectancy, fertility rates, infant mortality, and urbanization. *Quoted from the Earth Trends portal.*	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators, Literacy Statistics. Paris: UNESCO. Available online at http://www.uis.unesco.org/ev.php?URL_ID=6401&URL_DO=DO_TOPIC&URL_SECTION=201.

Table D-1 (continued)

Metric	Definition	Original Source
Literacy: Literacy rate, youth (age 15 to 24) (%)	Though it varies across countries, the youth literacy rate is usually defined as the percentage of the population aged 15-24 years who can both read and write, with comprehension, a short, simple statement regarding their everyday life. Literacy data can be used to assess gender, age-group, and geographic patterns of illiteracy within each country, as well as the achievement of national literacy programs and policies. According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO), "These estimates reflect the performance of the national education system, as well as the quality of the human resources within a country in relation to their potential for growth, contribution to development, and quality of life." Adult literacy correlates with GNP per capita, life expectancy, fertility rates, infant mortality, and urbanization. *Quoted from the Earth Trends portal.*	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. 2006. World Education Indicators, Literacy Statistics. Paris: UNESCO. Available online at http://www.uis.unesco.org/ev.php?URL_ID=6401&URL_DO=DO_TOPIC&URL_SECTION=201.
Livestock: Goat stocks (8head per person)	Goat stocks includes all goats in the country, regardless of place or purpose of their breeding. Goat (Capra spp.) figures include Hircus, Ibex, Nubiana, Pyrenaica, Tibetana, Kashmir, and Angora. DIVIDED BY POP. *Quoted from the Earth Trends portal.*	Food and Agriculture Organization of the United Nations (FAO), 2007. FAOSTAT on-line statistical service. FAO: Rome. Online at: http://faostat.fao.org/.
Local Air Quality Score (unitless scale - 0 is the worst possible score and 100 is the best)	"… is the average of city scores in each country, each city score being the lowest score of six indicators: sulfure dioxide, nitrogen dioxide, ground-level ozone, carbon monoxide, particulates, and lead." *Quoted from the SEDAC Data Dictionary.*	Prescott-Allen, Robert. 2001. The Wellbeing of Nations: A Country-by-Country Index of Quality of Life and the Environment. Washington, DC: Island Press. Table 17

Table D-1 (continued)

Metric	Definition	Original Source
Long term unemployment (% of labor force)	Persons unemployed in the long term as a percent of the total labor force.	OECD (Organisation for Economic Co-operation and Development). 2007. OECD Main Economic Indicators. Paris. [http://www.oecd.org/statsportal]. Accessed July 2007.
Meat Consumption: Per capita (Kg. per person)	Meat consumption per capita refers to the total meat retained for use in country per person per year. Total meat includes meat from animals slaughtered in countries, irrespective of their origin, and comprises horsemeat, poultry, and meat from all other domestic or wild animals such as camels, rabbits, reindeer, and game animals. *Quoted from the Earth Trends portal.*	Source: Food and Agriculture Organization of the United Nations (FAO), FAOSTAT on-line statistical service (FAO, Rome, 2004). Available online at: http://apps.fao.org.
Micro, Small, and Medium Enterprises: MSMEs per 1000 people	MSMEs per 1,000 people refers to the total number of micro, small, and medium enterprises (MSMEs) per 1,000 people in a country. MSMEs are defined in this dataset as enterprises employing no more than 250 employees. Over the last several years, increasing attention has been paid to the importance of MSMEs with regard to growth, employment, innovation, competition, and poverty reduction, though strong evidence of causal relationships remain elusive. *Quoted from the Earth Trends portal.*	Small and Medium Enterprise Department, International Finance Corporation (IFC). 2006. Micro, Small, and Medium Enterprises: A Collection of Published Data. Washington, DC: IFC. Available on-line at: http://www.ifc.org/ifcext/sme.nsf/Content/Resources.

