EVI Report

The Demonstration

Environmental Vulnerability Index (EVI)

SOPAC

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The Demonstration

Environmental Vulnerability Index (EVI)

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1. Vulnerability index – environment

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Acronyms

AOSIS	Alliance of Small Island States
BINAS	Biosafety Information Network and Advisory Service
BGS	British Geological Survey
CIA	US Central Intelligence Agency Fact Book
CIESIN	Centre for International Earth Science Information Network
CRED	Centre for Research on Epidemiology of Disasters
EMDAT	Emergency Events Database (CRED, OFDA, OECD, WHO)
EVI	Environmental Vulnerability Index and Profiles
FAO	UN Food & Agricultural Organisation
GEO3	Global Environment Outlook 3
GMO	Genetically-Modified Organism
GROMS	Global Register of Migratory Species
HDR	Human Development Report
IPCC	Intergovernmental Panel on Climate Change
ISAAA	International Service for the Acquisition of Agri-Biotech Applications
ITOPF	International Tanker-Owners Pollution Federation Ltd
IUCN	World Conservation Union
MEA	Multilateral Environmental Agreement
NOAA	US National Oceanic & Atmospheric Administration
NZAID	New Zealand Agency for International Development
OECD	Organisation for Economic Cooperation & Development
OFDA	Office of the US Foreign Disaster Assistance
PIC	Pacific Island Country
SEDAC	Social Economic Data Applications Centre
SIDS	Small Island Developing States
SIS	Small Island States
SOE	State of the Environment
SOPAC	South Pacific Applied Geoscience Commission
SPILLS	Worldwide Tanker Spill Database (etcentre.org)
SPREP	South Pacific Regional Environment Programme
SST	Sea-surface temperature
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USGS	US Geological Survey
WCMC	World Conservation Monitoring Centre
WDI	World Development Indicators
WHO	UN World Health Organisation
WRI	World Resources Institute
WTO	World Tourism Organisation

Contents

Figures & Tables

EXECUTIVE SUMMARY

This report presents the first functional results for the Environmental Vulnerability Index (EVI) for 235 countries and marks the completion of the development phase of the EVI. The results are presented in the form of a *Demonstration EVI*, which is fully-functional in all respects except that it is missing data for some of the EVI's indicators.

Without exception, the environment is the life-support system for all human systems and is an integral part of the development success of countries. The Environmental Vulnerability Index is among the first tools now being developed to focus environmental management at the same scales that environmentally-significant decisions are made, and focus them on outcomes at the scale of entire countries. This is an appropriate scale because it is the one at which major decisions affecting the environment in terms of policies, economics and social and cultural behaviours are implemented.

The EVI uses 54 *smart indicators* for estimating the vulnerability of the environment of a country to future shocks. It is reported simultaneously as a single dimensionless index, several sub-indices, and as a profile showing the results for each indicator. This means that in addition to an overall signal of vulnerability, the EVI can be used to identify specific problems. It has been designed to reflect the status of a country's environmental vulnerability, which refers to the extent to which the natural environment is prone to damage and degradation. It does not address the vulnerability of the social, cultural or economic environment, and not the environment that has become dominated by human systems (e.g. cities, farms).

Indicators for the EVI were selected to characterise the risks to and resilience (or its converse, vulnerability) of the complex interactive and hierarchical natural systems that support countries. Data are collected for each indicator and located within an EVI scale which ranges between 1-7, where the value EVI=1 indicates low, and EVI=7 indicates extreme vulnerability for a country relating to an indicator.

Demonstration EVI results are presented in rank order for 235 countries based on publicly available datasets as well as data collected from 32 collaborating countries. The list is accompanied by detailed analyses of 41 indicators for which sufficient data were available, and country profile sheets with vulnerability issues identified. We also present information on the results of testing the EVI and the steps needed for completion and meeting the needs identified by Barbados Programme of Action (BPoA).

To finalise the EVI, it will be necessary to distribute the results of this Demonstration EVI, revise, update and complete the data collected from collaborators, collect data for all outstanding indicators (13), set up permanent data collection mechanisms with all national and international stakeholders, host a second Think Tank to review all technical aspects of the index, retest the EVI using finalised data and channel the final EVI through regional and international processes such as Commission on Sustainable Development (CSD) and Barbados+10.

The general recommendations arising from the development of the Demonstration EVI are centred around cooperation among stakeholders to ensure that the requirements of BPoA on vulnerability are met in time for Barbados+10. They are:

1. The Barbados Programme of Action 1994 called for the development and operationalisation of a fully tested EVI, a move supported by the World Summit on Sustainable Development (WSSD) in 2002. This Demonstration EVI largely completes the development phase for the index, except that it is missing 13 (of 54)

indicators needed for finalisation. In order to meet the deadline for the review of the Barbados Programme of Action (Barbados+10) in 2004, it is necessary to complete all data collection, retest the EVI and finalise it. Support for this is needed.

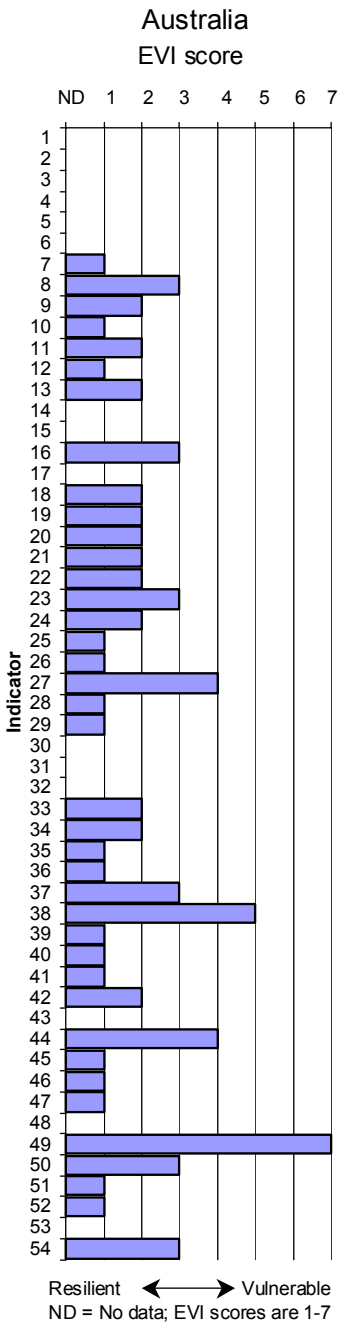
2. It has been demonstrated here that the EVI is technically feasible. Full testing and production of a final EVI will be possible when the final data are collected. The EVI should now be finalised.
3. To complete all data requirements for finalising the EVI it is now necessary that all stakeholders actively contribute to completing the EVI database by the end of 2003. This requires a coordinated effort with countries, international organisations and other stakeholders to ensure this deadline is met.
4. United Nations Environment Programme / Global Environment Facility should consider funding and hosting a global collaborative project to streamline data collection for sustainability, including state of the environment (SOE) and vulnerability (EVI) data collections in all countries. This would include UNEP, WRI, UN Dashboard of Sustainability, SOPAC, SPREP and other global and regional organisations.
5. The international scientific community should now as a priority develop sustainability thresholds for indicators already developed. This includes EVI, SoE and Ecological Footprint indicators. It is important that indicators not just measure conditions, but should be associated with trigger levels for when conditions are no longer sustainable.

Specific recommendations focused on the indicators of the EVI are:

- The World Meteorological Organisation (WMO) should consider organising its meteorological datasets so that they are in a form useable by the EVI and other environmental users.
- Satellite data on productivity and sea temperatures should be masked to allow for extraction of information separately for the Exclusive Economic Zones (EEZs) and territorial waters of countries.
- Collaborating countries will need to revisit their databases to bring them in line with changes in the EVI resulting from this work. This will require recollection of some data in line with the requirements of revised indicators, and completing the data collection process for indicators not evaluated so far.

In the pages that follow we present the Demonstration EVI test result sheets for the 32 collaborating countries.

Australia



	DATA	INDEX
EVI		**2.03**
Rank (from most to least vulnerable of 235)		**217**
Number of completed indicators (of 54)	39	
Percent of required indicators	72%	
REI - Risk exposure sub-index	63%	**2.00**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**2.00**
EDI - Environmental degradation sub-index	84%	**2.06**
Meteorological factors	0%	**--**
Geological factors	80%	**2.25**
Biological factors	89%	**2.00**
Country Characters	75%	**2.00**
Anthropogenic factors	81%	**2.00**

Areas of most environmental vulnerability

Extreme (EVI=7)	High (EVI=5)
GMOs	Pesticides

Areas of good environmental resilience

Volcanos	Tourists	Marine Reserves
Land area	Vehicles	Conflicts
Isolation	SO2	Legislation
Coastal settlements	Fisheries stocks	Habitat fragmentation
Population density	Degradation	Migratory Species
Loss of natural cover	Water resources	

Data deficiencies

Indicator number

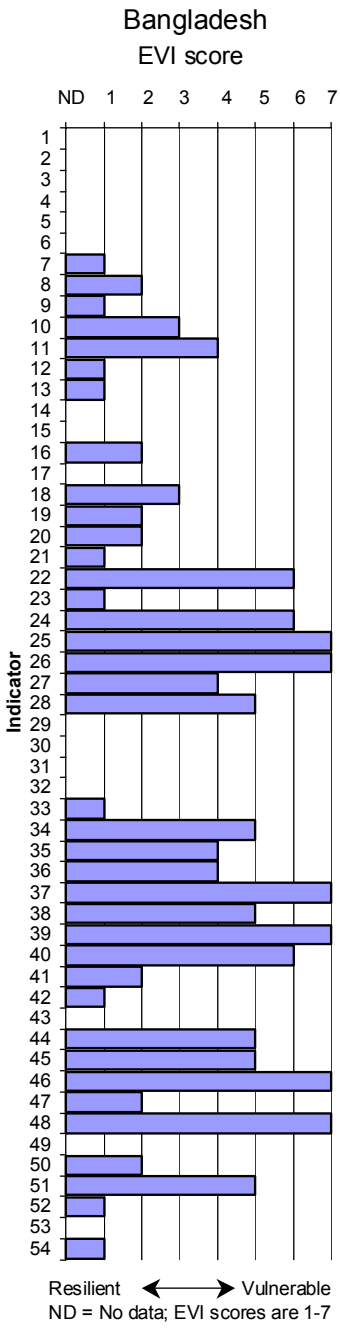
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Australia is ranked number 217 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 2.03, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 39 of the 54 indicators, 72%). This EVI score may change when data for the remaining indicators become available.

The country has low vulnerability overall, with approximately equal risk exposure, intrinsic vulnerability and past degradation (all sub-indices between 2.00 and 2.06). Geological factors contribute the most to the vulnerability of this country, though the difference between this and other factors is small.

Bangladesh



	DATA	INDEX
EVI		**3.58**
Rank (from most to least vulnerable of 235)		**42**
Number of completed indicators (of 54)	38	
Percent of required indicators	70%	
REI - Risk exposure sub-index	59%	**3.63**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**2.17**
EDI - Environmental degradation sub-index	84%	**4.06**
Meteorological factors	0%	**--**
Geological factors	80%	**1.25**
Biological factors	89%	**2.75**
Country Characters	75%	**2.17**
Anthropogenic factors	77%	**4.80**

Areas of most environmental vulnerability

Coastal settlements
Population density
Fertilisers
Fisheries effort
Conflicts
Sanitation

Areas of good environmental resilience

Volcanos
Tsunamis
Isolation
Relief
Extinctions
Intensive farming
Oil spills
Mining
Migratory spp.
Slides

Data deficiencies

Indicator number

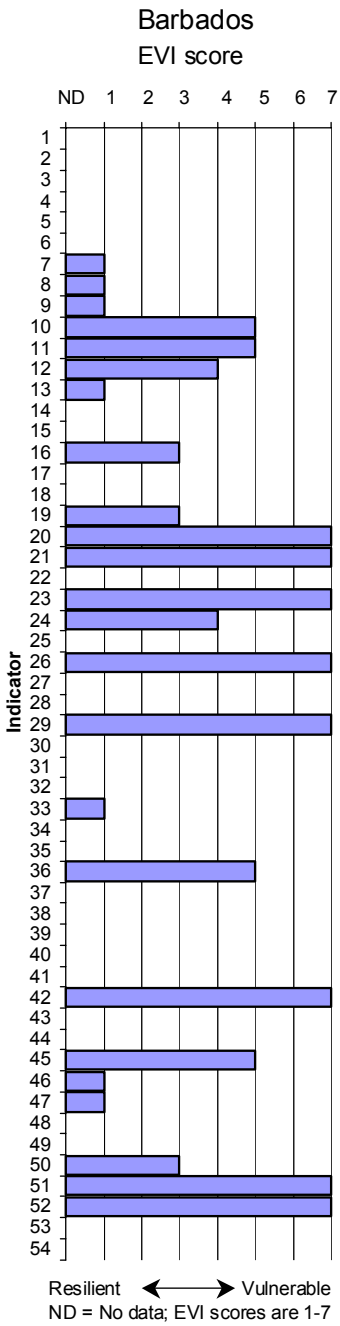
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Bangladesh is ranked as the 42nd -most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.58, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 38 of the 54 indicators, 70%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of past environmental damage (EDI=4.06) and risk exposure (REI=3.63). The greatest vulnerabilities are found in anthropogenic factors (4.80). The country shows relatively low vulnerability to geological factors.

Barbados



	DATA	INDEX
EVI		**4.17**
Rank (from most to least vulnerable of 235)		**6**
Number of completed indicators (of 54)	24	
Percent of required indicators	44%	
REI - Risk exposure sub-index	30%	**3.75**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.50**
EDI - Environmental degradation sub-index	53%	**4.90**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	67%	**5.83**
Country Characters	75%	**3.50**
Anthropogenic factors	35%	**4.56**

Areas of most environmental vulnerability

Endangered species
Extinctions
Intensive farming
Population density
Tourists
Mining
Habitat fragmentation
Migratory Species

Areas of good environmental resilience

Volcanos
Earthquakes
Tsunamis
Relief
Oil spills
Conflicts
Legislation

Data deficiencies

Indicator number

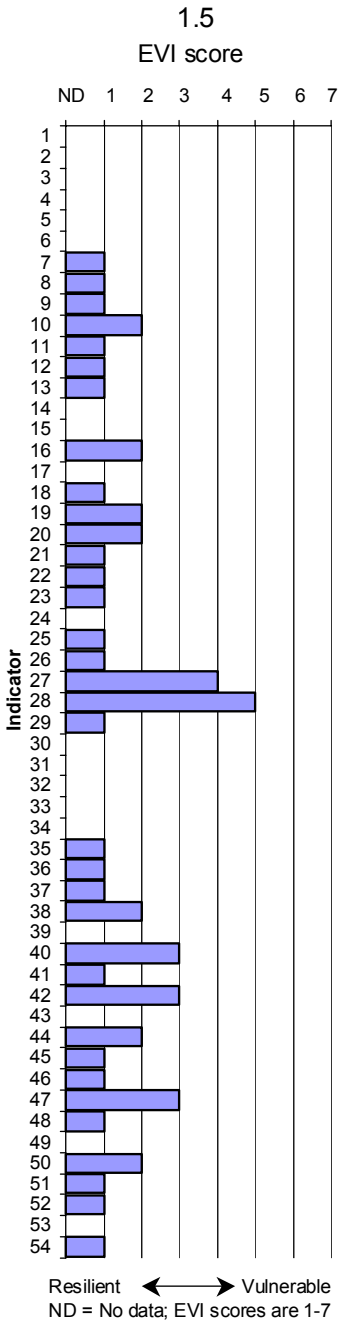
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Barbados is ranked as the 6th-most vulnerable of the 235 countries examined in this demonstration EVI. The high overall EVI score of 4.17, is however, at least partly an **artefact of the low data returns** for this country (data are held for 24 of the 54 indicators, 44%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of past environmental damage (EDI=4.90). The greatest vulnerabilities are found in biological factors (such as biodiversity) and anthropogenic factors. The country shows low vulnerability to geological factors.

