2005 Environmental Sustainability Index

Benchmarking National Environmental Stewardship

Appendix F
Comparing the ESI with Other Sustainability Indicators

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Appendix F – Comparison of the ESI to Other Sustainability Indicators

ESI v. Ecological Footprint Index

The Ecological Footprint Index converts a country's total resource consumption into the equivalent of hectares of biologically productive land, and then divides this by population to obtain a final value of hectares per capita. Like the ESI, it is measured on the national level, but the two indices differ considerably in their methodology and scope. Given that the Footprint Index is included in the ESI's Reducing Waste and Consumption Pressures indicator, we expect to find a relationship between the two indices.

The correlation between the ESI and the Ecological Footprint explains approximately 15% of the variation in the ESI. The correlation between the two indices is negative, meaning that large footprints tend to coincide with high ESI values. Since both indices measure certain aspects of sustainability, it may be surprising that high ESI scores are related to resource consumption.

One explanation for the inverse correlation is that the ESI covers a wider range of sustainability issues than the Ecological Footprint including Environmental Systems, and Socio-institutional Capacity indicators, as well as measures of International Environmental Collaboration and Stewardship. High levels of resource consumption are clearly not sustainable over the long-term. However, countries with small footprints are not necessarily sustainable either. If their footprints are small because of a lack of economic activity and pervasive poverty, their situation cannot be