Table D-1 (continued)

Metric	Definition	Original Source
NBI (National Biodiversity Index) (score between 0 and 1 with large values corresponding to high levels of species abundance and small values reflecting low levels of species abundance)	The NBI assesses a country's species richness by measuring species abundance. *Quoted from the SEDAC Data Dictionary.*	Convention on Biological Diversity, Global Biodiversity Outlook (2001).
Number of researchers in R&D per million inhabitants	"Scientific capacity is important for the development of new technologies for sustainable environmental management." *Quoted from the SEDAC Data Dictionary.*	World Bank. 2007b. World Development Indicators 2007. CD-ROM. Washington, D.C.; aggregates calculated for HDRO by the World Bank.
Nutrition: Calorie supply per capita from animal products (kilocalories/person/day)	Calorie supply from animal products per capita refers to the amount of available food from animal products, expressed in calories per person, per day. Animal products include: all types of meat and fish; animal fats and fish oils; edible offal; milk, butter, cheese, and cream; and eggs and egg products. *Quoted from the Earth Trends portal.*	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT on-line statistical service. Available on-line at http://apps.fao.org. FAO: Rome, 2004.

Table D-1 (continued)

Metric	Definition	Original Source
Nutrition: Grain fed to livestock as a percent of total grain consumed (%)	Grain fed to livestock as a percent of total grain consumption refers to the total domestic consumption of feed grain (grain consumed by animals) as a percentage of the total domestic grain consumption. Grains include wheat (including durum wheat), rice (milled), corn, barley, sorghum, millet, rye, oats, and mixed grains. Total domestic grain consumption is the quantity of dried grain used for feed, food, seed, and industrial purposes during the local 12-month marketing year of an individual country. *Quoted from the Earth Trends portal.*	United States Department of Agriculture (USDA) Foreign Agricultural Service (FAS). 2007. Production, Supply & Distribution Online Database. USDA: Washington, D.C. Available online at http://www.fas.usda.gov/psdonline/.
Official development asst. received (net disbursements) (% of GDP)	Official development asst. received (net disbursements) as percent of GDP.	Calculated on the basis of data on ODA from OECD-DAC (Organisation for Economic Co-operation and Development, Development Assistance Committee). 2007. Correspondence on official development assistance disbursed. May. Paris and GDP from World Bank. 2007b. World Development Indicators 2007. CD-ROM. Washington, D.C. (UNDP HDI 2008 Report)
Organic Farming: Organic land area as a percent of total agricultural area	Organic land area as a percent of total agricultural area refers to the amount of land either fully converted to organic agriculture or in the process of conversion as a percentage of a country's total agricultural land. *Quoted from the Earth Trends portal.*	Willer, Helga and Yussefi, Minou, Eds. 2006. The World of Organic Agriculture - Statistics and Emerging Trends 2006. International Federation of Organic Agriculture Movements (IFOAM). Bonn, Germany: IFOAM. Available online at: http://www.ifoam.org/press/press/Statistics_2006.html.

Table D-1 (continued)

Metric	Definition	Original Source
Other Greenhouse Gases per capita (metric tons per capita)	"...emissions of CO2 other than from burning fuel (see above), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF), including CO2 emissions/removals from land-use change and forestry." *Quoted from the SEDAC Data Dictionary.*	UN Framework Convention on Climate Change
Patents granted to residents (# of patents per million people)	Number of patents granted per million people.	Calculated on the basis of data on patents from WIPO (World Intellectual Property Organization). 2007. "Patents Granted by Office (1985-2005)." Geneva. [http://wipo.int/ipstats/en/statistics/]. Accessed May 2007 and data on population from UN (United Nations). 2007e. World Population Prospects 1950-2050: The 2006 Revision. Database. Department of Economic and Social Affairs, Population Division. New York. Accessed July 2007. (UNDP HDI 2008 Report)
Percent GDP from industry	Percent gross domestic product (GDP) from industry represents the proportion of an economy's total domestic output of goods and services which are a result of value added by the industrial sector. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.