Botswana



	DATA	INDEX
EVI		**1.57**
Rank (from most to least vulnerable of 235)		**232**
Number of completed indicators (of 54)	35	
Percent of required indicators	65%	
REI - Risk exposure sub-index	52%	**1.57**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**1.50**
EDI - Environmental degradation sub-index	79%	**1.60**
Meteorological factors	0%	**--**
Geological factors	80%	**1.00**
Biological factors	78%	**1.29**
Country Characters	75%	**1.50**
Anthropogenic factors	69%	**1.83**

Areas of most environmental vulnerability

High (EVI=5)

Loss of natural cover

Areas of good environmental resilience

Volcanos	Intensive farming	Potential for introductions
Earthquakes	Coastal settlements	Marine Reserves
Tsunamis	Population density	Conflicts
Country fragmentation	Tourists	Sanitation
Isolation	Vehicles	Habitat fragmentation
Relief	SO2	Migratory Species
Extinctions	Fertilisers	Slides
Natural Vegetation	Water resources	

Data deficiencies

Indicator number

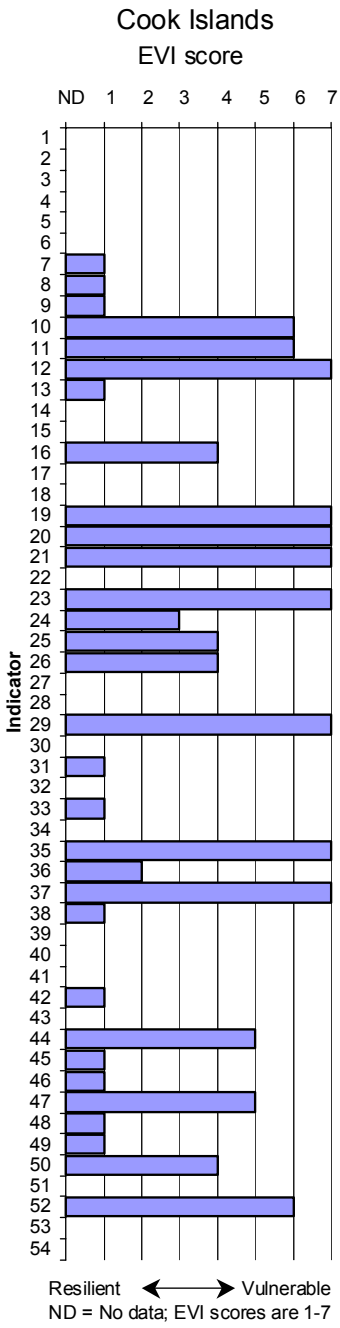
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Botswana is ranked number 232 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 1.57, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 35 of the 54 indicators, 65%). This EVI score may change when data for the remaining indicators become available.

The country has very low vulnerability overall, with approximately equal risk exposure, intrinsic vulnerability and past degradation (all sub-indices between 1.50 and 1.60). Anthropogenic factors contribute the most to the vulnerability of this country (1.83), though the difference between this and intrinsic country characters and biological factors is small (1.50 and 1.29 respectively). The country is not very vulnerable to geological factors.

Cook Islands



	DATA	INDEX
EVI		**3.77**
Rank (from most to least vulnerable of 235)		**28**
Number of completed indicators (of 54)	31	
Percent of required indicators	57%	
REI - Risk exposure sub-index	44%	**3.25**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**4.67**
EDI - Environmental degradation sub-index	68%	**3.85**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	67%	**6.17**
Country Characters	75%	**4.67**
Anthropogenic factors	62%	**3.06**

Areas of most environmental vulnerability

Isolation
Introductions
Endangered species
Extinctions
Intensive farming
Tourists
Vehicles
Fertilisers

Areas of good environmental resilience

Volcanos
Earthquakes
Tsunamis
Relief
Waste production
Oil spills
Pesticides
Mining
Marine Reserves
Conflicts
Sanitation
GMOs

Data deficiencies

Indicator number

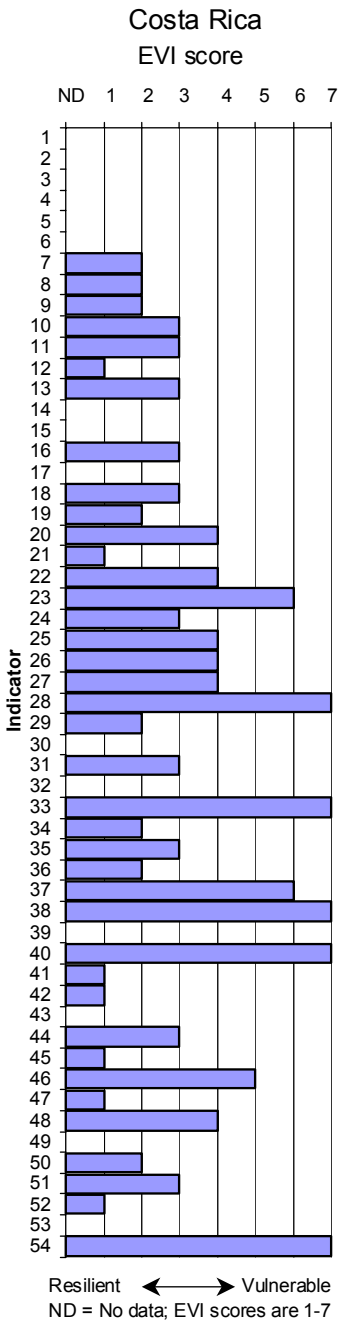
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Cook Islands is ranked as the 28th -most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.77, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 31 of the 54 indicators, 57%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=4.67), with past environmental damage and risk exposure at lower levels (EDI=3.85, REI=3.25). The greatest vulnerabilities are found in biological factors (6.17) and intrinsic country characters (4.67). The country shows low vulnerability to geological factors.

Costa Rica



	DATA	INDEX
EVI		**3.31**
Rank (from most to least vulnerable of 235)		**74**
Number of completed indicators (of 54)	39	
Percent of required indicators	72%	
REI - Risk exposure sub-index	63%	**3.76**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**2.50**
EDI - Environmental degradation sub-index	84%	**3.13**
Meteorological factors	0%	**--**
Geological factors	80%	**3.25**
Biological factors	89%	**3.00**
Country Characters	75%	**2.50**
Anthropogenic factors	81%	**3.67**

Areas of most environmental vulnerability

Loss of natural cover
Oil spills
Pesticides
Degradation
Slides

Areas of good environmental resilience

Isolation
Extinctions
Water resources
Mining
Marine Reserves
Conflicts
Migratory Species

Data deficiencies

Indicator number

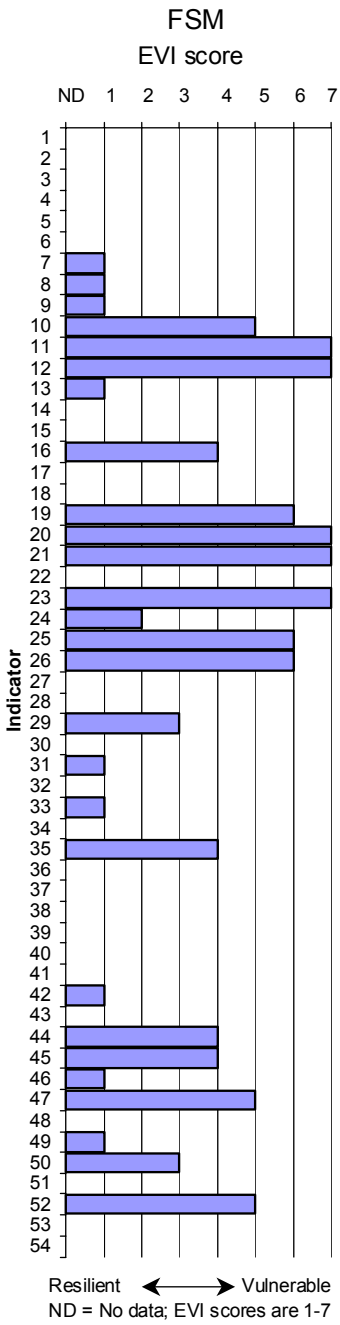
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Costa Rica is ranked as the 74th -most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.31, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 39 of the 54 indicators, 72%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from moderately high levels of risk exposure and past environmental degradation (REI=3.76, EDI=3.13). The greatest vulnerabilities are found in anthropogenic and geological factors (3.67 and 3.25, respectively). The country shows relatively low vulnerability to intrinsic country characters.

Federated States of Micronesia



	DATA	INDEX
EVI		**3.74**
Rank (from most to least vulnerable of 235)		**31**
Number of completed indicators (of 54)	27	
Percent of required indicators	50%	
REI - Risk exposure sub-index	33%	**2.56**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**4.50**
EDI - Environmental degradation sub-index	63%	**4.25**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	67%	**5.67**
Country Characters	75%	**4.50**
Anthropogenic factors	46%	**3.08**

Areas of most environmental vulnerability

Country fragmentation
Isolation
Endangered species
Extinctions
Intensive farming

Areas of good environmental resilience

Volcanos
Earthquakes
Tsunamis
Relief
Waste production
Oil spills
Mining
Conflicts
GMOs

Data deficiencies

Indicator number

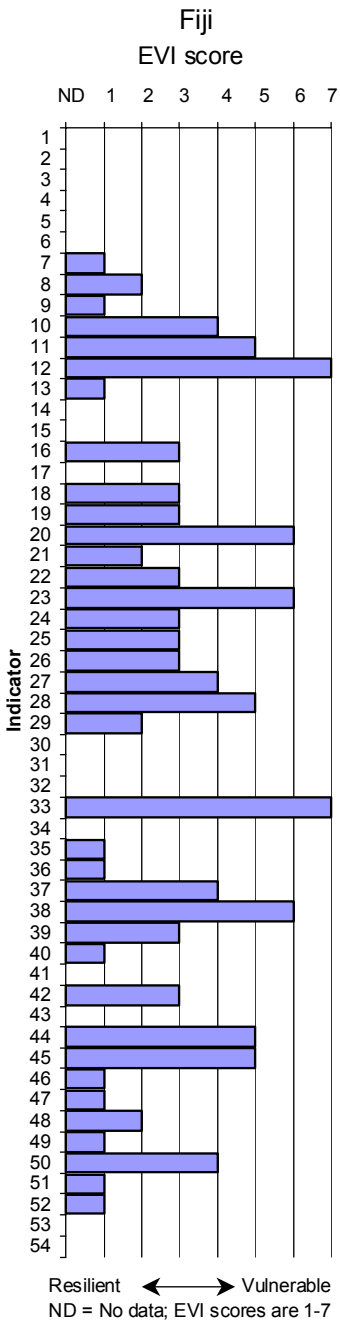
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Federated States of Micronesia is ranked number 31 in terms of vulnerability score out of the 235 countries examined in this demonstration EVI (rank order is from most to least vulnerable). The overall EVI score of 3.74, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 27 of the 54 indicators, 50%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=4.50) and past environmental damage (EDI=4.25). The greatest vulnerabilities are found in biological factors (5.67) and intrinsic country characters (4.50). The country shows low vulnerability to geological factors.

Fiji



	DATA	INDEX
EVI		**3.08**
Rank (from most to least vulnerable of 235)		**102**
Number of completed indicators (of 54)	37	
Percent of required indicators	69%	
REI - Risk exposure sub-index	56%	**2.93**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**4.00**
EDI - Environmental degradation sub-index	84%	**2.88**
Meteorological factors	0%	**--**
Geological factors	60%	**1.33**
Biological factors	89%	**3.38**
Country Characters	75%	**4.00**
Anthropogenic factors	77%	**2.95**

Areas of most environmental vulnerability

The first 2 factors reached the score of 7, the remainder were scored 6

Isolation
Oil spills
Endangered species
Intensive farming
Pesticides

Areas of good environmental resilience

Volcanos
Tsunamis
Relief
Vehicles
SO2
Degradation
Conflicts
Legislation
GMOs
Habitat fragmentation
Migratory Species

Data deficiencies

Indicator number

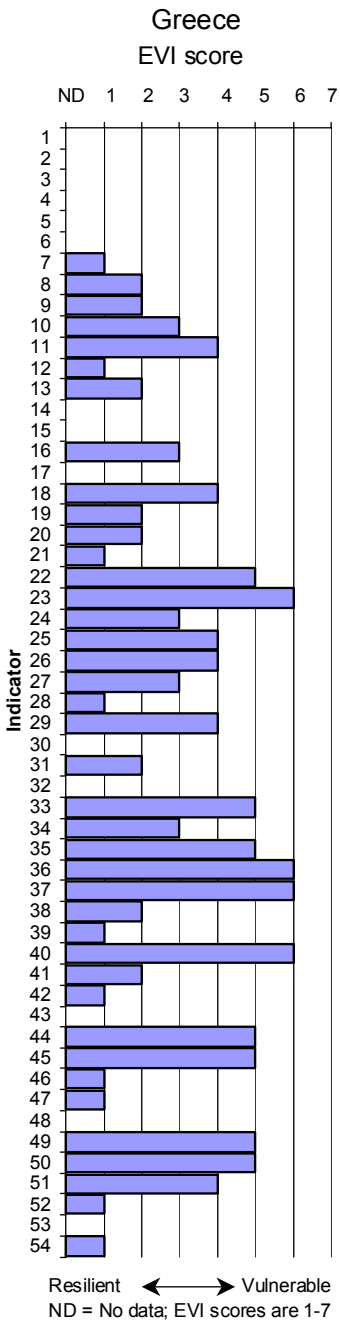
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Fiji is ranked as the 102nd -most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.08, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 37 of the 54 indicators, 69%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from intrinsic vulnerability (IRI=4.00). The greatest vulnerabilities are found in intrinsic country characters, followed by biological factors (4.00 and 3.38, respectively). The country shows relatively low vulnerability to geological factors.

Greece



	DATA	INDEX
EVI		**3.10**
Rank (from most to least vulnerable of 235)		**100**
Number of completed indicators (of 54)	40	
Percent of required indicators	74%	
REI - Risk exposure sub-index	67%	**2.94**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.00**
EDI - Environmental degradation sub-index	84%	**3.31**
Meteorological factors	0%	**--**
Geological factors	80%	**1.50**
Biological factors	89%	**3.00**
Country Characters	75%	**3.00**
Anthropogenic factors	85%	**3.45**

Areas of most environmental vulnerability

No vulnerability scores of 7. The score 6 is the highest for the following:

Intensive farming
SO2
Fertilisers
Degradation

Areas of good environmental resilience

Volcanos	Mining
Isolation	Conflicts
Extinctions	Legislation
Loss of natural cover	Migratory Species
Fisheries effort	Slides

Data deficiencies

Indicator number

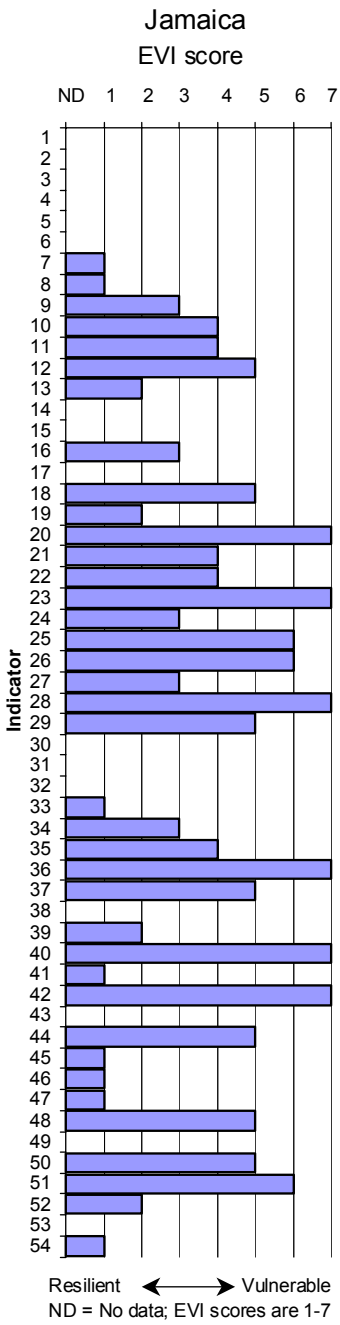
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Greece is ranked as the 100th -most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.10, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 40 of the 54 indicators, 74%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from moderately high levels of past environmental damage and intrinsic vulnerability (EDI=3.31, IRI=3.00). The greatest vulnerabilities are found in anthropogenic factors (3.45). The country shows relatively low vulnerability to geological factors.