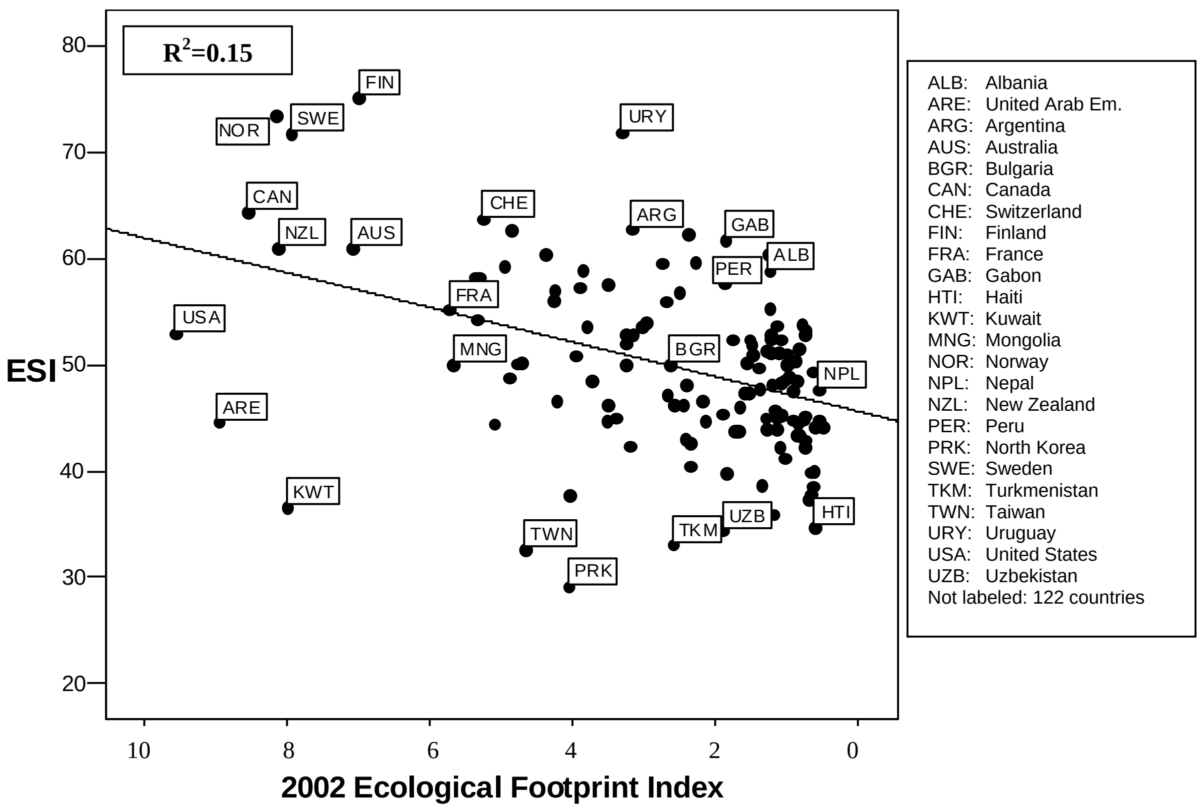

Figure F.1: Regression of 2005 ESI on 2000 Ecological Footprint Index

Note: The direction of the Ecological Footprint has been reversed so that high values on both axes correspond to higher sustainability held out as a policy aspiration. Rich countries with larger footprints tend to have lower human vulnerability and higher capacity values, meaning that they are better equipped to deal with environmental pollution and the resulting health, ecological, and economic impacts. Countries with both large footprints and high capacity can therefore invest in reducing pollution stresses, and address but not negate, their high natural resource consumption rates.

Environmental Vulnerability Index

Environmental vulnerability includes susceptibility to natural hazards, sea-level rise, natural resource depletion, fragile ecosystems, and geographical isolation. Although low vulnerability is not completely parallel with sustainability, high environmental vulnerability creates a variety of impediments to sustainable development.

The South Pacific Applied Geoscience Commission (SOPAC), in collaboration with the United Nations Environment Programme (UNEP) and others, has developed an Environmental Vulnerability Index (EVI) to measure vulnerability. The Index aims to provide a sense of the environmental conditions that predispose a country to internal and external shocks that adversely impact its physical entities (people, buildings, ecosystems), economy, and wellbeing.

A weak relationship was found between the ESI and the EVI, and no significant trend could be detected. Based on different conceptual foundations, the EVI and ESI clearly gauge different aspects of environmental sustainability. High environmental vulnerability reduces a country's capacity to address other issues such as reducing environmental stresses and improving natural resource use efficiency. These issues are included in the ESI but are not at the heart of the EVI.