Table D-1 (continued)

Metric	Definition	Original Source
Percent GDP from manufacturing	Percent gross domestic product (GDP) from manufacturing represents the proportion of an economy's total domestic output of goods and services which are a result of value added by the manufacturing sector. Manufacturing is considered by the World Bank as part of industry; as such, when summing GDP percentages, the agriculture sector, the industry sector and the services sector should roughly equal 100. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.
Percentage of the population with insufficient food	"Insufficient food means food consumption below minimum energy requirement." *Quoted from the SEDAC Data Dictionary*.	Prescott-Allen, Robert. 2001. The Wellbeing of Nations: A Country-by-Country Index of Quality of Life and the Environment. Washington, DC: Island Press. Table 3
Pesticide use (Kg. pesticides used per year per km^2 of total land area)	Kg. pesticides used per year per km^2 of total land area.	WRI 2000-2001 & OECD 1999
Politics and Freedom: Regulatory Quality Index (Index: -2.5 worst governance, 0 average, 2.5 best governance)	The Regulatory Quality Index is a measure of "the incidence of market unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the burdens imposed by excessive regulation in areas such as foreign trade and business development." It attempts to describe the degree to which governments create an atmosphere that encourages trade and foreign investment. *Quoted from the Earth Trends portal.*	Governance Matters VII: Aggregate and Individual Governance Indicators, 1996-2007. D. Kaufmann, A. Kraay, and M. Mastruzzi (2008). World Bank Policy Research Working Paper 4654. Available online at: http://go.worldbank.org/2E0SXCR850.

Table D-1 (continued)

Metric	Definition	Original Source
Population density (people per square km^2)	Population density is the number of persons per square kilometer of land area. This data set contains estimates for all countries from 1950 to 2005 at five year intervals. The projections reported here assume medium fertility (the "medium-fertility assumption" of the United Nations Population Division). *Quoted from the Earth Trends portal.*	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations. Available on-line at http://www.un.org/esa/population/ordering.htm
Population using improved sanitation (% of the population)	Population using improved sanitation as a % of the total population	UN (United Nations). 2006a. Millennium Development Goals Indicators Database. Department of Economic and Social Affairs, Statistics Division. New York. [http://mdgs.un.org]. Accessed May 2007, based on a joint effort by UNICEF and WHO.
Population without electricity (% of the population)	This metric was originally published as an absolute number (million persons), and was transformed into a percentage of the population using the countries' total population.	IEA (International Energy Agency). 2006. World Energy Outlook 2006. Paris.
Population: Above age 65, both sexes (% of the population)	Population above age 65, both sexes refers to the de facto population of a given country or region older than age 65 as of July 1 of a given year. The projections reported here assume medium fertility (the "medium-fertility assumption" of the United Nations Population Division). Divided by pop. *Quoted from the Earth Trends portal.*	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2005. World Population Prospects: The 2004 Revision. Dataset on CD-ROM. New York: United Nations. Available on-line at http://www.un.org/esa/population/ordering.htm

Table D-1 (continued)

Metric	Definition	Original Source
Population: Below age 15, both sexes (% of the population)	Population below age 15, both sexes refers to the de facto population of a given country or region below age 15 as of July 1 of a given year. The projections reported here assume medium fertility (the "medium-fertility assumption" of the United Nations Population Division). *Quoted from the Earth Trends portal.* This metric was originally published as an absolute number (million persons), and was transformed into a percentage of the population using the countries' total population.	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2005. World Population Prospects: The 2004 Revision. Dataset on CD-ROM. New York: United Nations. Available on-line at http://www.un.org/esa/population/ordering.htm
Population: Growth rate of total population (%)	Growth rate of total population is the average annual percent change in mid-year population for a country or region in the indicated period. Percent changes in population are calculated using the exponential growth rate equation, which assumes continuous, exponential growth over time. The projections reported here assume medium fertility (the "medium-fertility assumption" of the United Nations Population Division). *Quoted from the Earth Trends portal.*	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. World Population Prospects: The 2006 Revision. Dataset on CD-ROM. New York: United Nations. Available on-line at http://www.un.org/esa/population/ordering.htm
Poverty: National poverty rates (% of national population)	National poverty rates is the percentage of a country's population living below the country's established national poverty line. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.