Jamaica



	DATA	INDEX
EVI		**3.84**
Rank (from most to least vulnerable of 235)		**22**
Number of completed indicators (of 54)	38	
Percent of required indicators	70%	
REI - Risk exposure sub-index	59%	**3.50**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.83**
EDI - Environmental degradation sub-index	84%	**4.19**
Meteorological factors	0%	**--**
Geological factors	80%	**1.50**
Biological factors	89%	**4.25**
Country Characters	75%	**3.83**
Anthropogenic factors	77%	**4.15**

Areas of most environmental vulnerability

Endangered species
Intensive farming
Loss of natural cover
SO2
Degradation
Mining

Areas of good environmental resilience

Volcanos
Earthquakes
Oil spills
Water resources
Marine Reserves
Conflicts
Legislation
Slides

Data deficiencies

Indicator number

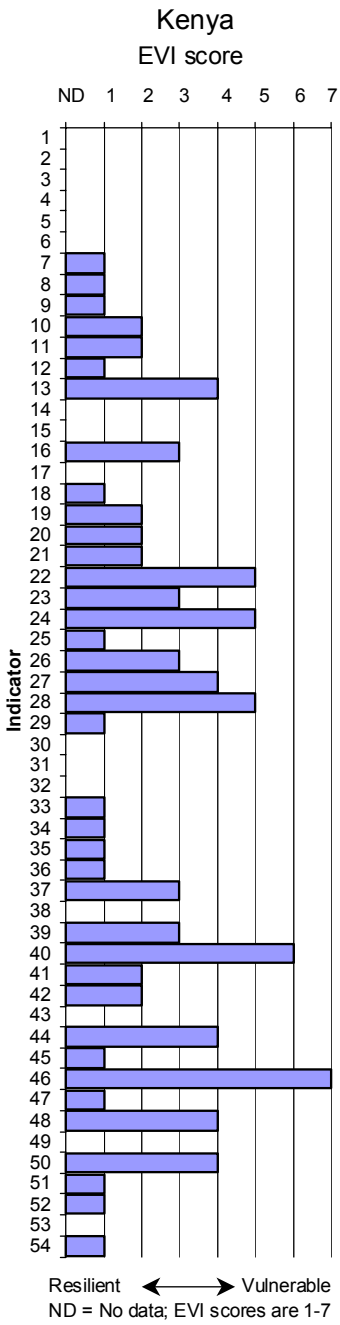
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Jamaica is ranked as the 22nd -most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.84, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 38 of the 54 indicators, 70%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of past environmental damage (EDI=4.19). Intrinsic vulnerability and risk exposure are more moderate (REI=3.50, IRI=3.83). The greatest vulnerabilities are found in biological and anthropogenic factors. The country shows lower vulnerability to geological factors.

Kenya



	DATA	INDEX
EVI		**2.45**
Rank (from most to least vulnerable of 235)		**183**
Number of completed indicators (of 54)	38	
Percent of required indicators	70%	
REI - Risk exposure sub-index	59%	**1.81**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**2.67**
EDI - Environmental degradation sub-index	84%	**3.00**
Meteorological factors	0%	**--**
Geological factors	80%	**1.00**
Biological factors	89%	**2.63**
Country Characters	75%	**2.67**
Anthropogenic factors	77%	**2.60**

Areas of most environmental vulnerability

Extreme (EVI=7)	Very high (EVI=6)
Conflicts	Degradation

Areas of good environmental resilience

Volcanos	Tourists	Legislation
Earthquakes	Oil spills	Habitat fragmentation
Tsunamis	Industry	Migratory Species
Isolation	Vehicles	Slides
Potential for introductions	SO2	
Coastal settlements	Marine Reserves	

Data deficiencies

Indicator number

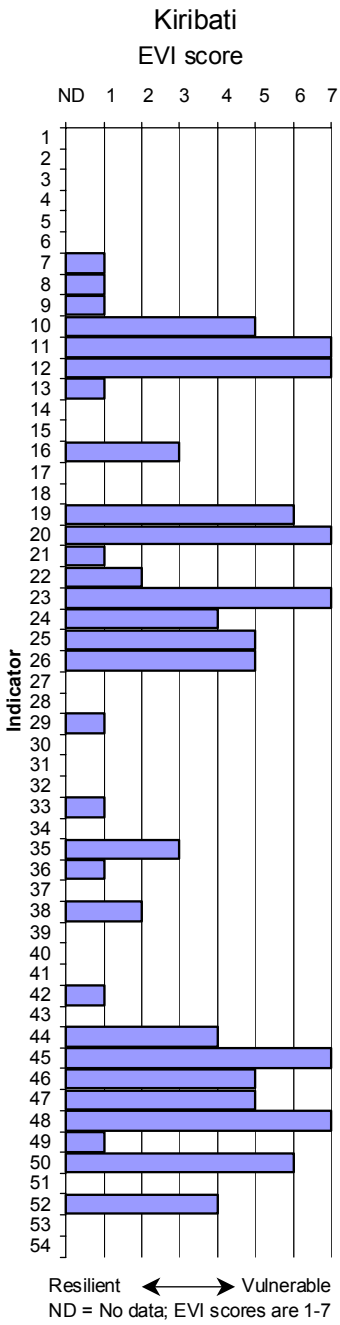
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Kenya is ranked number 183 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 2.45, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 38 of the 54 indicators, 70%). This EVI score may change when data for the remaining indicators become available.

The country has low vulnerability overall, with the most vulnerable aspects being its moderate past environmental degradation (EDI=3.00). Risk exposure is low and intrinsic vulnerability low to moderate on the EVI scale (REI=1.81, IRI=2.67). The country shows low vulnerability to geological factors (1.00).

Kiribati



	DATA	INDEX
EVI		**3.70**
Rank (from most to least vulnerable of 235)		**34**
Number of completed indicators (of 54)	30	
Percent of required indicators	56%	
REI - Risk exposure sub-index	37%	**2.00**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**4.83**
EDI - Environmental degradation sub-index	74%	**4.43**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	78%	**4.43**
Country Characters	75%	**4.83**
Anthropogenic factors	54%	**3.43**

Areas of most environmental vulnerability

Country fragmentation
Isolation
Endangered species
Intensive farming
Marine Reserves
Sanitation

Areas of good environmental resilience

Volcanos
Earthquakes
Tsunamis
Relief
Extinctions
Tourists
Oil spills
SO2
Mining
GMOs

Data deficiencies

Indicator number

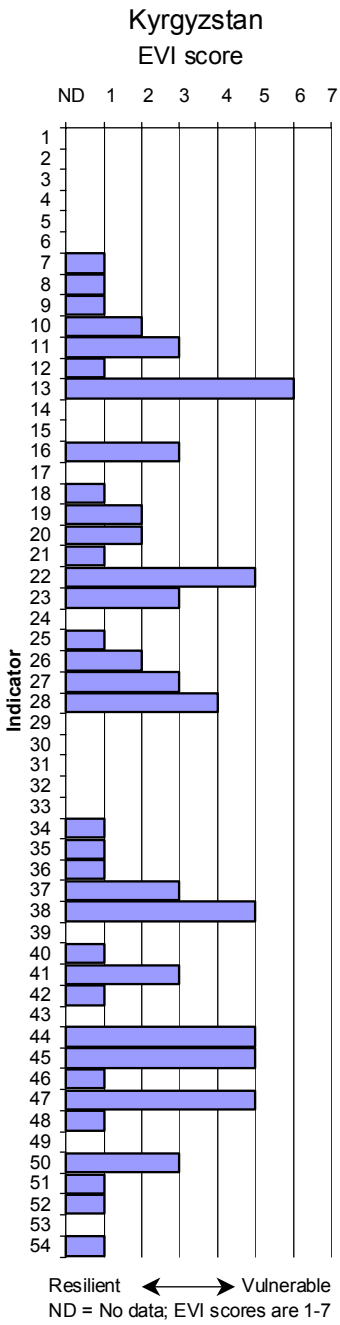
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Kiribati is ranked number 34 in terms of vulnerability score out of the 235 countries examined in this demonstration EVI (rank order is from most to least vulnerable). The overall EVI score of 3.70, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 30 of the 54 indicators, 56%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=4.83) and past environmental damage (EDI=4.43). The greatest vulnerabilities are found in intrinsic country characters (4.83) and biological factors (4.43). The country shows low vulnerability to geological factors.

Kyrgyzstan



	DATA	INDEX
EVI		**2.31**
Rank (from most to least vulnerable of 235)		**198**
Number of completed indicators (of 54)	35	
Percent of required indicators	65%	
REI - Risk exposure sub-index	52%	**1.86**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.00**
EDI - Environmental degradation sub-index	79%	**2.47**
Meteorological factors	0%	**--**
Geological factors	80%	**1.00**
Biological factors	78%	**2.14**
Country Characters	75%	**3.00**
Anthropogenic factors	69%	**2.44**

Areas of most environmental vulnerability

Very high (EVI=6)	High (EVI=5)
Relief	Natural Vegetation
	Pesticides
	Terrestrial Reserves
	Marine Reserves
	Legislation

Areas of good environmental resilience

Volcanos	Coastal settlements	Conflicts
Earthquakes	Industry	Sanitation
Tsunamis	Vehicles	Habitat fragmentation
Isolation	SO2	Migratory Species
Potential for introductions	Degradation	Slides
Extinctions	Mining	

Data deficiencies

Indicator number

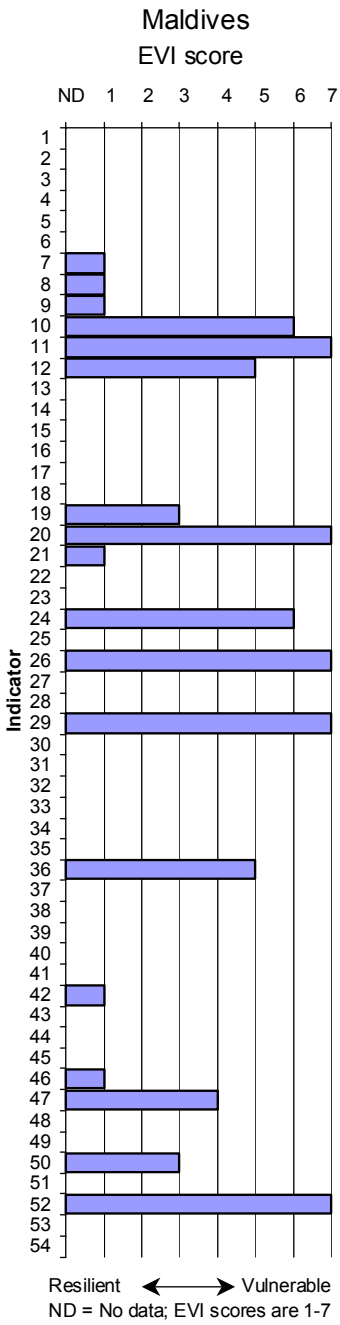
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Kyrgyzstan is ranked number 198 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 2.31, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 35 of the 54 indicators, 65%). This EVI score may change when data for the remaining indicators become available.

The country has low vulnerability overall, with the most vulnerable aspects being its moderate intrinsic vulnerability (IRI=3.00). Risk exposure is low and acquired vulnerability low to moderate on the EVI scale (REI=1.86, EDI=2.47). The country shows low vulnerability to geological factors (1.00).

Maldives



	DATA	INDEX
EVI		**4.21**
Rank (from most to least vulnerable of 235)		**4**
Number of completed indicators (of 54)	19	
Percent of required indicators	35%	
REI - Risk exposure sub-index	26%	**4.14**
IRI - Intrinsic resilience/vulnerability sub-index	63%	**5.60**
EDI - Environmental degradation sub-index	37%	**3.29**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	56%	**4.80**
Country Characters	63%	**5.60**
Anthropogenic factors	23%	**4.17**

Areas of most environmental vulnerability

Country fragmentation
Endangered species
Population density
Tourists
Migratory Species

Areas of good environmental resilience

Volcanos
Earthquakes
Tsunamis
Extinctions
Mining
Conflicts

Data deficiencies

Indicator number

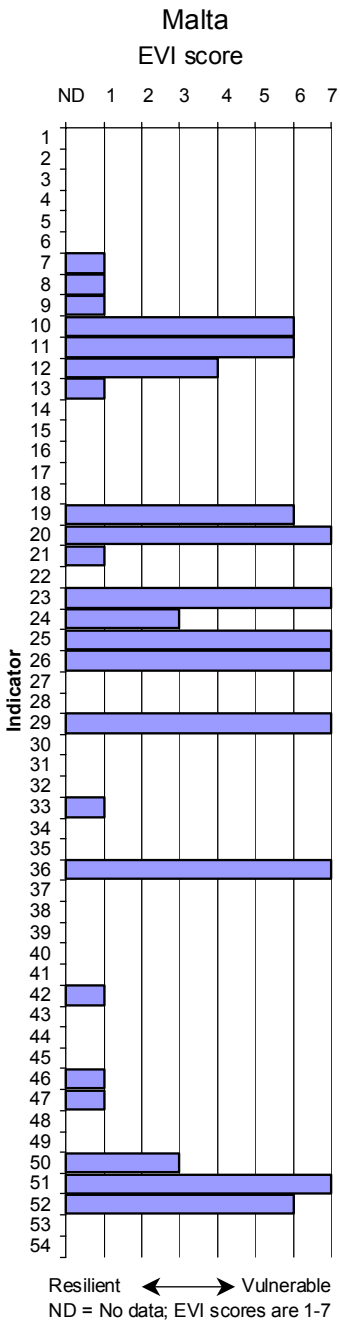
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Maldives is ranked as the 4th-most vulnerable of the 235 countries examined in this demonstration EVI. The high overall EVI score of 4.21, is however, at least partly **an artefact of the low data returns** for this country (data are held for 19 of the 54 indicators, 35%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability and high risk exposure (IRI=5.60, REI=4.14). The greatest vulnerabilities are found in intrinsic country characteristics, biological factors (such as biodiversity) and anthropogenic factors. The country shows low vulnerability to geological factors.

Malta



	DATA	INDEX
EVI		**4.00**
Rank (from most to least vulnerable of 235)		**9**
Number of completed indicators (of 54)	23	
Percent of required indicators	43%	
REI - Risk exposure sub-index	30%	**3.88**
IRI - Intrinsic resilience/vulnerability sub-index	63%	**4.00**
EDI - Environmental degradation sub-index	53%	**4.10**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	67%	**5.00**
Country Characters	63%	**4.00**
Anthropogenic factors	35%	**4.33**

Areas of most environmental vulnerability

Endangered species
Intensive farming
Coastal settlements
Population density
Tourists
SO2
Habitat fragmentation

Areas of good environmental resilience

Volcanos
Earthquakes
Tsunamis
Relief
Extinctions
Oil spills
Mining
Conflicts
Legislation

Data deficiencies

Indicator number

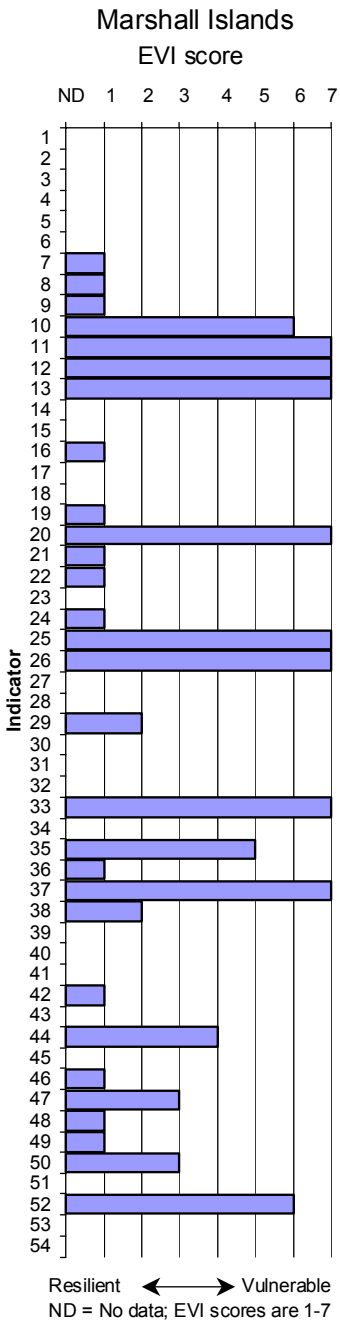
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Malta is ranked as the 9th-most vulnerable of the 235 countries examined in this demonstration EVI. The high overall EVI score of 4.00, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 23 of the 54 indicators, 43%). This EVI score may change significantly when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=4.00) and acquired vulnerability (EDI=4.10). The greatest vulnerabilities are found in biological factors, follwed by anthropogenic and then intrinsic country characteristics. The country shows low vulnerability to geological factors.