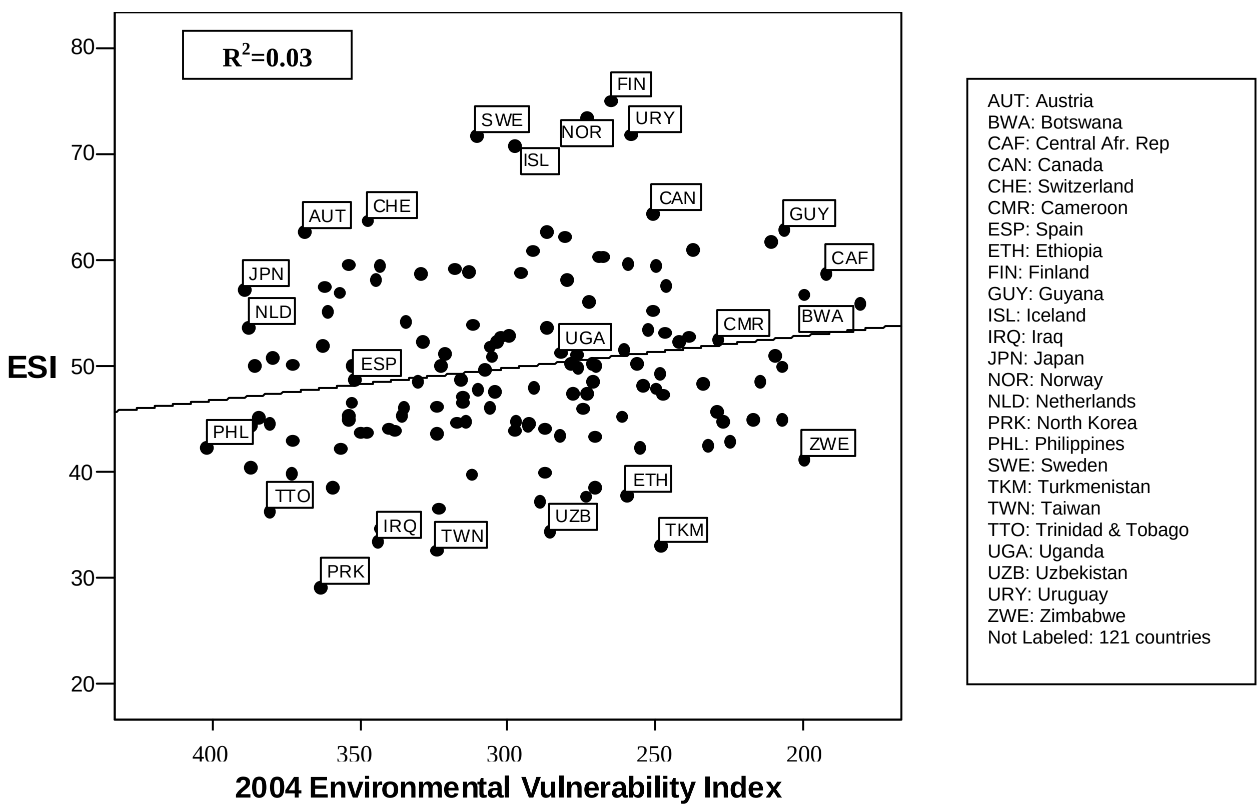

Figure F.2: Regression of 2005 ESI on 2003 Environmental Vulnerability Index
Note: Direction of the EVI has been reversed so that high values
on both axes correspond to higher sustainability

Table F.1: Correlations Between 2005 ESI Components and Other Indices

		Ecological Footprint per capita	2004 Environmental Vulnerability Index
	ESI	0.4 ***	-0.18 *
Components	Environmental Systems	0.22 *	-0.65 ***
	Reducing Environmental Stresses	-0.46 ***	-0.52 ***
	Reducing Human Vulnerability	0.65 ***	0.37 ***
	Social and Institutional Capacity	0.62 ***	0.34 ***
	Global Stewardship	-0.29 ***	-0.04
Indicators	Air Quality	0.56 ***	0.09
	Biodiversity	-0.20 *	-0.50 ***
	Land	-0.16	-0.73 ***
	Water Quality	0.49 ***	-0.18 *
	Water Quantity	0.01	-0.43 ***
	Reducing Air Pollution	-0.61 ***	-0.58 ***
	Reducing Ecosystem Stresses	0.07	-0.23 ***
	Reducing Population Growth	0.48 ***	0.43 ***
	Reducing Waste & Consumption Pressures	-0.62 ***	0.00
	Reducing Water Stress	-0.38 ***	-0.63 ***
	Natural Resource Management	-0.35 ***	-0.39 ***
	Environmental Health	0.56 ***	0.48 ***
	Basic Human Sustenance	0.63 ***	0.49 *
	Reducing Environment-Related Natural Disaster Vulnerability	0.22 ***	-0.18 *
	Environmental Governance	0.62 ***	0.32 ***
	Eco-Efficiency	-0.31 ***	-0.21 **
	Private Sector Responsiveness	0.63 ***	0.40 ***
	Science and Technology	0.80 ***	0.43 ***
	Participation in International Collaborative Efforts	0.28 ***	0.30 ***
	Greenhouse Gas Emissions	-0.40 ***	-0.29 ***
	Reducing Transboundary Environmental Pressures	-0.35 ***	-0.05

* statistically significant at 0.05 level ** statistically significant at 0.01 level *** statistically significant at <0.01 level

Note: High ESI scores correspond to higher environmental sustainability, but Ecological Footprint and EVI scores correspond to high resource consumption and vulnerability, respectively.

Table F.1 shows how and why the ESI and comparative indices diverge. The Ecological Footprint, for example, is a measure primarily of environmental pressure, especially consumption pressure, with no overt effort to balance pressure measures with systems, impact or capacity measures. Therefore the Footprint has a strong correlation with the ESI Waste and Consumption indicator. Interestingly, its highest positive correlation is with the Science and Technology indicator, which reflects the fact that developed countries with high per capita incomes tend to have strong scientific and technological sectors as well as high resource use intensities.