Table D-1 (continued)

Metric	Definition	Original Source
Public Health: Contraceptive prevalence rate (percent of married women age 15-49)	Contraceptive prevalence rate is the percentage of women aged 15 to 49 in a marital or consensual union, who are currently using contraception. Contraception includes both modern (sterilization, the Pill, condoms, vaginal barrier methods, etc.) and traditional (periodic or prolonged abstinence, withdrawal, etc.) methods. *Quoted from the Earth Trends portal.*	Department of Economic and Social Affairs, United Nations Population Division (UNPD). 2005. World Contraceptive Use. New York: UNPD. Available on-line at: http://www.un.org/esa/population/publications/contraceptive2005/WCU2005.htm.
Public Health: Per capita total expenditure on health (international dollars per person)	Per capita total expenditure on health is the sum of general government (public) expenditures on health and private expenditures on health expressed on a per-person basis. Annual values are provided in international dollars, calculated using estimates of local currency purchasing power parity (PPP) compared to United States (US) dollars. The international dollar measure minimizes the consequences of differing price levels between countries; in theory one international dollar can purchase an equivalent amount of goods and services in any country. *Quoted from the Earth Trends portal.*	World Health Organization (WHO). 2006. World Health Report 2006: Annex Table 3. Geneva: WHO. Available online at: http://www.who.int/whr/2006/annex/en/index.html and in the WHO Statistical Information System (WHOSIS): Core Health Indicators.
Public Health: Solid fuel use (%)	Solid fuel use measures the percentage of the total population that burn solid fuels in their households, primarily for cooking fuel. Solid fuels include coal or biomass fuels such as wood, charcoal, agricultural residues, and animal dung.	World Health Organization (WHO). 2006. Global Health Atlas: World Health Statistics. Geneva: WHO. Available on-line at: http://www.who.int/GlobalAtlas/.

Table D-1 (continued)

Metric	Definition	Original Source
Religious Fractionalization Index (fractionalization score: higher means more diverse)	Fractionalization is "a measure of diversity among individuals" (Bossert, et al., 2006)	Alesina, Alberto, et al, 2003. " Fractionalization," Journal of Economic Growth, Springer, vol. 8(2), pages 155-94, June.
Religious freedom index (Units: 1-3=Free; 4-5=Partly free; 6-7=Not free)	Religious Freedom is defined by the Center for Religious Freedom as freedom from "persecution where the focus or the grounds are themselves religious - where a person's religion is a component of the persecution or discrimination they suffer". An example of religious discrimination is a school that bans Islamic dress. This institutionalized ban would infringe on the Muslim students' right to live according to their religion. *Quoted from the Earth Trends portal.*	Freedom House, Center for Religious Freedom. 2000. Religious Freedom in the World: A Global Survey of Religious Freedom and Persecution. Available on-line at: http://www.freedomhouse.org/religion/publications/rfiw/fig1.htm. Washington: Freedom House.
Research and Development expenditure (% of GDP)	Research and Development expenditure as a % of GDP	World Bank. 2007b. World Development Indicators 2007. CD-ROM. Washington, D.C.; aggregates calculated for HDRO by the World Bank.
Suspended solids per liter water (mg.)	"A measure of water quality and turbidity." *Quoted from the SEDAC Data Dictionary.*	Socioeconomic Data and Applications Center (SEDAC), Center for International Earth Science Information Network (CIESIN), Columbia University

Table D-1 (continued)

Metric	Definition	Original Source
Total external debt (current US$ per person)	Total external debt is debt owed to nonresidents of a country repayable in foreign currency, goods, or services. It is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of International Monetary Fund (IMF) credit, and short-term debt. Short-term debt includes all debt having an original maturity of one year or less and interest in arrears on long-term debt. Long-term debt includes all debt having a maturity of more than one year. Data are in million current U.S. dollars. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2008. 2008 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://go.worldbank.org/U0FSM7AQ40.
Total fertility Rate (average number of births per woman based on current age-specific fertility rates)	"Fertility contributes significantly to population growth, and thus to pressures on natural resources." *Quoted from the SEDAC Data Dictionary*.	Population Reference Bureau (PRB), 2004 World Population Data Sheet

Table D-1 (continued)