Marshall Islands



	DATA	INDEX
EVI		**3.45**
Rank (from most to least vulnerable of 235)		**55**
Number of completed indicators (of 54)	29	
Percent of required indicators	54%	
REI - Risk exposure sub-index	41%	**3.64**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**5.17**
EDI - Environmental degradation sub-index	63%	**2.42**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	67%	**2.83**
Country Characters	75%	**5.17**
Anthropogenic factors	54%	**3.50**

Areas of most environmental vulnerability

Country fragmentation	Coastal settlements
Isolation	Population density
Relief	Oil spills
Endangered species	Fertilisers

Areas of good environmental resilience

Volcanos	Natural Vegetation
Earthquakes	Ecological overfishing
Tsunamis	SO2
Endemics	Mining
Introductions	Conflicts
Extinctions	Sanitation
	GMOs

Data deficiencies

Indicator number

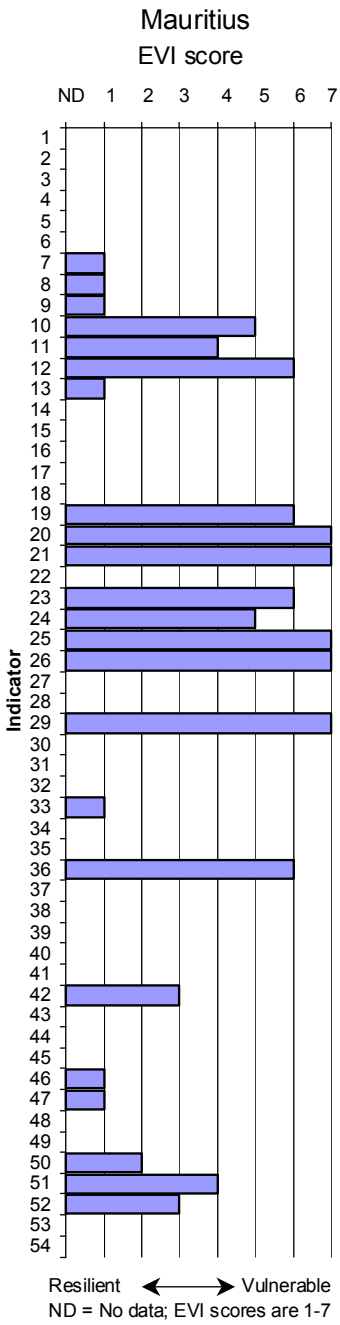
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Marshall Islands is ranked number 55 in terms of vulnerability score out of the 235 countries examined in this demonstration EVI (rank order is from most to least vulnerable). The overall EVI score of 3.45, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 29 of the 54 indicators, 54%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=5.17). The greatest vulnerabilities are found in intrinsic country characters. The country shows low vulnerability to geological factors.

Mauritius



	DATA	INDEX
EVI		**4.00**
Rank (from most to least vulnerable of 235)		**10**
Number of completed indicators (of 54)	23	
Percent of required indicators	43%	
REI - Risk exposure sub-index	30%	**3.38**
IRI - Intrinsic resilience/vulnerability sub-index	63%	**3.60**
EDI - Environmental degradation sub-index	53%	**4.70**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	67%	**5.67**
Country Characters	63%	**3.60**
Anthropogenic factors	35%	**4.11**

Areas of most environmental vulnerability

Endangered species
Extinctions
Coastal settlements
Population density
Tourists

Areas of good environmental resilience

Volcanos
Earthquakes
Tsunamis
Relief
Oil spills
Conflicts
Legislation

Data deficiencies

Indicator number

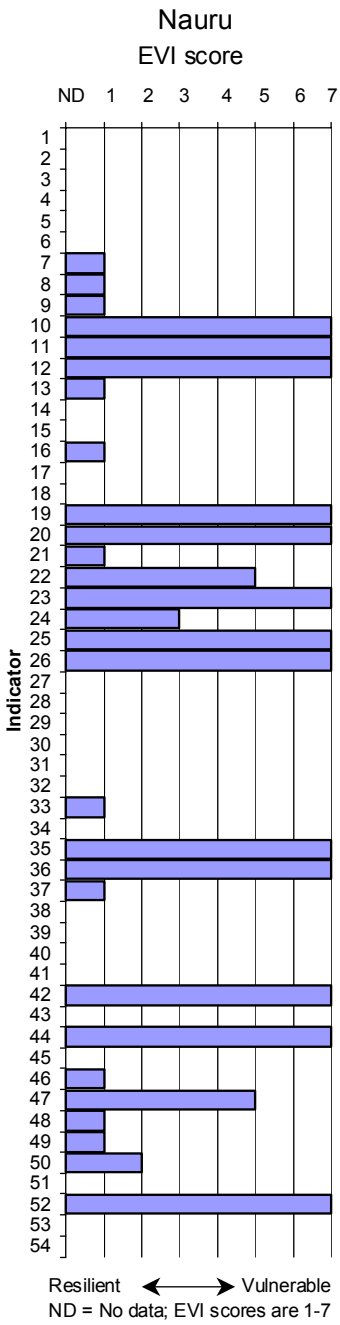
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Mauritius is ranked as the 10th-most vulnerable of the 235 countries examined in this demonstration EVI. The high overall EVI score of 4.00, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 23 of the 54 indicators, 43%). This EVI score may change significantly when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of past environmental damage (EDI=4.70). The greatest vulnerabilities are found in biological factors, followed by anthropogenic factors. The country shows low vulnerability to geological factors.

Nauru



	DATA	INDEX
EVI		**4.18**
Rank (from most to least vulnerable of 235)		**5**
Number of completed indicators (of 54)	28	
Percent of required indicators	52%	
REI - Risk exposure sub-index	33%	**3.67**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**4.17**
EDI - Environmental degradation sub-index	68%	**4.54**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	78%	**5.29**
Country Characters	75%	**4.17**
Anthropogenic factors	46%	**4.33**

Areas of most environmental vulnerability

land area	Coastal settlements
Country fragmentation	Population density
Isolation	Vehicles
Introductions	SO2
Endangered species	Mining
Intensive farming	Terrestrial Reserves
	Migratory Species

Areas of good environmental resilience

Volcanos	Oil spills
Earthquakes	Fertilisers
Tsunamis	Conflicts
Relief	Sanitation
Endemics	GMOs
Extinctions	

Data deficiencies

Indicator number

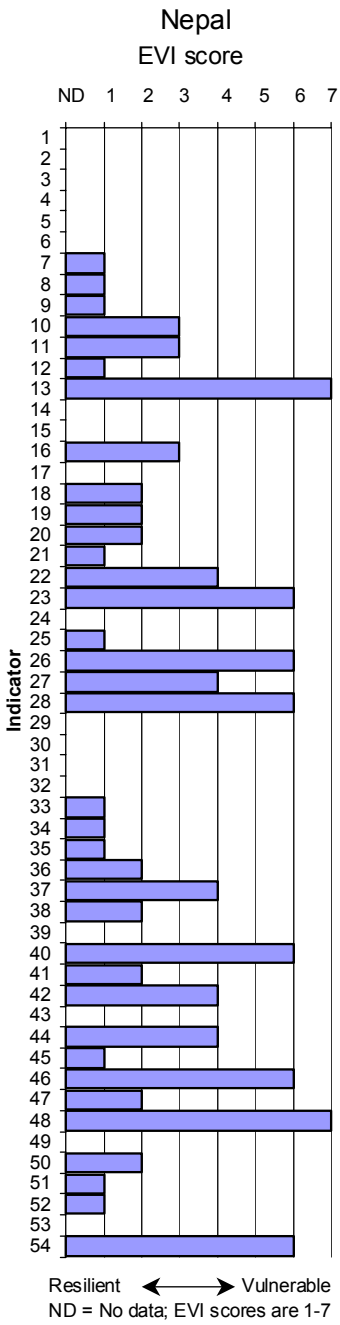
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Nauru is ranked number 5 on the EVI scale, as the 5th-most vulnerable of the 235 countries examined in this demonstration EVI. The high overall EVI score of 4.18, is however, at least partly an **artefact of the low data returns** for this country (data are held for 28 of the 54 indicators, 52%). This EVI score is expected to change significantly when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high intrinsic vulnerability, and high past environmental damage (IRI=4.17; EDI=4.54). The greatest vulnerabilities are found in biological factors (such as biodiversity), anthropogenic factors and country characteristics. The country shows low vulnerability to geological factors.

Nepal



	DATA	INDEX
EVI		**2.97**
Rank (from most to least vulnerable of 235)		**120**
Number of completed indicators (of 54)	36	
Percent of required indicators	67%	
REI - Risk exposure sub-index	56%	**2.60**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.17**
EDI - Environmental degradation sub-index	79%	**3.27**
Meteorological factors	0%	**--**
Geological factors	80%	**2.25**
Biological factors	78%	**2.57**
Country Characters	75%	**3.17**
Anthropogenic factors	73%	**3.21**

Areas of most environmental vulnerability

Extreme (EVI=7)	Very high (EVI=6)
Relief	Intensive farming
Sanitation	Population density
	Loss of natural cover
	Degradation
	Conflicts
	Slides

Areas of good environmental resilience

Volcanos	Oil spills
Earthquakes	Industry
Tsunamis	Vehicles
Isolation	Marine Reserves
Extinctions	Habitat fragmentation
Coastal settlements	Migratory Species

Data deficiencies

Indicator number

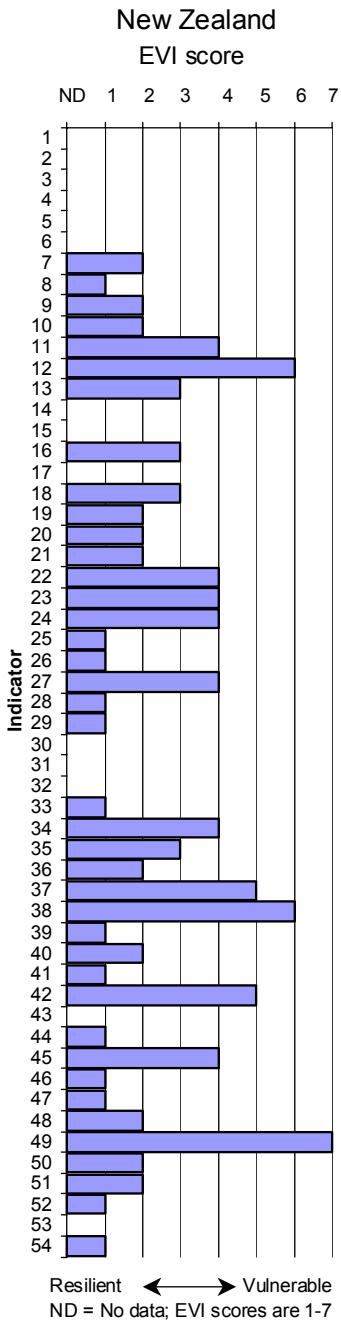
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Nepal is ranked number 120 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 2.97, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 36 of the 54 indicators, 67%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from moderate levels of intrinsic vulnerability and past environmental degradation (IRI=3.17, EDI=3.27). The greatest vulnerabilities are found in anthropogenic factors (3.21), followed by country characteristics (3.17). The country shows relatively low vulnerability to geological and biological factors.

New Zealand



	DATA	INDEX
EVI		**2.60**
Rank (from most to least vulnerable of 235)		**164**
Number of completed indicators (of 54)	40	
Percent of required indicators	74%	
REI - Risk exposure sub-index	63%	**2.29**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.33**
EDI - Environmental degradation sub-index	89%	**2.65**
Meteorological factors	0%	**--**
Geological factors	80%	**1.50**
Biological factors	89%	**2.75**
Country Characters	75%	**3.33**
Anthropogenic factors	85%	**2.55**

Areas of most environmental vulnerability

Extreme (EVI=7)	Very High (EVI=6)
GMOs	Isolation
	Pesticides

Areas of good environmental resilience

Earthquakes	Fisheries stocks	Slides
Coastal settlements	Water resources	
Population density	Terrestrial Reserves	
Loss of natural cover	Conflicts	
Tourists	Legislation	
Oil spills	Migratory Species	

Data deficiencies

Indicator number

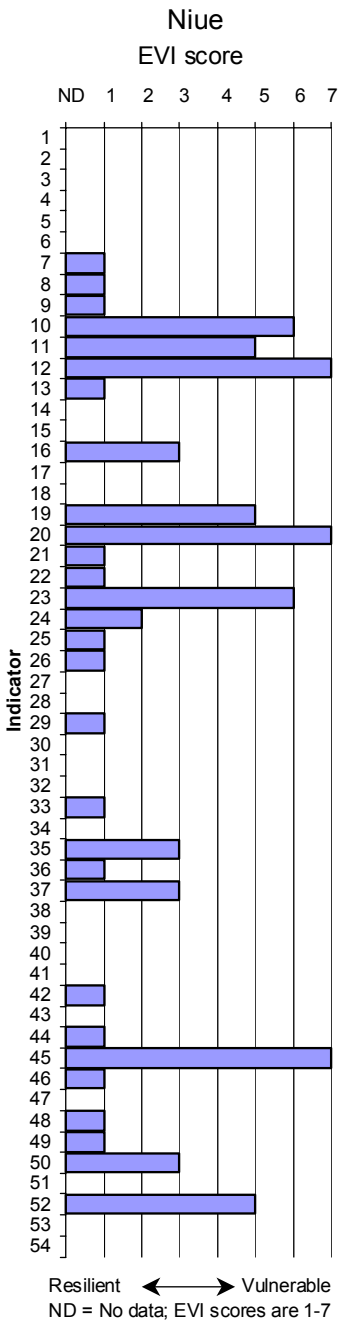
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

New Zealand is ranked number 164 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 2.60, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 40 of the 54 indicators, 74%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from moderate levels of intrinsic vulnerability (IRI=3.33), with moderate to low levels of risk exposure (2.29) and past environmental degradation (2.65). The greatest vulnerabilities are found in country characteristics (3.33). The country shows low vulnerability to geological factors.

Niue



	DATA	INDEX
EVI		**2.69**
Rank (from most to least vulnerable of 235)		**150**
Number of completed indicators (of 54)	29	
Percent of required indicators	54%	
REI - Risk exposure sub-index	37%	**1.80**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**4.17**
EDI - Environmental degradation sub-index	68%	**2.69**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	78%	**3.86**
Country Characters	75%	**4.17**
Anthropogenic factors	50%	**1.77**

Areas of most environmental vulnerability

Extreme (EVI=7)	Very high (EVI=6)
Isolation	Land area
Endangered species	Intensive farming
	Marine Reserves

Areas of good environmental resilience

Volcanos	Coastal settlements	Terrestrial Reserves
Earthquakes	Population density	Conflicts
Tsunamis	Tourists	Sanitation
Relief	Oil spills	GMOs
Extinctions	SO2	
Natural Vegetation	Mining	

Data deficiencies

Indicator number

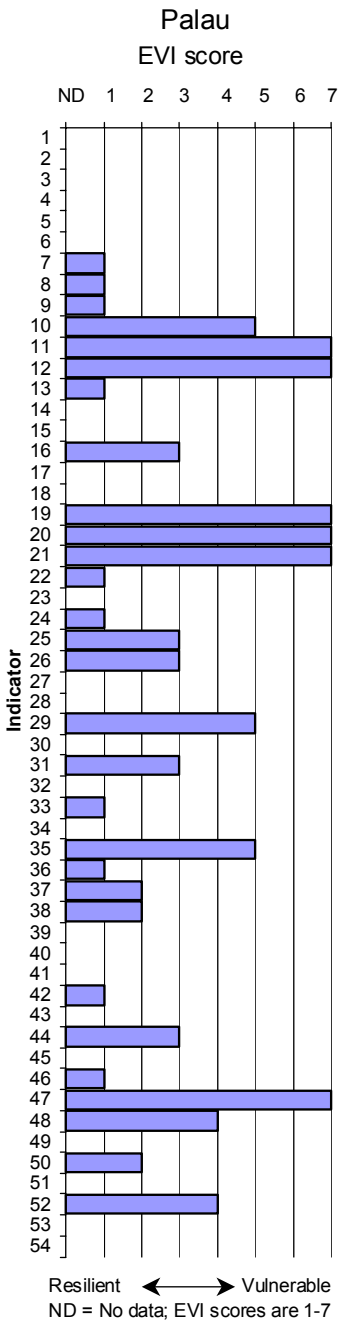
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Niue is ranked number 150 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 2.69, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 29 of the 54 indicators, 54%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=4.17), with relatively low levels of risk exposure (1.80) and moderate to low levels of past environmental degradation (2.69). The greatest vulnerabilities are found in country characteristics (4.17) and biological factors (3.86). The country shows low vulnerability to geological and anthropogenic factors.