The Environmental Vulnerability Index is an index of states and pressures, as shown in the systematically high correlation with the ESI Systems and Stress indicators. The lower correlation levels with the ESI human impact, capacity, and global stewardship measures reflect the different scopes and purposes of these indices.

Millennium Development Goal 7

In September 2000, 189 nations adopted the United Nations Millennium Declaration, committing themselves to a series of "Millennium Development Goals" to alleviate poverty and promote sustainable development. The United Nations Secretariat and its specialized agencies and programs, as well as representatives of IMF, the World Bank, and OECD have defined 8 goals, 18 targets and 48 indicators to measure progress towards the Millennium Development goals. Among the eight goals, Goal 7 is to ensure environmental sustainability.

Goal 7 includes three targets and eight indicators but for two of them, sufficient data are currently not available. The indicators included in this analysis are: Proportion of land area covered by forest (FAO), Ratio of area protected to maintain biological diversity to surface area (UNEP-WCMC), Energy use (kg oil equivalent) per $1 GDP (PPP) (IEA, World Bank), Carbon dioxide emissions per capita (UNFCCC, UNSD), Consumption of ozone-depleting CFCs (ODP tons) (UNEP-Ozone Secretariat), Proportion of population with sustainable access to an improved water source, and Proportion of population with access to improved sanitation.

In an experimental analysis, we attempt to create an index based on the six available MDG Goal 7 indicators. We can then compare the performance of countries on both the MDG Goal 7 index and the ESI in order to identify interesting similarities or differences between the two measures.

To create the MDG Goal 7 index, we first apply principal component analysis and use the resulting principal components and factor loadings to transform the original data into a single index. The initial PCA suggests keeping three principal components (see Table F.2).

The first principal component is most highly correlated with Carbon dioxide emissions per capita, Proportion of the population with sustainable access to an improved water source, and the Proportion of population with access to improved sanitation. The second component correlates with Protected area ratio to surface area, while the third is most highly correlated with the Proportion of land area covered by forest.

For the final index, we calculate the principal component scores for the selected principal components and add these values together for every country. We then regress the ESI on the new MDG Goal 7 index. The result is a strong positive correlation between the two indices, as shown in Figure F.3. Nearly 30% of the ESI variation is explained by the MDG Goal 7 index. However, we note that the MDG Goal 7 index could only be calculated for 56 countries due to missing data, and the interpretation of the strong relationship is therefore restricted to this set of countries. The list of countries is shown in Table F.3.

Table F.2: Variance explained by the principal components

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.2	31.7	31.9	2.2	31.7	31.7
2	1.3	18.9	50.6	1.3	18.9	50.6
3	1.2	16.9	67.5	1.2	16.9	67.5
4	0.9	12.9	80.4			
5	0.6	9.2	89.6			
6	0.4	5.6	95.2			
7	0.3	4.8	100			