Metric	Definition	Original Source
Trade in Forest Products: Imports, value (US dollars per person)	Forest products imports show the value, in thousands of U.S. dollars, of all forest products transfered into a particular country or region to be sold. Forest products include industrial roundwood (including sawlogs and veneer logs, pulpwood and particles, chips and particles, wood residues, and other industrial roundwood), fuelwood and charcoal, sawnwood, wood-based panels (including veneer sheets, plywood, particle board, and fibreboard), wood pulp (including mechanical, chemical, semi-chemical, dissolving, and recovered paper), and paper and paperboard (including newsprint, printing and writing paper, and other paper and paperboard). Both non-coniferous and coniferous species are included. *Quoted from the Earth Trends portal.* This metric was originally published as an absolute number, and was transformed into a per capita figure using the countries' total population.	Food and Agriculture Organization of the United Nations (FAO). 2008. FAOSTAT Online Statistical Service. Rome: FAO. Available online at: http://faostat.fao.org/.
Transportation: Motor gasoline consumption per capita (Liters per person)	Motor gasoline consumption per capita measures the average volume of motor gasoline consumed by a specified country per person for use in the transportation sector. *Quoted from the Earth Trends portal.*	International Energy Agency (IEA) Statistics Division. 2006. Energy Balances of OECD Countries (2008 edition)-- Extended Balances and Energy Balances of Non-OECD Countries (2007 edition)-- Extended Balances. Paris: IEA. Available at http://data.iea.org/ieastore/default.asp.

Table D-1 (continued)

Metric	Definition	Original Source
Transportation: Passenger cars per 1000 people	Passenger cars per 1000 people refers to road motor vehicles intended for the carriage of passengers and designed to seat no more than nine people (including the driver) per 1000 members of a country's population. These numbers exclude buses, freight vehicles, and two-wheelers such as mopeds and motorcycles. *Quoted from the Earth Trends portal.*	Development Data Group, The World Bank. 2006. 2006 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://publications.worldbank.org/ecommerce/catalog/product?item_id=631625.
Transportation: Pump prices for diesel fuel (US dollars per liter)	This variable refers to the pump prices of the most widely sold grade of diesel fuel in a given country. Prices have been converted from the local currency to U.S. Dollars. *Quoted from the Earth Trends portal.*	The World Bank. 2004. World Development Indicators 2004 (see http://publications.worldbank.org/ecommerce/catalog/product?item_id=990561) (The World Bank, Washington, D.C.)
Transportation: Volume of public road transport (passenger-km per person)	Volume of Public Transport (Road) measures the usage of a city's road-based public transport modes (i.e. buses, microbuses, and taxis) throughout a single year, measured in million passenger-kilometers. The data are calculated by multiplying the number of passengers by the number of kilometers they travel per year. *Quoted from the Earth Trends portal.*.	International Road Federation (IRF). 2002. World Road Statistics 2002 on CD-ROM, Table 5B (available on-line at:http://www.irfnet.org/wrs.asp). Geneva: International Road Federation.
Urban and Rural Areas: Growth rate of rural population (%)	Growth rate of rural population is the average annual rate of change of the midyear population in areas defined as rural. This dataset contains estimates from 1950 to 2030 in five year intervals. For 2010 to 2030, all data are forecasts based on assumptions enumerated in the technical notes. Data are available for most countries. *Quoted from the Earth Trends portal.*	United Nations, Department of Economic and Social Affairs, Population Division. 2006. World Urbanization Prospects: The 2005 Revision. Urban and Rural Areas Dataset (POP/DB/WUP/Rev.2005/1/Table A.3), dataset in digital form. Available on-line at http://esa.un.org/unup/. New York: United Nations.