Palau



	DATA	INDEX
EVI		**3.31**
Rank (from most to least vulnerable of 235)		**73**
Number of completed indicators (of 54)	29	
Percent of required indicators	54%	
REI - Risk exposure sub-index	44%	**2.42**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**4.17**
EDI - Environmental degradation sub-index	58%	**3.82**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	67%	**4.50**
Country Characters	75%	**4.17**
Anthropogenic factors	54%	**2.93**

Areas of most environmental vulnerability

Country fragmentation
Isolation
Introductions
Endangered species
Extinctions
Legislation

Areas of good environmental resilience

Volcanos	Ecological overfishing
Earthquakes	Oil spills
Tsunamis	SO2
Relief	Mining
Natural Vegetation	Conflicts

Data deficiencies

Indicator number

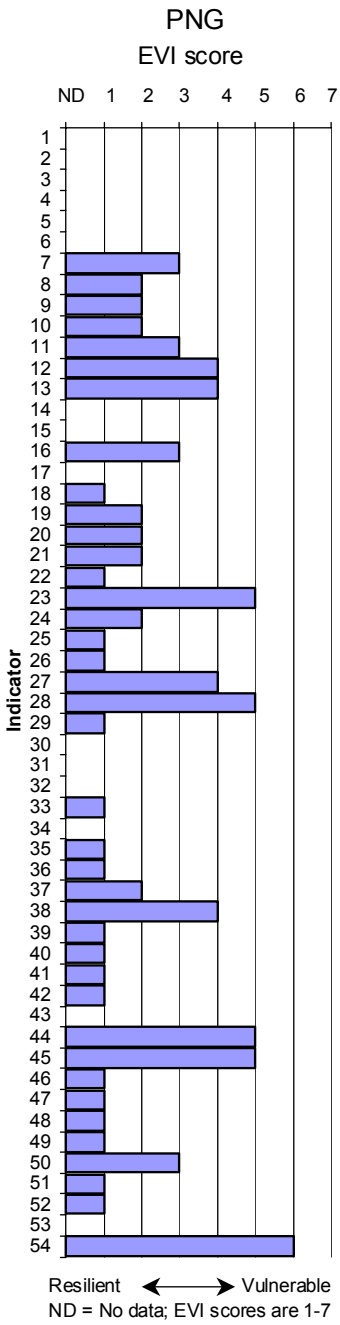
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Palau is ranked as the 73rd -most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.31, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 29 of the 54 indicators, 54%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=4.17). The greatest vulnerabilities are found in biological factors (4.50) and intrinsic country characters (4.17). The country shows relatively low vulnerability to geological factors.

Papua New Guinea



	DATA	INDEX
EVI		**2.26**
Rank (from most to least vulnerable of 235)		**205**
Number of completed indicators (of 54)	39	
Percent of required indicators	72%	
REI - Risk exposure sub-index	59%	**2.25**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.17**
EDI - Environmental degradation sub-index	89%	**1.94**
Meteorological factors	0%	**--**
Geological factors	80%	**3.25**
Biological factors	89%	**2.00**
Country Characters	75%	**3.17**
Anthropogenic factors	81%	**1.90**

Areas of most environmental vulnerability

Very high (EVI=6)	High (EVI=5)
Slides	Intensive farming
	Loss of natural cover
	Terrestrial Reserves
	Marine Reserves

Areas of good environmental resilience

Potential for introductions	Vehicles	Conflicts
Natural Vegetation	SO2	Legislation
Coastal settlements	Fisheries stocks	Sanitation
Population density	Degradation	GMOs
Tourists	Water resources	Habitat fragmentation
Oil spills	Mining	Migratory Species

Data deficiencies

Indicator number

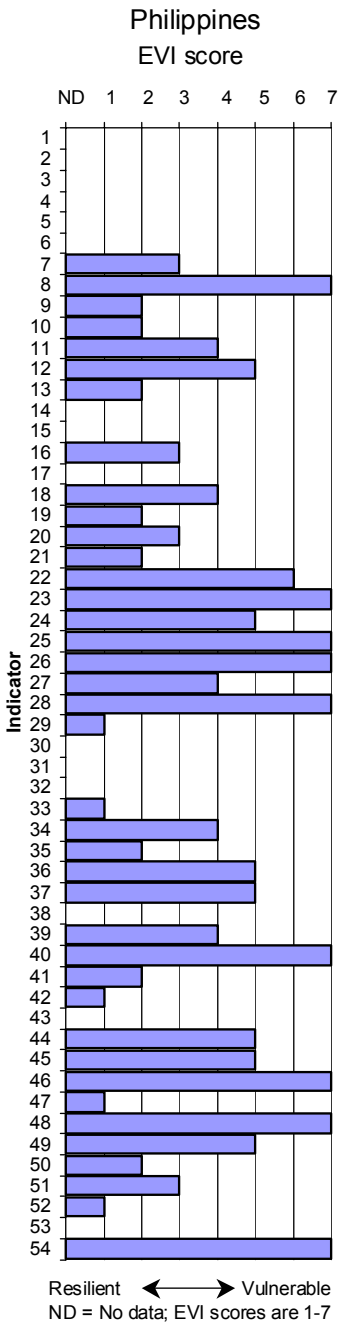
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Papua New Guinea is ranked number 205 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 2.26, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 39 of the 54 indicators, 72%). This EVI score may change when data for the remaining indicators become available.

The country has low vulnerability overall, with the most vulnerable aspects being its moderate intrinsic vulnerability (IRI=3.17). Environmental degradation and risk exposure are respectively low and low-to-moderate on the EVI scale (EDI=1.94, REI=2.25). Most of the vulnerability in the country can be attributed to geological (3.25) and intrinsic country characteristics. The country shows low vulnerability to anthropogenic factors (1.90).

Philippines



	DATA	INDEX
EVI		**4.03**
Rank (from most to least vulnerable of 235)		**8**
Number of completed indicators (of 54)	39	
Percent of required indicators	72%	
REI - Risk exposure sub-index	59%	**4.00**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.00**
EDI - Environmental degradation sub-index	89%	**4.41**
Meteorological factors	0%	**--**
Geological factors	80%	**4.75**
Biological factors	89%	**3.75**
Country Characters	75%	**3.00**
Anthropogenic factors	81%	**4.29**

Areas of most environmental vulnerability

Earthquakes
Intensive farming
Coastal settlements
Population density
Loss of natural cover
Degradation
Conflicts
Sanitation
Slides

Areas of good environmental resilience

Tourists
Oil spills
Mining
Legislation
Migratory Species

Data deficiencies

Indicator number

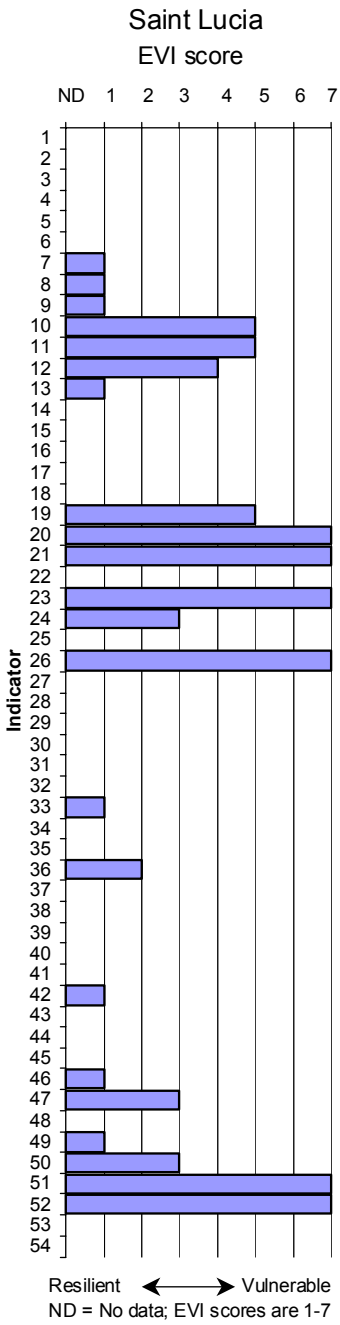
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Philippines is ranked as the 8th-most vulnerable of the 235 countries examined in this demonstration EVI. The high overall EVI score of 4.03, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 39 of the 54 indicators, 72%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of past environmental damage and high risk exposure (EDI=4.41, REI=4.00). The greatest vulnerabilities are found in geological and anthropogenic factors. The country shows lower vulnerability to intrinsic country characteristics.

Saint Lucia



	DATA	INDEX
EVI		**3.64**
Rank (from most to least vulnerable of 235)		**37**
Number of completed indicators (of 54)	22	
Percent of required indicators	41%	
REI - Risk exposure sub-index	26%	**2.86**
IRI - Intrinsic resilience/vulnerability sub-index	63%	**3.60**
EDI - Environmental degradation sub-index	53%	**4.20**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	67%	**6.00**
Country Characters	63%	**3.60**
Anthropogenic factors	31%	**2.88**

Areas of most environmental vulnerability

Endangered species
Extinctions
Intensive farming
Population density
Habitat fragmentation
Migratory Species

Areas of good environmental resilience

Volcanos
Earthquakes
Tsunamis
Relief
Oil spills
Mining
Conflicts
GMOs

Data deficiencies

Indicator number

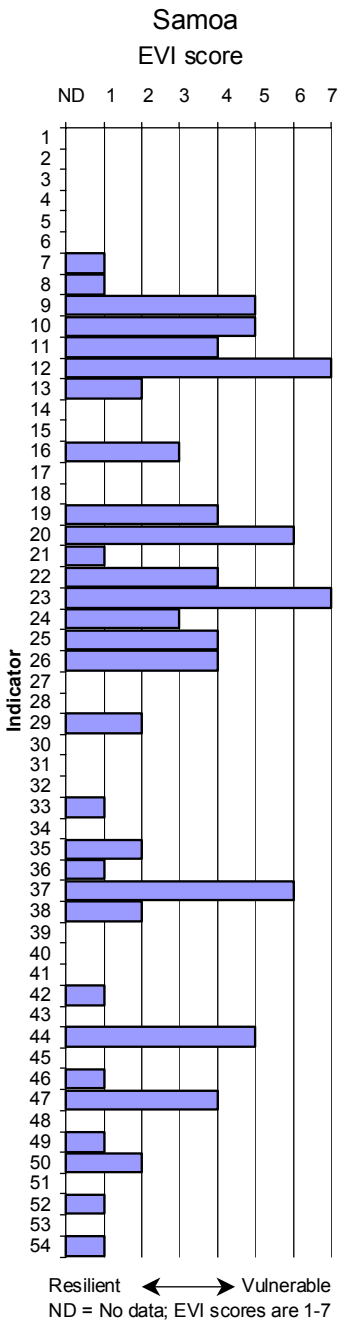
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Saint Lucia is ranked number 37 in terms of vulnerability score out of the 235 countries examined in this demonstration EVI (rank order is from most to least vulnerable). The overall EVI score of 3.64, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 22 of the 54 indicators, 41%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of past environmental damage (EDI=4.20), and to a lesser extent from intrinsic vulnerability (IRI=3.60). The greatest vulnerabilities are found in biological factors (6.00). The country shows low vulnerability to geological factors.

Samoa



	DATA	INDEX
EVI		**3.03**
Rank (from most to least vulnerable of 235)		**110**
Number of completed indicators (of 54)	30	
Percent of required indicators	56%	
REI - Risk exposure sub-index	44%	**2.25**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.83**
EDI - Environmental degradation sub-index	63%	**3.42**
Meteorological factors	0%	**--**
Geological factors	80%	**2.00**
Biological factors	78%	**3.71**
Country Characters	75%	**3.83**
Anthropogenic factors	50%	**2.62**

Areas of most environmental vulnerability

Extreme (EVI=7)	Very High (EVI=6)
Isolation	Endangered species
Intensive farming	Fertilisers

Areas of good environmental resilience

Volcanos	Mining
Earthquakes	Conflicts
Extinctions	GMOs
Oil spills	Migratory Species
SO2	Slides

Data deficiencies

Indicator number

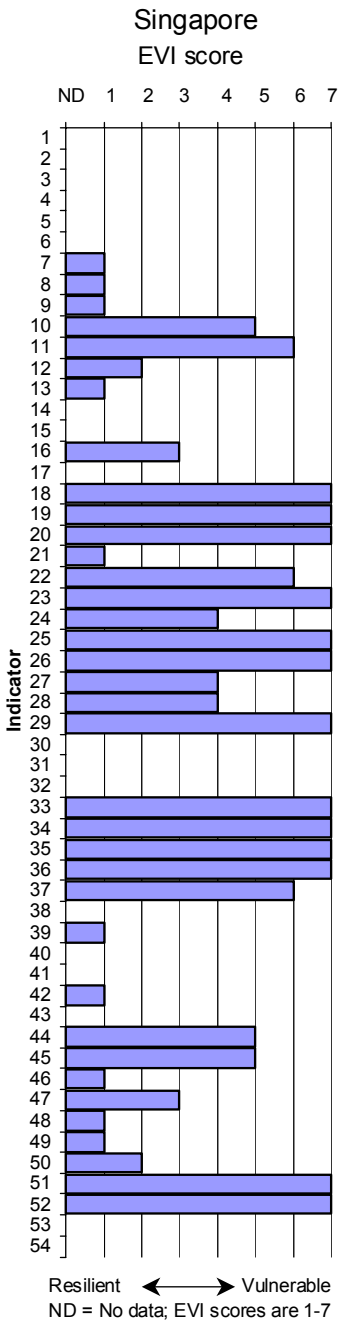
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Samoa is ranked number 110 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.03, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 30 of the 54 indicators, 56%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from moderate levels of intrinsic vulnerability and past environmental degradation (IRI=3.83, EDI=3.42). The greatest vulnerabilities are found in country characteristics (3.83), followed by biological factors (3.71). The country shows relatively low vulnerability to geological factors.

Singapore



	DATA	INDEX
EVI		**4.33**
Rank (from most to least vulnerable of 235)		**2**
Number of completed indicators (of 54)	36	
Percent of required indicators	67%	
REI - Risk exposure sub-index	56%	**4.93**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**3.17**
EDI - Environmental degradation sub-index	79%	**4.20**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	89%	**5.75**
Country Characters	75%	**3.17**
Anthropogenic factors	73%	**4.63**

Areas of most environmental vulnerability

Potential for introductions	Oil spills
Introductions	Industry
Endangered species	Vehicles
Intensive farming	SO2
Coastal settlements	Habitat fragmentation
Population density	Migratory Species
Tourists	

Areas of good environmental resilience

Volcanos	Fisheries stocks
Earthquakes	Mining
Tsunamis	Conflicts
Relief	Sanitation
Extinctions	GMOs

Data deficiencies

Indicator number

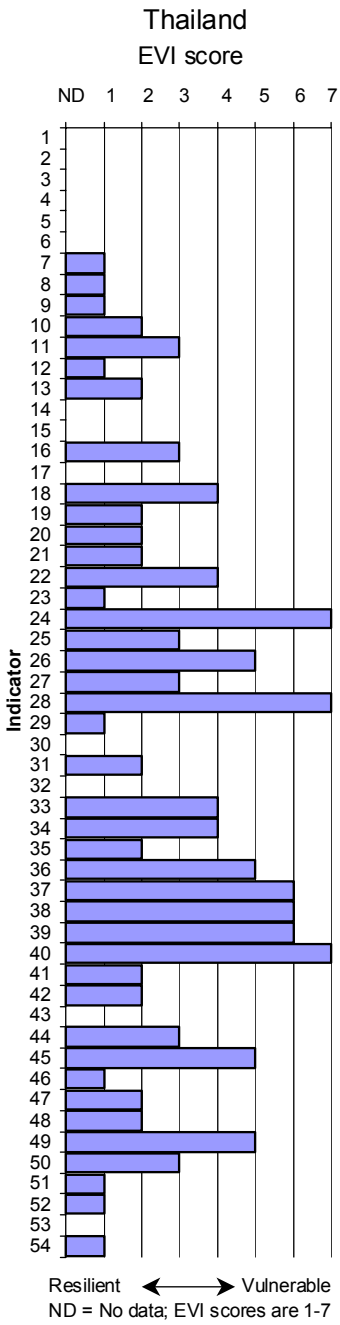
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Singapore is ranked number 2 on the EVI scale, as the 2nd -most vulnerable of the 235 countries examined in this demonstration EVI. The high overall EVI score of 4.33, is however, at least partly an **artefact of the low data returns** for this country (data are held for 36 of the 54 indicators, 67%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high risk exposure and high past environmental damage (REI=4.93; EDI=4.20). Intrinsic resilience is relatively lower at IRI=3.17. The greatest vulnerabilities are found in biological factors (such as biodiversity) and anthropogenic factors, while the country shows low vulnerability to geological factors. Intrinsic country characters make the country moderately vulnerable.