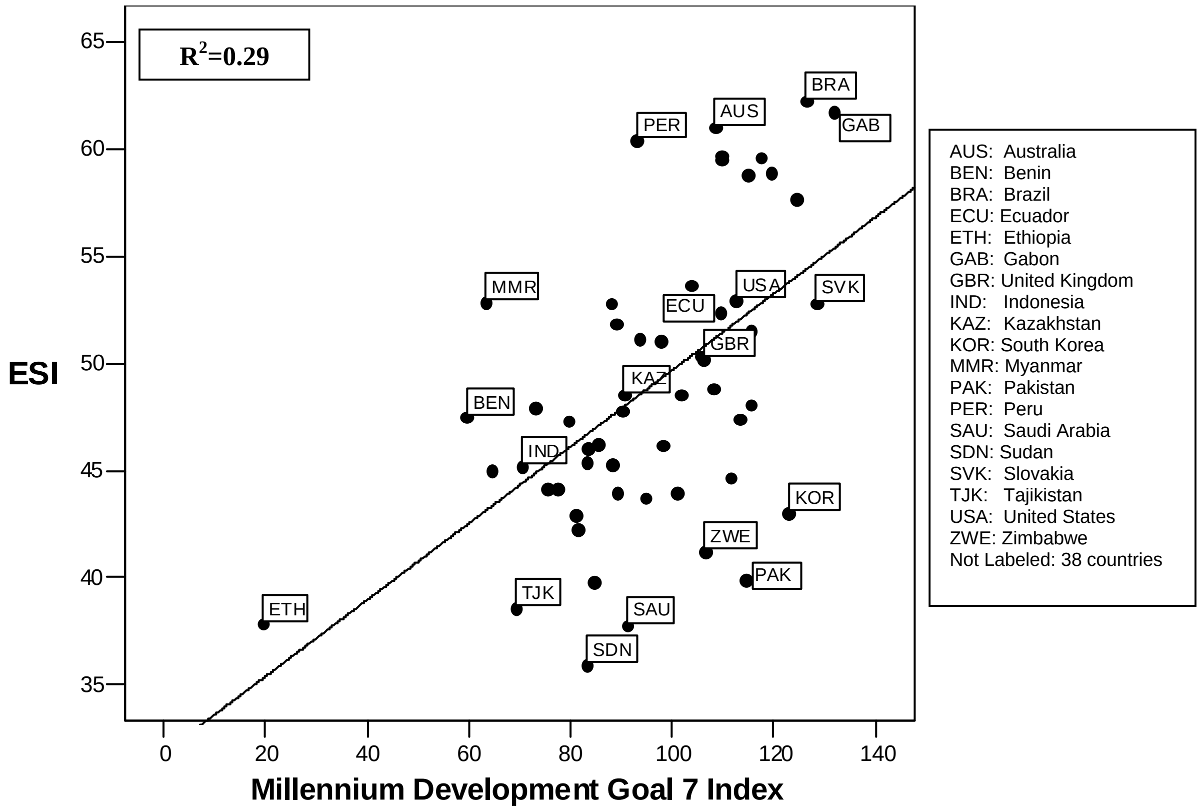

Figure F.3: Regression of 2005 ESI on Millennium Development Goal 7 Index

Table F.3 Countries included in the MDG Goal 7 Index

#	Country	#	Country	#	Country
1	Angola	20	Gabon	39	Pakistan
2	Albania	21	United Kingdom	40	Panama
3	Australia	22	Georgia	41	Peru
4	Azerbaijan	23	Ghana	42	Paraguay
5	Benin	24	Guatemala	43	Romania
6	Bangladesh	25	Honduras	44	Saudi Arabia
7	Bolivia	26	Indonesia	45	Sudan
8	Brazil	27	India	46	Senegal
9	Chile	28	Iran	47	Slovakia
10	Côte d'Ivoire	29	Jamaica	48	Tajikistan
11	Cameroon	30	Jordan	49	Tunisia
12	Dem. Rep. Congo	31	Kazakhstan	50	Tanzania
13	Colombia	32	Kenya	51	United States
14	Costa Rica	33	South Korea	52	Venezuela
15	Dominican Rep.	34	Sri Lanka	53	Viet Nam
16	Algeria	35	Mexico	54	South Africa
17	Ecuador	36	Myanmar	55	Zambia
18	Egypt	37	Niger	56	Zimbabwe
19	Ethiopia	38	Oman		

Figure F.3 suggests that countries with similar scores on the MDG Goal 7 index, experience a range of environmental conditions. For example, while Brazil and South Korea both have high MDG scores, Brazil performs much better on the ESI. South Korea, Saudi Arabia and other countries have relatively high MDG index values because they succeed in providing the basic human services measured by MDG Goal 7 index. However, these countries fail to perform well on several of the dimensions covered by the ESI, including Environmental Systems and Reducing Environmental Stresses.

Developing countries such as Pakistan and Zimbabwe have low CO_2 emissions, and CFC consumption, which contribute to high MDG Goal 7 index scores, but also have low Capacity and high Human Vulnerability scores, which reduce their ESI values. The results suggest that measuring basic human needs such as water supply and sanitation, combined with a narrow set of proxies for sustainable resource as done in MGD 7, is not sufficient to track the broader set of environmental sustainability issues that are measured by the ESI.