Table D-1 (continued)

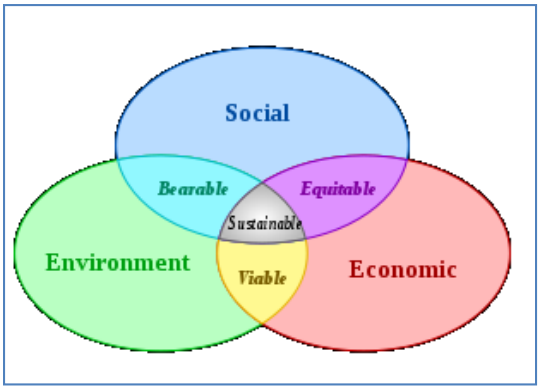
Metric	Definition	Original Source
Urban and Rural Areas: Total population in cities with more than 100,000 inhabitants (% of population in 2000)	Total population in cities with more than 100,000 inhabitants refers to the number of people living in cities that have a population greater than 100,000. *Quoted from the Earth Trends portal.*	The World Bank Group. 2004. Urban Population in World Bank Regions by City Size. Available on-line at: http://www.worldbank.org/urban/env/population-regions.htm. Washington, DC: World Bank.
Urban and Rural Areas: Urban population as a percent of total population (%)	Urban Population as a Percent of Total Population is the proportion of a country's total national population that resides in urban areas. Any person not residing in an area classified as urban is counted in the rural population. Definitions of urban populations vary slightly from country to country. *Quoted from the Earth Trends portal.*	United Nations, Department of Economic and Social Affairs, Population Division. 2006. World Urbanization Prospects: The 2005 Revision. Urban and Rural Areas Dataset (POP/DB/WUP/Rev.2005/1/Table A.2), dataset in digital form. Available on-line at http://esa.un.org/unup/. New York: United Nations.
Urban population weighted TSP concentration (micrograms TSP per m^3)	Poor ambient air quality affects both human and ecosystem health. Many studies have linked exposure to particulate matter (PM) to adverse health effects in humans such as increased asthma attacks, chronic bronchitis, decreased lung function, and premature death. PM can travel over long distances and is a significant contributor to reduced visibility. The deposition of PM can change the nutrient composition of soils and surface waters and affects the diversity of ecosystems. *Quoted from the SEDAC Data Dictionary*.	Socioeconomic Data and Applications Center (SEDAC), Center for International Earth Science Information Network (CIESIN), Columbia University

Appendix E: A Brief History of the Concentric Circles Approach to Sustainable Development

By Andrés Tarté

I credit my father, a brilliant scientist, and arguably the foremost expert in matters of sustainability in my home country of Panama, for my exposure at an early age to the idea of sustainable development. An illustration of the so-called 'triple bottom-line' – an integration of the environmental, social, and economic dimensions of development – is probably the easiest way to get someone to understand the concept. It is usually illustrated using three distinct circles, one for each dimension, that share some parts of their area with each other, like this:

Figure E-1: The Dimensions of Sustainable Development – Classic Illustration Approach



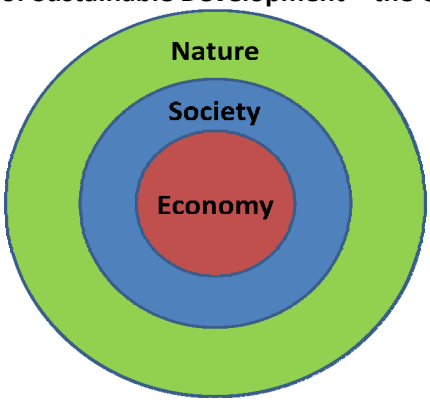
Source: IUCN, 2006.

The very small area in the middle that all three circles have in common represents sustainable development. However, my father was never satisfied with this illustrative approach. The illustration implies that there is room for development outside the 'sustainable' area, which if you think about it, is impossible: if it's not sustainable, it cannot be called development; sooner or later, it will mean destruction.

So a few years ago he conceived a different approach, one that he thought would be more in tune to the planet's reality. This would be the concentric circles approach, which he consequently included in his 2006 book, *Picnic con Hormigas*[36]. It looks like this:

[36] Tarté, Rodrigo. 2006. Picnic con Hormigas: Reflexiones sobre Gestión del Conocimiento y Desarrollo (Sostenible). Ciudad del Saber, Panama.

Figure E-2: The Dimensions of Sustainable Development – the Concentric Circles Approach



Source: Adapted from Tarté, 2006.