Thailand



	DATA	INDEX
EVI		**3.05**
Rank (from most to least vulnerable of 235)		**109**
Number of completed indicators (of 54)	41	
Percent of required indicators	76%	
REI - Risk exposure sub-index	67%	**3.33**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**2.33**
EDI - Environmental degradation sub-index	89%	**3.00**
Meteorological factors	0%	**--**
Geological factors	80%	**1.00**
Biological factors	89%	**2.88**
Country Characters	75%	**2.33**
Anthropogenic factors	88%	**3.65**

Areas of most environmental vulnerability

Ecological overfishing
Loss of natural cover
Degradation

Areas of good environmental resilience

Volcanos	Tourists
Earthquakes	Conflicts
Tsunamis	Habitat fragmentation
Isolation	Migratory Species
Intensive farming	Slides

Data deficiencies

Indicator number

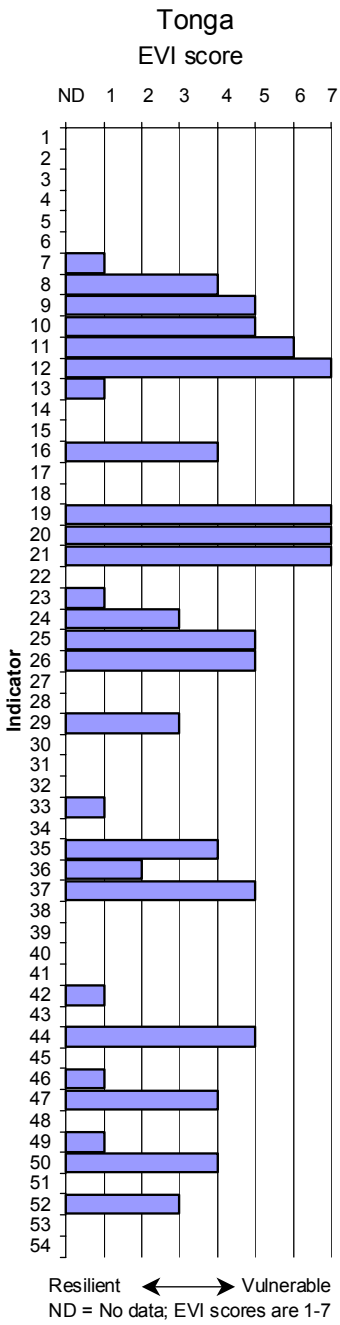
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Thailand is ranked as the 109th -most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.05, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 41 of the 54 indicators, 76%). Thailand does, however have one of the highest percentages of completed data, with 80% required for a valid EVI. The EVI score given here may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from moderate risk exposure and past environmental damage (REI=3.33, EDI=3.00). The greatest vulnerabilities are found in anthropogenic factors (3.65). The country shows relatively low vulnerability to geological factors.

Tonga



	DATA	INDEX
EVI		**3.78**
Rank (from most to least vulnerable of 235)		**27**
Number of completed indicators (of 54)	27	
Percent of required indicators	50%	
REI - Risk exposure sub-index	37%	**3.30**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**4.50**
EDI - Environmental degradation sub-index	58%	**3.82**
Meteorological factors	0%	**--**
Geological factors	60%	**3.33**
Biological factors	67%	**4.67**
Country Characters	75%	**4.50**
Anthropogenic factors	46%	**3.08**

Areas of most environmental vulnerability

Isolation
Introductions
Endangered species
Extinctions

Areas of good environmental resilience

Volcanos
Relief
Intensive farming
Oil spills
Mining
Conflicts
GMOs

Data deficiencies

Indicator number

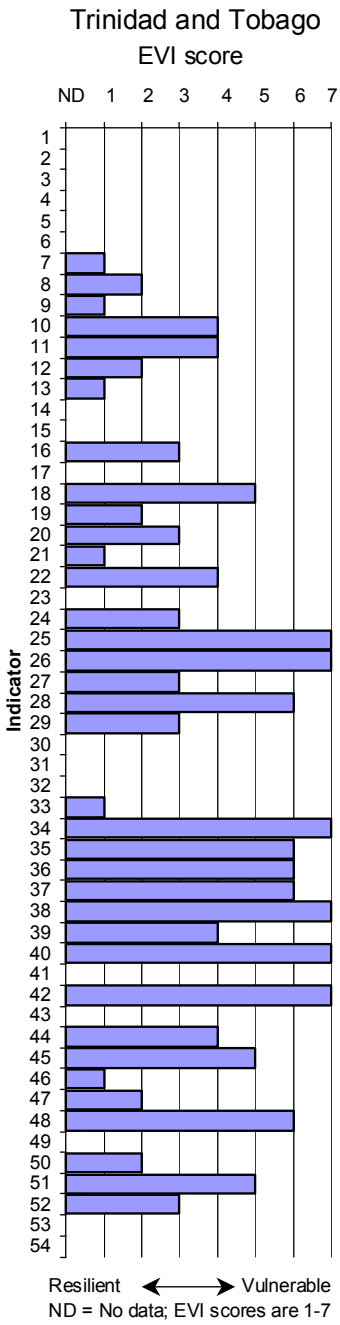
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Tonga is ranked as the 27th -most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.78, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 27 of the 54 indicators, 50%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=4.50), with past environmental damage and risk exposure at lower levels (EDI=3.82, REI=3.30). The greatest vulnerabilities are found in biological and intrinsic country characters (4.67 and 4.50 respectively). The country shows moderate vulnerability to geological factors.

Trinidad and Tobago



	DATA	INDEX
EVI		**3.92**
Rank (from most to least vulnerable of 235)		**18**
Number of completed indicators (of 54)	36	
Percent of required indicators	67%	
REI - Risk exposure sub-index	59%	**4.25**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**2.67**
EDI - Environmental degradation sub-index	74%	**4.07**
Meteorological factors	0%	**--**
Geological factors	60%	**1.33**
Biological factors	78%	**3.00**
Country Characters	75%	**2.67**
Anthropogenic factors	77%	**5.00**

Areas of most environmental vulnerability

Coastal settlements
Population density
Industry
Pesticides
Degradation
Mining

Areas of good environmental resilience

Volcanos
Tsunamis
Relief
Extinctions
Oil spills
Conflicts

Data deficiencies

Indicator number

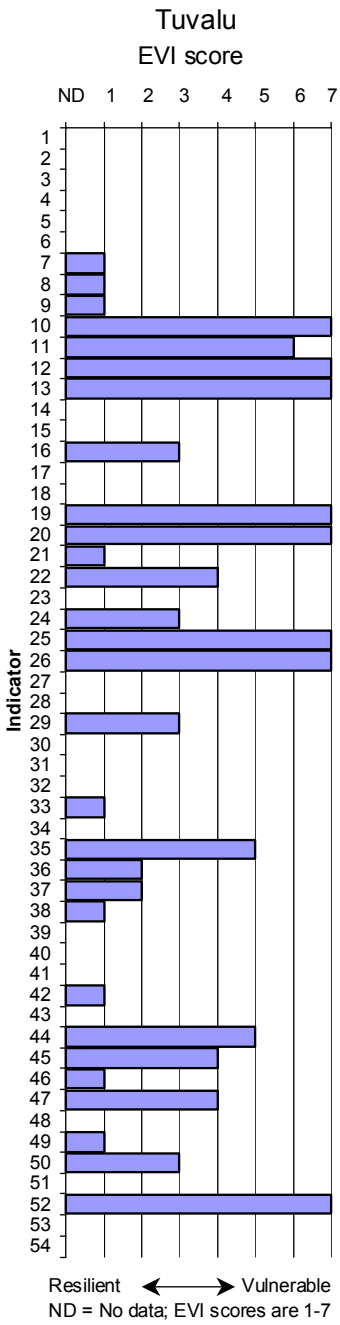
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Trinidad & Tobago is ranked as the 18th-most vulnerable of the 235 countries examined in this demonstration EVI. The overall EVI score of 3.92, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 36 of the 54 indicators, 67%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of risk exposure, with moderately high levels of past environmental damage (REI=4.25, EDI=4.07). Instrinsic vulnerability is relatively low at IRI=2.67. The greatest vulnerabilities are found in anthropogenic factors. The country shows lower vulnerability to geological factors and resulting from intrinsic country characteristics.

Tuvalu



	DATA	INDEX
EVI		**3.76**
Rank (from most to least vulnerable of 235)		**29**
Number of completed indicators (of 54)	29	
Percent of required indicators	54%	
REI - Risk exposure sub-index	41%	**2.82**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**5.50**
EDI - Environmental degradation sub-index	63%	**3.75**
Meteorological factors	0%	**--**
Geological factors	60%	**1.00**
Biological factors	67%	**4.83**
Country Characters	75%	**5.50**
Anthropogenic factors	54%	**3.14**

Areas of most environmental vulnerability

Land area
Isolation
Relief
Introductions
Endangered species
Coastal settlements
Population density
Migratory Species

Areas of good environmental resilience

Volcanos
Earthquakes
Tsunamis
Extinctions
Oil spills
Pesticides
Mining
Conflicts
GMOs

Data deficiencies

Indicator number

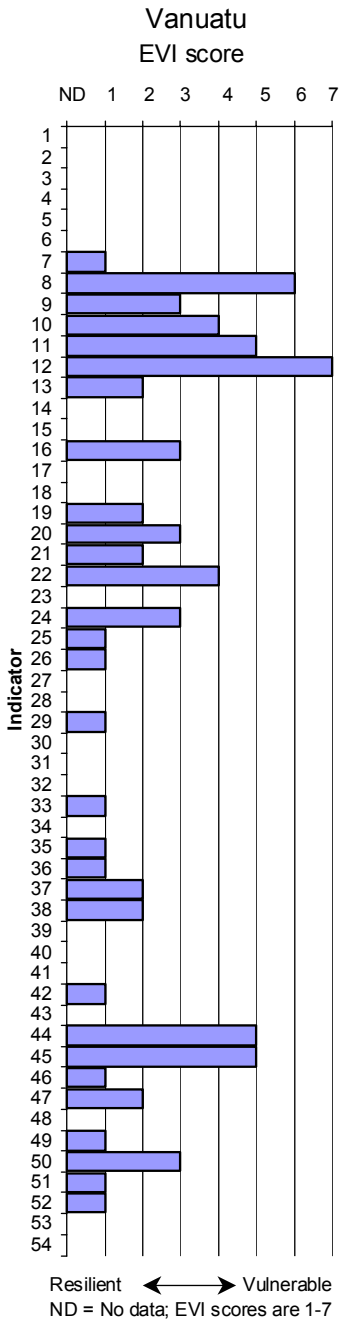
1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Tuvalu is ranked number 29 in terms of vulnerability score out of the 235 countries examined in this demonstration EVI (rank order is from most to least vulnerable). The overall EVI score of 3.76, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 29 of the 54 indicators, 54%). This EVI score may change when data for the remaining indicators become available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=5.50), with past environmental damage moderate levels (EDI=3.75). The greatest vulnerabilities are found in intrinsic country characters (5.50) and biological factors (4.83). The country shows low vulnerability to geological factors.

Vanuatu



	DATA	INDEX
EVI		**2.50**
Rank (from most to least vulnerable of 235)		**177**
Number of completed indicators (of 54)	30	
Percent of required indicators	56%	
REI - Risk exposure sub-index	41%	**1.82**
IRI - Intrinsic resilience/vulnerability sub-index	75%	**4.00**
EDI - Environmental degradation sub-index	68%	**2.38**
Meteorological factors	0%	**--**
Geological factors	60%	**3.33**
Biological factors	67%	**2.50**
Country Characters	75%	**4.00**
Anthropogenic factors	58%	**1.73**

Areas of most environmental vulnerability

Extreme (EVI=7)	Very high (EVI=6)
Isolation	Earthquakes

Areas of good environmental resilience

Volcanos	SO2
Coastal settlements	Mining
Population density	Conflicts
Tourists	GMOs
Oil spills	Habitat fragmentation
Vehicles	Migratory Species

Data deficiencies

Indicator number

1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54

Missing data

Vanuatu is ranked number 177 in environmental vulnerability of the 235 countries examined in this demonstration EVI. The overall EVI score of 2.50, is however, at least partly an **artefact of the incomplete data returns** for this country (data are held for 30 of the 54 indicators, 56%). This EVI score may change when data for the remaining indicators become available, particularly as Vanuatu's main vulnerabilities appear to be related to extreme weather events for which no data are currently available.

Most of the country's measured vulnerability is derived from high levels of intrinsic vulnerability (IRI=4.00), with moderate to low levels of past environmental degradation (EDI=2.38) and low levels of risk exposure (REI=1.82). The greatest vulnerabilities are found in country characteristics, with geological factors of moderate to high significance (3.33). The country shows low vulnerability to anthropogenic factors (1.73).

1 INTRODUCTION

1.1 Background of the project

Vulnerability has received growing international recognition as an issue of central concern to the sustainable development of countries. The vulnerability of a country, or its converse resilience, is the result of an interplay of factors, which can result in damage to social, economic or environmental systems. The factors affecting the degree of vulnerability can include remoteness, transboundary issues, migrations, civil unrest, geographic dispersion, natural disasters, a high degree of economic openness, small internal markets and a limited or damaged natural resource base.

The issue of vulnerability was first raised in the context of the Global Summit on Small Island Developing States (SIDS) held in Barbados in 1994. Concern over the vulnerability of SIDS was expressed because it was perceived that these counties were at a disadvantage in relation to other countries because of their small size and susceptibility to disturbance. SIDS, with the support of the United Nations, expressed the desire in the Barbados Programme of Action (BPoA) that a vulnerability index integrating ecological fragility and economic vulnerability should be developed to reflect the status of their countries.

Although efforts to develop vulnerability indices for countries are not new, popular focus has been on economic and social vulnerabilities, giving only a limited understanding of the overall problem. The Environmental Vulnerability Index (EVI), a project being undertaken by SOPAC looks specifically, and for the first time, into the issue of environmental vulnerability. That is, the risk of damage to the natural environment, which underpins all human activities.

In 1998 with funding from the New Zealand government, a SOPAC study team was put together to undertake development of a method for determining and quantifying environmental vulnerability at the scale of entire countries. The study has progressed since that time through several phases of development:

- **Phase I** (Aug 1998-Feb 1999) To develop an EVI model with initial testing on three countries;
- **Phase II** (Mar 1999-Feb 2000) To subject the EVI to peer review, create an EVI database for the Pacific SIDS, develop the model and test it on several Pacific Island countries;
- **Phase III** (Mar 2000 – April 2003: current phase) To globalise the EVI, including the establishment of a global database, setting of levels for the indicators, and calculating EVI values for a range of countries around the globe. This phase also was to include some testing of the model; and peer review
- **Final steps to completion** (May 2003-May 2004) It is envisaged that the EVI would be completed and fully tested in this final phase, of the project during 2003-4 in time for Barbados+10.

In February 1999 the team was able to produce its Phase I results in a report entitled *'Environmental Vulnerability Index (EVI) to summarise national environmental vulnerability profiles'*. That report was extensively peer reviewed during Phase II of the project and critically discussed at an Expert Think Tank meeting held in Fiji in September 1999. SOPAC and the Foundation for International Studies (of the University of Malta's Islands and Small States Institute), with the support of the United Nations Environment Programme also organised a meeting of experts in Malta in late 1999 to further review the EVI. This process of development and refinement was accompanied by the accumulation of environmental

vulnerability data profiles from several Pacific countries including Fiji, Samoa, Tuvalu and Vanuatu. The data provided the basis for preliminary testing of the model, which was completed in February 2000 and presented in the Phase II Report. Progress reports produced in March 2001 and 2002 detailed the first two years of work on Phase III of the project. These were concerned with the establishment of partnerships with 32 collaborating countries around the globe, creation of a global EVI database, collection of data from collaborators and public sources, and the establishment of mechanisms for controlling the quality and expediting collection of data from collaborating countries.

Support for the EVI:

DONORS - New Zealand, Norway, Ireland & Italy
ORGANISATIONS - UNEP, FIS (University of Malta), ISDR, WMO, CROP
SOPAC MEMBER COUNTRIES - Australia, Cook Is., Fiji, French Polynesia, FSM, Guam, Kiribati, Marshall Is., Nauru, New Caledonia, New Zealand, Niue, Papua New Guinea, Samoa, Solomon Is., Tonga, Tuvalu, Vanuatu.
COLLABORATING COUNTRIES - Bangladesh, Barbados, Botswana, Costa Rica, Greece, Jamaica, Kenya, Kyrgyz Republic, Malta, Mauritius, Nepal, Palau, Philippines, St Lucia, Singapore, Thailand, Trinidad

1.2 Aims for Phase III and the Demonstration EVI

The aims during Phase III of the EVI Project were to complete the following tasks:

1. Develop the EVI Model (testing & refinement, setting scoring levels for indicators, EVI evaluated, with profiles for at least 20 countries);
2. Establish an international EVI database and stakeholder partnerships (establish collaboration with 32 countries around the globe, including most Pacific SIDS, create electronic EVI database from public sources and using data supplied by collaborators)
3. Carry out capacity building / sustainability tasks (in-country training and data-gathering techniques in SIDS);
4. Increase awareness of the issue of environmental vulnerability (EVI publications, presentations at meetings, EVI website, distribution of reports for peer review); and
5. Expert peer review.