Three circles, one within the other: economic activity within the boundaries of society, and society within the boundaries of the natural environment. So simple, so obvious, and yet, no one else had come up with it, or so we thought at the time. I certainly had not seen anything like it before, and neither had he.

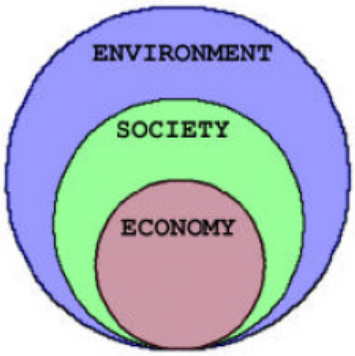
A few years later, I decided to do some detective work and try to find out if my father had indeed invented this new illustrative approach. After conducting an extensive search on the World Wide Web, we were able to put the matter to rest. Here's what I was able to find:

The earliest evidence of this approach references a book from 1995:

- K. Peattie, *Environmental marketing management. Meeting the green challenge*, Financial Times. Pitman Publishing, London (**1995**).

The book itself is not online, nor in my school's library, so I was not able to check it out and see what the graph looks like in it. But it is credited by a 2006 article (Lozano, *Envisioning Sustainability Three-Dimensionally*), as the source of the following drawing:

Figure E-3: The Concentric Circles Approach Taken from Lozano, 2006



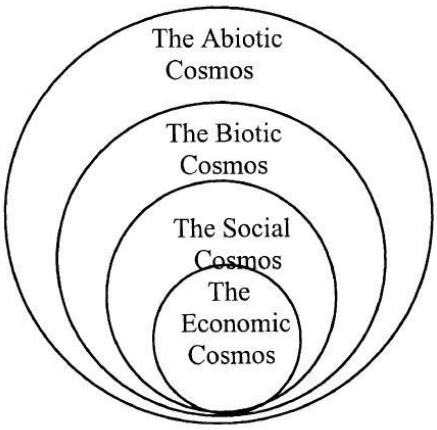
Source: Lozano, 2006.

The article also credits two other sources for the drawing, but Peattie's is the earliest. The first of these two other sources is:

- Mebratu, D. **1996**. *Sustainability as a Scientific Paradigm*. Lund: International Institute for Industrial Environmental Economics.

This time I was able to view the source and copy the illustration that appears in it:

Figure E-4: The Concentric Circles Approach Taken from Mebratu, 1996

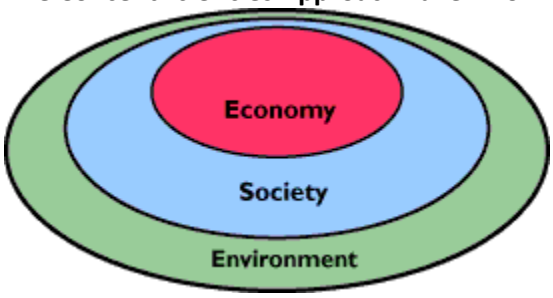


Source: Mebratu, 1996.

Note that the outer circle takes things one step further, although I think it implies that there is no life outside our planet…

The third source credited by Lozano is Maureen Hart. She is by far the source that gets more credit for the approach, referenced in the great majority of websites that include the drawing (and copy it directly from her website, http://www.sustainablemeasures.com):

Figure E-5: The Concentric Circles Approach Taken from Hart, 1998



Source: Hart, 1998.

The earliest reference made to her mentions this source from **1998**:

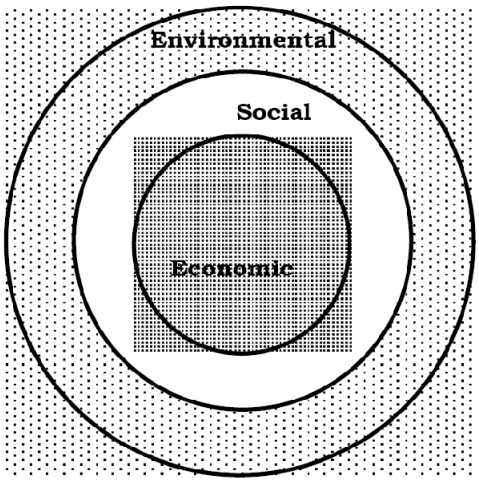
- Hart, Maureen, Sustainable Community Indicators Trainers' Workshop, Hart Environmental Data. http://www.sustainablemeasures.com/Training/Indicators/Circle3.html

Now, this is an internet source that says 'copyright 1998' at the bottom, so it is possible that the site was created in 1998, but the graph added later on. However, there is no doubt that by 1999, Hart had already published the illustration, because this other publication gives her credit:

- Meter, Ken. *The Neighborhood Sustainability Indicators Guidebook*. Crossroads Resource Center, **1999** (available online at: http://www.crcworks.org/guide.pdf).

On that publication, the drawing has been slightly modified and appears like this (the shaded area has been named by Meter as the 'sustainability zone'):

Figure E-6: The Concentric Circles Approach Taken from Meter, 1999



Source: Meter, 1999.

Finally, an online course module on Strategic Environmental Assessment developed by the United Nations University mentions the concentric circles concept (http://sea.unu.edu/course/?page_id=50), and credits this source:

- Levett, R. (**1997**) "Indicators for a Civilised City", contribution to ERIC seminar, London, 7 October.

This source would come before Hart (1998), but after Peattie (1995) and Mebratu (1996).

So, to sum up, there's evidence of at least six occurrences (including my father) where the basic same approach arose spontaneously in different places, and at different times. I guess that makes it even more valid…

August, 2009.

Appendix F: Table of Critical Values for Pearson's R

Table F-1 lists the critical values for Pearson's R based on their corresponding alpha level, $P(H_0)$, and number of samples (n) – in this case, the number of countries tested for correlation between a given metric and proximity/movement relative to the Quadrant.

Table F-1: Table of Critical Values for Pearson's R

Source:
http://faculty.fortlewis.edu/CHEW_B/Documents/Table%20of%20critical%20values%20for%20Pearson%20correlation.htm

Alpha level	0.100	0.050	0.010	0.001
n	Critical values for Pearson's R			
4	0.900	0.950	0.990	0.999
5	0.805	0.878	0.959	0.991
6	0.729	0.811	0.917	0.974
7	0.669	0.754	0.875	0.951
8	0.621	0.707	0.834	0.925
9	0.582	0.666	0.798	0.898
10	0.549	0.632	0.765	0.872
11	0.521	0.602	0.735	0.847
12	0.497	0.576	0.708	0.823
13	0.476	0.553	0.684	0.801
14	0.458	0.532	0.661	0.780
15	0.441	0.514	0.641	0.760
16	0.426	0.497	0.623	0.742
17	0.412	0.482	0.606	0.725
18	0.400	0.468	0.590	0.708
19	0.389	0.456	0.575	0.693
20	0.378	0.444	0.561	0.679
21	0.369	0.433	0.549	0.665
22	0.360	0.423	0.537	0.652
23	0.352	0.413	0.526	0.640
24	0.344	0.404	0.515	0.629
25	0.337	0.396	0.505	0.618
26	0.330	0.388	0.496	0.607
27	0.323	0.381	0.487	0.597
28	0.317	0.374	0.479	0.588
29	0.311	0.367	0.471	0.579
30	0.306	0.361	0.463	0.570

Table F-1 (continued)

Alpha level	0.100	0.050	0.010	0.001
n	Critical values for Pearson's R			
35	0.283	0.334	0.430	0.532
40	0.264	0.312	0.403	0.501
45	0.248	0.294	0.380	0.474
50	0.235	0.279	0.361	0.451
60	0.214	0.254	0.330	0.414
70	0.198	0.235	0.306	0.385
80	0.185	0.220	0.286	0.361
90	0.174	0.207	0.270	0.341
100	0.165	0.197	0.256	0.324
200	0.117	0.139	0.182	0.231
300	0.095	0.113	0.149	0.189
400	0.082	0.098	0.129	0.164
500	0.074	0.088	0.115	0.147
1000	0.052	0.062	0.081	0.104