Most of these tasks have been on-going since the inception of Phase III in March 2000, and progress on them was reported in our Phase III progress reports in 2001 and 2002 (Pratt et al. 2001, Kaly et al. 2002).

In this Report we focus on the outcomes of Tasks 1 and 2 above. We report on the status of the global EVI database, sources of data utilised, scoring for the EVI's indicators and demonstration results for 235 countries. Although our initial aim during this phase was to produce completed EVIs for at least 20 countries, we found that we were unable to gather data for sufficient indicators to calculate a valid (at least 80% of indicators evaluated) EVI for any country, despite the excellent input from collaborators. The main reason for this, as discussed below, is that it was impossible to set levels for indicators with small numbers of observations. A shortage of data for 13 of the 54 indicators lead us to redefine our aims for the conclusion of Phase III. In this report, therefore, we present results for the '*Demonstration EVI'*, which is a fully-functional EVI model with two differences. The first is that EVI values are calculated using only the data available for any country and does not reach the 80% of indicators data requirement set for the EVI. The second difference is that data for some indicators are proxies and not the data originally defined for the model – in many cases, these are improvements and are likely to be retained in the final model. It was

an expected part of the development process that the detailed form of some indicators might change during refinement.

2 GENERAL DESCRIPTION OF VULNERABILITY, INDICES & THE EVI

2.1 The nature and terminology of vulnerability

The natural environment is unequivocally the life support for all human systems. Far from being a luxury available only to those who can afford it, successful environmental management will increasingly become the basis for the success or failure of the economies and social systems of entire countries.

The topic of environmental vulnerability is concerned with the *risk* of damage to the natural environment of a country. For the natural environment, the entities at risk, termed *responders*, include ecosystems, habitats, populations and communities of organisms, physical and biological processes (e.g. beach building, reproduction), energy flows, diversity, genes, ecological resilience and ecological redundancy. Each of these responders (ecosystem goods, services and relationships) may be affected by natural and anthropogenic hazards, the risk of which may vary with time, place and human behaviour. The obvious complex nature of vulnerability has required the development of vulnerability theory to provide a framework for logical development and measurement.

The theory identifies three aspects[1], which can be identified wherever vulnerability is considered. These are: (i) the risk of hazards occurring, (ii) the intrinsic resilience[2] and (iii) the extrinsic resilience to hazardous events. The risk associated with hazards is dependent on the frequency and intensity of events that, by definition, may adversely affect the environment. The intrinsic resilience of the environment refers to the innate characteristics of a country that would tend to make it more or less able to cope with natural and anthropogenic hazards. For example, Nepal is intrinsically invulnerable to sea-level rise, regardless of the worldwide level of risk and any other damage that might be sustained to its environments. Extrinsic resilience results from external forces acting on the environment and describes the ecological integrity or level of degradation of ecosystems. 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 they are likely to be to future hazards.

Risks to the natural environment include any events or processes that can cause damage. These include natural and human events and processes, such as the weather and pollution. It has been suggested that natural hazards should not be included in discussions of environmental vulnerability because unless we identify certain natural events as being altered by humans (e.g. human-induced sea-level rise), all natural events must be '*normal*' and are therefore not part of vulnerability. This view implies that nature cannot damage nature and/or that natural hazards operate more-or-less in isolation. Natural and human hazards affect the environment in interactive ways, therefore an integrated approach is required when analysing vulnerability issues. For example, the effects of cyclones on natural communities are worse where marine and shoreline ecosystems have been degraded by pollution and over-harvesting. High levels of natural disturbance can drive populations of organisms down to low levels or make their populations more variable. This in turn, makes the risk of local extinction from other hazards more likely. The frequency and intensity of natural disturbances cannot be separated from the effects of human disturbances and needs to be incorporated in the concept of environmental vulnerability.

[1] The three aspects (risk, and intrinsic and extrinsic resilience) apply to environmental, social and economic vulnerability.
[2] We define resilience as the converse of vulnerability, i.e. an entity is vulnerable to the extent that it is not resilient.

Environmental vulnerability is a density function, and any expressions of it need to reflect this. In any consideration of the effects of a hazard on the condition and function of the natural environment, it is necessary to take into consideration, the area over which the effects of the hazard are to be absorbed or attenuated. For example, in terms of damage to the environment, 10 litres of oil will do more damage as pollution on 1 square metre of land than it would if it were distributed over 1 square kilometre. On the smaller plot of land, local ecological communities of organisms are likely to be overwhelmed by the influx of such a relatively large amount of pollution, and shifts in ecosystem quality and function may be expected.

2.2 Review of environmental indicators and indices

We reviewed 30 environmental and vulnerability indicators to determine the types of indices and indicators being developed internationally and the context of the EVI. Globally, 4 major groups of indices and indicators have been developed. These are:

- State of the Environment (SOE);
- Sustainable Development (SD);
- Ecological Footprint (EF);
- Vulnerability. (see also Table 1, Appendix 7.3).

The number of indicators used in these studies ranges between 4 and 121, with a tendency for larger numbers of indicators for environmental indices and smaller numbers for economic indices (Table 1).

Almost all of these indicators report observed values for a country in relation to the world-wide range or are based on policy and do not attempt to set limits for indicator values that might show where state of the environment, or sustainable development are occurring within sustainable limits. With this approach, it is difficult to ensure the future because as conditions decline, countries would merely occupy a new position in the range and no mechanism is available to identify when a country has exceeded sustainable limits.

Very few of the indicators developed are expressed in relation to area, with most being expressed as changes through time or on a per capita basis. We would argue that for most environmental indicators, it is the density, per unit area over which effects can be attenuated that is the most important denominator (Table 7).

Table 1: Summary of main environmental and vulnerability indices and indicators currently under development.

Title	Type	# Indicators
EUROSTAT	Vulnerability (as risk exposure)	60
Australian SOE	SOE	75
ANZECC	SOE	75
South Africa SOE	SOE	102
UK SOE	SOE	15 (indicators also used)
ENTRI System	SOE	20+
Leading Environmental Indicators	SOE	16
Living Planet	SOE, Ecological Footprint	8 indices (indicators also used)
Ecological Footprint	Ecological Footprint	Not fixed
Water Poverty Index	SOE (partial)	4
Pesticide Impact ranking Index	Vulnerability	3 indices (number of indicators not given)

Title	Type	# Indicators
Index of watershed indicators	SOE, some partial Vulnerability	15
Reefs at Risk	Partial Vulnerability	10+
OECD	SOE	121
Wellbeing of Nations	SOE, SD	51 (+socio-economic indicators)
World Bank Wealth of Nations	Economic SD index	Not given
CSD	SD	58
Environmental Sustainability Index	SD	66
Sustainable Development Index (Mexican)	SD	22
Sustainable Development Index (IISD Net)	SD	Variable, depends on user
Compass Index of Sustainability	SD	Variable, depends on user
Genuine Progress Indicator	SD	24
Human Development Index	SD	16
Index of Environmental Friendliness	Vulnerability (as risk exposure), SOE	23
Economic Vulnerability Index	Vulnerability	5
Coral Reef Vulnerability Index to Climate Change	Vulnerability	36
Vulnerability Assessment to Climate Change and Sealevel Rise	Vulnerability	20
Key indicators for Global Vulnerability Mapping	Vulnerability	Under development
Composite Human Vulnerability Index	Vulnerability	19
Island Indicators	Vulnerability	15

2.3 Uniqueness of the EVI approach

The EVI is unique among the studies reviewed above. It has been designed to be flexible to the range of conditions found around the globe and to provide a relatively rapid assessment of the overall vulnerability of countries, while also allowing for the identification of major issues. It is focused on the potential for damage to the natural environment on the basis that it is the natural environment that is the foundation for the economic and social structures of nations. As such the EVI is an essential aspect of understanding the environment and the influences of social and economic variables on sustainability, and is needed to complement state-of-the-environment and Ecological Footprint information. Further, the EVI uses a scoring system devised to instantly provide users with an assessment of how vulnerable countries are overall, and in terms of particular aspects of their risk to hazards, intrinsic characters, past damage and influences of meteorology, geological events, biodiversity and anthropogenic factors. Instead of focusing only on where a country sits on a scale from best to worst in terms of current world conditions, scoring is focused more on what is vulnerable or not.

It is possible that all countries could score a value of 7 (most vulnerable) for a single indicator, if it has been shown that the trigger point for environmental damage is outside of the currently-observed range across the globe. Trigger points are not known for many of the indicators, but the framework described here forces us to think in these terms and find the trigger values with further research. The EVI is a valuable new tool focused on ensuring the future by showing policymakers and managers how to adjust their actions to lower the environmental vulnerability of a country.

2.4 Summary of the mechanics of the EVI

The EVI model is a simple framework for holding, organising and presenting information on the potential for damage to the natural environments of countries. It attempts to provide an overview, or generalisation, of conditions in a country through inference from the condition in a relatively small number of smart indicators chosen for that purpose. The way in which the EVI has been constructed allows for much flexibility, so that the model can be used to meet a range of needs (see Box 1), across global conditions and at a range of scales other than that of countries (the scale of provinces, islands or regions).

Box 1: Uses of the EVI.

National scale:

- Provides comprehensive general sense of the environmental condition and vulnerability of a country. Predictive value for identifying vulnerability issues, types of hazards and approaches to stewardship of the environment
- Planning at national and provincial levels
- Mechanism for identifying environmental data requirements and organising current data
- Guidelines to help governments establish limits and targets and how to best use environmental data
- Anthropogenic indicators could be used for stimulating government action, particularly because they provide guidance on how policies could be changed to effect improvements.
- Geological, climatological and biological indicators can stimulate policies to minimise the risk of disasters

Regional and global scale:

- A planning tool at the regional level. A signal to regional organisations and donors of where assistance is required
- Examines transboundary environmental problems and process
- Provides performance indicator for donor funding
- Determining LDC status

Generally:

- Converts environmental data to a simple form with immediate uses, allowing for better information to decision-makers and policy-makers
- Prioritises environmental actions at any scale
- Measures change in environmental condition and vulnerability with repeat assessments (every 5 years)
- Raises awareness of environmental vulnerability and the actions that increase or decrease it
- Makes the interactive linkages between environmental condition and human welfare more identifiable and measurable
- Identifies environmental problems so that further investigations may be undertaken to understand their causes
- Is a research tool and could be used to understand the effects of environmental processes in different ecoregions
- Facilitates collaboration among departments and international agencies by providing a common basis for sharing data and assessment
- Tool for monitoring sustainable development
- Complements SOE reporting by identifying issues and allowing for comparisons

2.4.1 Definitions

The EVI is a numerical indicator that reflects the status of a country's environmental vulnerability, where:

- "Environment" includes those biophysical systems that can be sustained without human support;
- "Vulnerability" is the extent to which the environment is prone to damage and degradation; and
- "Damage" is the loss of diversity, extent, quality and function of environments.

The definitions given here are pragmatic and only to be used for the purposes of the EVI.

2.4.2 Theoretical framework

The maintenance of ecosystem or ecological integrity is at the heart of the development of a vulnerability index for the environment, because it is ecosystem integrity that is threatened by natural and anthropogenic hazards. The notion of ecosystem integrity is so complex that it cannot be expressed through a single indicator, but rather requires a set of indicators at different spatial and temporal scales and hierarchical levels of the ecosystem. Ecosystem integrity depends on biodiversity, ecosystem functioning and resilience, all of which are such interrelated variables, that factors which affect just one of these can have far-reaching ecosystem-wide consequences.

The risks to the environment are any events or processes that can cause damage to ecosystem integrity. These include natural and human events and processes such as 'the weather' and 'pollution'. Some researchers have identified natural hazards as those in which natural environmental conditions depart from 'normal' to such an extent that systems of interest (human, environmental) may be adversely affected. The problem with this definition is that unless we identify certain natural events as being anthropogenically altered (e.g. anthropogenically-accelerated sea-level rise), all events are 'normal'. The implication from this line of reasoning is that the changes we see to the natural world as a result of natural hazards are deemed 'unacceptable' from a human perspective. This means that except in the case of anthropogenic risks, in an assessment of environmental vulnerability, what we really are examining is unacceptable departures from our (human) view of how the environment should change. For the purposes of this study, we will accept that hazardous events should include those which cause sudden and seemingly-negative impacts on natural systems.

Although most identifiable risk events are capable of causing damage, it is only the larger and more intense events that are likely to cause wholesale changes in the environment, at least in the short to mid-term. Some of the more important risks which can impact on the environment include meteorological events (e.g. cyclones, droughts, heat waves, floods, tornadoes), geological events (earthquakes, tsunamis, volcanoes), anthropogenic impacts (mining, habitat destruction, pollution), biological events (plagues, blooms), climate change and sea-level rise.

The entities at risk, termed the 'responders' include ecosystems, habitats, populations and communities of organisms, physical and biological processes (e.g. beach building, reproduction), energy flows, diversity, ecological resilience and ecological redundancy.

Three aspects of environmental vulnerability were identified which would need to be incorporated into an EVI. These are:

1. The level of risk to hazards which act on the environment within a country. This relates to the frequency and where possible, the intensity of hazardous events which may affect the environment. These are based on levels observed over the past 5-10 years for most hazards, but may include data for much longer periods for geological events. These indicators measure potential risk only: There is no logical expectation that patterns of risk expression during the immediate history of a state will necessarily result in similar risk levels today or in the future;
2. Intrinsic resilience of the environment to risks refers to characteristics of a country which would tend to make it less/more able to cope with natural and anthropogenic hazards; and
3. Extrinsic resilience results from external forces acting on the environment and describes the ecological integrity or level of degradation of ecosystems. 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 risks.

These three aspects of vulnerability form two sub-indices for the EVI as follows:
REI = Risk Exposure sub-Index incorporates measures of the level of risk to hazards; and
RI = Resilience sub-Index which incorporates measures of intrinsic resilience (IRI – intrinsic resilience sub-index) + extrinsic resilience (EDI – environmental degradation sub-index) which describe how the environments of a country might be able to resist damage from hazards.

2.4.3 The sub-indices and smart indicators

Because the risks are many and ecosystem resilience and integrity are complex in character, it was necessary to use a set of indicators to characterise them. This means that not all aspects were covered, but that a subset of variables was selected which describes frequency and intensity of risks, intrinsic resilience, and the health of ecosystems, organisms, physical features of the environment and mitigators of effects.

For the purposes of the EVI the following definitions relating to indicators and indices were used:

- An indicator was defined as any variable which characterises the level of risk, resilience or environmental degradation in a state;
- The sub-indices (the REI, RI) were defined as an aggregated average of the scores for indicators which relate separately to risk, and intrinsic resilience / degradation; and
- An index (the EVI) was defined as an aggregated average of all indicators regardless of the sub-index to which they belong, to give an overall measure of the environmental vulnerability of a state.

The criteria for the selection of indicators were that they:

- Should be applicable globally;
- Would have data that were available or easily obtainable;
- Should be likely to measure change or be a proxy for change which would do significant harm to the environment;
- Should be independent of the source of change;
- Could not be selected on any political criteria but relate only to environmental vulnerability;
- Could be weighted to reflect the probability of change to the environment and the amount of damage which might be done;
- Should be relatively easy for users to understand;
- Be well-defined;
- Be as uncorrelated with each other as possible to limit redundancy, and unintended form of weighting.

A total of 54 indicators of environmental vulnerability were finally selected for inclusion in the index. This included 27 indicators of risk (REI), 8 indicators of intrinsic resilience and 19 indicators of environmental integrity or degradation (the latter two forming the IRI and EDI, respectively). These sub-indices are reported with the EVI as a way of summarising the main forms of vulnerability found in countries and predicted by *vulnerability theory* to assist in the process of identifying major areas of weakness or strength. In addition to the three sub-indices (REI, IRI & EDI), we also separately calculate the vulnerability attributable to meteorological (6 indicators), geological (5), biological (9), and anthropogenic (26) factors, in addition to intrinsic country characters (equivalent to the IRI with 8 indicators) (Meteorological [Met], Geological [Geo], Biological [Bio], Anthropogenic [Anthro] and country characteristics [CC] sub-indices) to further assist in identification of broad areas of concern for a country.

Many of the indicators are expressed as a fraction of area of land rather than absolute numbers because it is risk density or proportion of area degraded that is of interest from an environmental perspective. A summary table of the indicators selected is provided in Table 2 below.

Table 2: Summary of Indicators selected for the EVI.

Number	Short Name	Sub-Index	Category	Main Issues
1	Sea temperature	REI	Met	Coral bleaching, fisheries, currents, eddies, ENSO
2	High winds	REI	Met	Cyclones, tornadoes, storms, erosion, habitat damage, disturbance
3	Dry periods	REI	Met	Drought, dry spells, water resources, disturbance
4	Wet periods	REI	Met	Floods, wet spells, coral reefs, pollution, erosion
5	Heat spells	REI	Met	Heat waves, desertification, water resources, fire, temperature stress, coral bleaching
6	Cold spells	REI	Met	Cold snaps, temperature stress
7	Volcanos	REI	G	Eruptions, landslides, geysers, gas, fires, ash, dust, marine kills, river and lake damage
8	Earthquakes	REI	G	Earthquakes, landslides, Tsunamis
9	Tsunamis	REI	G	Tidal waves, erosion, habitat disturbance, kills
10	land area	IRI	CC	Richness of habitat types, refugia, species redundancy and richness
11	Fragmentation	IRI	CC	Fragmentation, erosion, exposure at borders and coasts
12	Isolation	IRI	CC	Proximity to refugia, recolonisation, biodiversity
13	Relief	IRI	CC	Biodiversity of habitats and species
14	Lowlands	IRI	CC	Floods, accumulating pollution, sensitive habitats
15	Coastal vulnerability	IRI	CC	Storm surges, cyclones, erosion
16	Endemics	IRI	CC	Biodiversity, Unique species
17	Pathogens	REI	B	Ecosystem stress, eutrophication, pollution, introductions, disturbance
18	Potential for introductions	REI	B	Potential for introductions
19	Introductions	EDI	B	Past introductions, biodiversity
20	Endangered species	EDI	B	Biodiversity, keystone species
21	Extinctions	EDI	B	Biodiversity, ecosystem structure and function
22	Natural Vegetation	EDI	B	Ecological redundancy, biodiversity, ecosystem services and goods
23	Intensive farming	EDI	B	Pollution, eutrophication, ecosystem services
24	Ecological Overfishing	EDI	B	Resources, depletion, community structure
25	Coastal settlements	EDI	A	Stress on coastal ecosystems, pollution, eutrophication
26	Population density	REI	A	All incidental damage caused by human activities
27	Population growth	REI	A	Potential for future incidental damage by humans
28	Loss of natural cover	REI	A	Pollution attenuation, biodiversity, soil formation, natural resources, groundwater regeneration, CO_2 fixing
29	Tourists	REI	A	Additional human loads not included in resident statistics
30	Wastewater	REI	A	Eutrophication, pollution
31	Production wastes	REI	A	Pollution, habitat destruction, groundwater damage
32	Waste treatment	REI	A	Proportion of wastes rendered less harmful
33	Oil spills	REI	A	Pollution
34	Toxic industries	REI	A	Pollution, acid rain
35	Vehicles	REI	A	Habitat damage, habitat fragmentation, pollution, mining, hazardous wastes
36	SO_2	REI	A	Pollution, attenuation, acid rain
37	Fertilisers	REI	A	Eutrophication, pollution, soil damage, reduction of land productivity
38	Pesticides	REI	A	Pollution, soil damage, damage to reproductive systems of organisms
39	Fisheries effort	REI	A	Rate of resource depletion and moving to new stocks
40	Degradation	EDI	A	Rate of habitat loss, eutrophication and loss of ecosystem services
41	Water	EDI	A	Use of surface free water and groundwater, groundwater, river, lake and habitat damage; dams
42	Deep mining	REI	A	Pollution, habitat destruction, groundwater damage
43	Surface mining	EDI	A	Habitat disturbance
44	Terrestrial Reserves	EDI	A	Increases resilience, pollution attenuation, limits losses of biodiversity

Number	Short Name	Sub-Index	Category	Main Issues
45	Marine Reserves	EDI	A	Increases resilience, pollution attenuation, limits losses of biodiversity
46	War	EDI	A	Habitat disturbance, pollution, habitat degradation, inappropriate and inefficient use of resources for emergency needs
47	Legislation	EDI	A	Controls, management of goods and services
48	Sanitation	EDI	A	Eutrophication, pollution
49	GMOs	EDI	A	Changes to genetic diversity, inappropriate use of agrochemicals, cross-over of genes to wild organisms, unpredictable impacts on species fitness
50	Shared Borders	IRI	CC	Introductions, lack of control of effects from neighbouring countries
51	Fragmentation of vegetation	EDI	A	Biodiversity, resilience and persistence of species
52	Migratory Species	REI	B	Lack of determination of welfare of species while they are outside the country's control
53	Ice	EDI	G	Habitat degradation
54	Slides	REI	G	Disturbance

Several indicators initially selected were discarded because they either did not have data available and data were unlikely to be procured in the near future, they were ambiguous or bimodal in their responses; or were redundant and the information they intended to capture was present in another indicator.

Data required for calculating the EVI, to set the response levels of each indicator and to test the model have already been collected for many of the EVI indicators. In the Pacific these data were obtained by visiting some of the countries to work with local authorities and from country reports, UN, WHO, SOPAC, SPREP, FAO and other publications from international agencies, centres for risk assessment and management (such as Tsunami Centre, NOAA), local experts and government officers.

For full testing of the EVI model, it was recommended by the Think Tank that data be obtained from 15 countries from around the globe. These countries should represent the range of environmental conditions and are required to globalise the EVI. For the EVI to be applied it is necessary to globalise it from the start, as it is only in the context of the entire world that the vulnerability of any state or SIDS can be assessed.

To address this need, data collection in several target countries has been carried out in partnership with collaborators who have coordinated local efforts with authorities and other key national, regional and international organisations the compilation of relevant data.

2.4.4 Quantifying vulnerability

The overriding principle in constructing the EVI was not to introduce complexities into the model unless there was a justifiable reason to do so.

Environmental indicators are of a heterogeneous nature, that is they include variables for which the responses are numerical, qualitative and on different scales (linear, non-linear, or with different ranges). To deal with the heterogeneity, it was necessary to map the possible responses to the indicators onto a 1-7 scale. Where data were not available, no value was given for the indicator and the denominator of the average adjusted down by one value. Where an indicator was considered 'non-applicable' in a state (such as volcanic eruptions in Tuvalu which has no volcanoes), the lowest vulnerability score of 1 is attributed to that indicator.

Mapping on the 1-7 scale for each of the indicators was set wherever possible using the experts who attended the Think Tank. The remainder were set using the technical literature or by consultation with other generalists and specialists in each field.

Appropriate weighting of the EVI indicators was considered important by the participants at the Think Tank (Kaly et al. 1999). The purpose of weighting was to identify those indicators, which were most important to the measurement of vulnerability and ensure that the signals they contributed to the EVI were larger than less important indicators. The EVI as it stands now does not use weighting. When the Think Tank participants were asked to weight indicators, the net result was a cancelling of all weights applied – participants had very different views on which indicators were more important than others.

In parallel with scoring each indicator against the 1-7 scale, the EVI model incorporates a way of assessing the reliability of data. These reliability values will be reported alongside each index and should be read with them. The data reliability scores give the number indicators for which data are not currently available, the number of responses which are based on real data; and the number of responses based on 'best guess' or estimated by the operator and/or authorities.

2.4.5 Strengths & weaknesses

As for all methods of summarising and modelling data, the EVI developed here is associated with a number of strengths and weaknesses which must be understood for its proper application and use. The Think Tank participants and expert reviews identified a set of strengths and weaknesses that have been added to those compiled by the SOPAC team.

The strengths of the EVI have been identified as follows:

- It is the first comprehensive and convenient measurement of environmental vulnerability;
- Permits comparisons among countries;
- Identifies a number of indicators which describe the features of risk and resilience for a country;
- Can be used as a measure of change in environmental vulnerability;
- Can be used to identify in-country vulnerability and therefore areas of major concern;
- Stimulates debate at the science / policy interface at national and international levels and amongst disciplines;
- It is able to incorporate quantitative and qualitative data on different response scales and non-linearities;
- Is globally applicable;
- Could be used for awareness-raising;
- Indicators and weightings chosen by a panel of international experts;
- Differences in interpretation of users can be minimised by training;
- Has been designed with a set of validation tests to be performed and criteria to be met before it is passed over to be used by decision-makers;
- Is based on a theoretical framework that prompted the EVI team and expert panel to find indicators for all identified aspects of vulnerability;
- Identifies areas of environmental concern which could provide a focus for new or improved data collection.

The weaknesses of the EVI were identified as follows:

- There is subjectivity in assigning weights to indicators and non-linearities to the scores (as in other indices);
- Some complex environmental factors have been represented by proxy indicators because they could not be measured directly;
- The EVI is affected by the indicators chosen and the results obtained may differ if different variables were chosen;

- The method of aggregating the indicator scores does not allow for the contribution of a variable to be conditional on, or amplified by another variable (e.g. feedback, multiplicative or inhibitory effects). That is, it assumes a non-interactive system;
- The EVI is subject to problems with differences in the interpretation of users, although this could be minimised with training;
- Some of the data may be difficult to obtain.

In addition to the above strengths and weaknesses, users of the EVI will need to be aware of the following conditions:

1. The EVI emphasises short-term environmental change, rather than longer term trends;
2. It does not address climate change and sea-level rise because it is an 'instantaneous' expression of vulnerability, describing the risks to and resilience of the environment of a state now, rather than attempting to predict impacts expected in the future (it is not a state of the environment statement or an impact assessment);
3. Some local variations, short and long term effects and other details are not incorporated into the model because these would make it too complex.

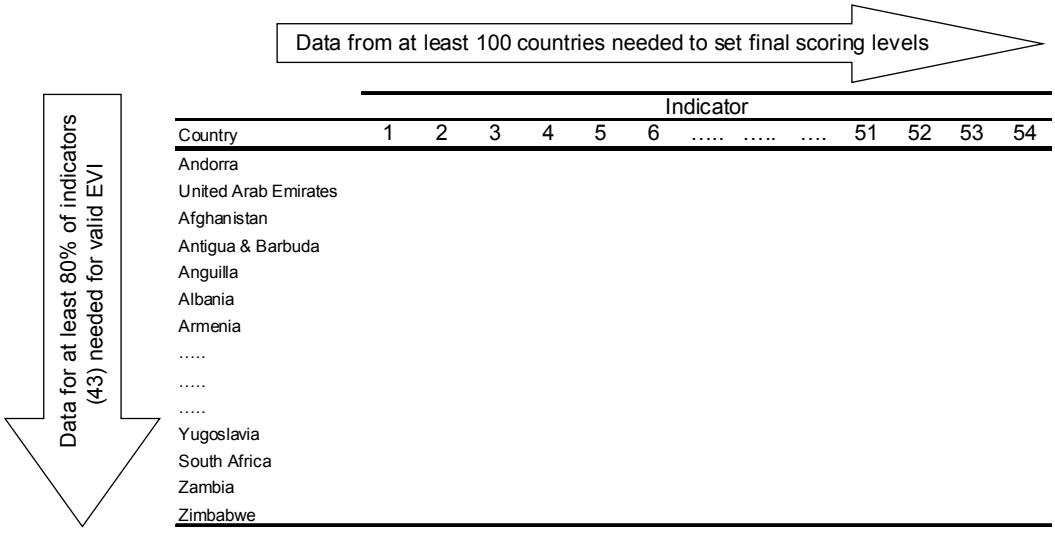
3 GENERAL APPROACH AND METHODS

The Demonstration EVI we present here is fully functional in every respect except that it is lacking data for some indicators and cannot therefore be considered a completed index.

Testing of the EVI during Phase III of the project required four activities:

1. The establishment of links with countries that would agree to collaborate with the EVI team for the purposes of development of the index;
2. The collection of country data from at least 15 countries around the globe additional to those from the Pacific Region included since Phase II, for testing within a global context;
3. The creation of a '100-Country-Database' from public sources for more extensive testing on an indicator-by-indicator basis where data are available (Figure 1); and
4. Testing of individual indicators, setting levels for scoring values and testing of the EVI as a whole (Figure 1).

Figure 1: Concept diagram showing data requirements for the two separate functions of (a) setting indicator scoring levels and (b) calculating valid EVI scores for the Demonstration EVI.



3.1 Establishing collaborators and the EVI database

A list of target countries established during Phase II of the project was used as the basis for inviting countries to become collaborators on the project. Invitations were extended through a combination of regional meetings, in-country visits, UNEP introductions and by inviting target countries to attend an EVI Globalisation Meeting in Geneva 27-29 August 2001.

Country data for the EVI were collected through direct collaboration with all SOPAC Member countries, other SIDS, and the target countries selected to globalise the context of the EVI. For all of these countries, the aim was to collect 100% of the required data using in-country sources to allow for the calculation of complete EVI profiles for each. Collecting data in-country would also allow us to compare sources of data and test the EVI model for sensitivities due to differing estimates of particular indicators, a measure of the robustness of the model. Each country was given a hard and/or electronic copy of the EVI indicator questionnaire and asked to fill it out, citing sources of the data and person collecting them. The data collected using this method were stored in a Country EVI Database.

A second database was established for the storage of data collected for a large number of countries on individual indicators that were available in the public domain. These data came from published papers, reports, web sites or the databases of other organisations and institutions collecting data for their own purposes on climate, weather, disasters, economic activity, imports and exports and aspects of human welfare. This database was dubbed the "100 Country Database" because it was our intention to collect data for amenable indicators for at least that number of countries. In reality, depending on the indicator and source, the number could vary anywhere between 30 and the 244 countries as listed by International Standards Organisation (ISO).

3.2 Understanding characteristics of the data and setting the EVI scoring for indicators

Testing was carried out for 3 of the EVI's indicators using the 100 Country Database. The aim of these tests was to develop a protocol that could be used in the coming year for all other indicators to understand the underlying statistical distributions of the data and identify any transformations of the data that might be needed to make the EVI model additive so that values for the EVI and its sub-indices can be legitimately calculated without risk of excessive distortions. The results of these investigations could then be used to set levels on the EVI scale, with the aid of available information on how changes in the value of an indicator might

affect the environmental vulnerability of a country. Four major aspects of indicators were considered before EVI scoring levels could be set. These were:

1. Whether an indicator was applicable to a country;
2. Whether the indicator was correlated with country size;
3. Whether the scale of the indicator was better represented on a linear, logarithmic or other scale; and
4. What the trigger levels would be for an indicator. A trigger level would be defined as the level reached by an indicator beyond which environmental conditions would be considered unsustainable.

It is intended that later this year, testing will be extended to fully meet the requirements of Criteria 1 and 2 (See 3.3). This work will require testing and setting the scoring for all indicators, testing for correlations with other indicators, and testing the sensitivity of the EVI model to different sources of data and its ability to detect change through time and differences among countries.

The initial testing reported here involved the following elements, each calculated using either Microsoft™ Excel or Statsoft™ Statistica:

1. The plotting of all data available for an indicator in the raw state as a frequency distribution of countries in 20 evenly-spaced value categories to examine any obvious underlying patterns for an indicator. For example, the distribution of raw values may be bimodal, with a group of countries having a small value, and another group having very large values, with few countries in between.
2. Fitting of four possible distribution curves to the observed data and subjecting them to statistical tests (in this case a Kolmogorov-Smirnov (K-S) test) to determine whether the fit is a good one and whether the underlying distribution for that indicator could be explained by one of the more commonly recognised statistical distributions. The distributions tested initially were: normal, rectangular, exponential and lognormal, which would tend to identify that the data for an indicator were distributed linearly, evenly, as a power function, or as a logarithmic function, respectively. A significant K-S test indicates a poor fit to the proposed distribution, while a non-significant one means that we cannot reject a null-hypothesis of no difference between our observed values and those expected is the underlying distribution is indeed in the form being tested (see also Appendix 7.4 for further information on distributions).
3. Examining the raw data to determine whether there is a correlation between the indicator and the size of country. This was done using a simple correlation coefficient test which ran the value of an indicator against the value for size of the country. In most cases, indicators are already articulated as a density function (i.e. a value divided by land area or sea area) to eliminate a signal on size of a country. The correlation test was run to determine whether this division by size was necessary, or whether it could be discarded.
4. Transformation of the data if a non-linear function is found to be a good fit (e.g. exponential or logarithmic). This preserves the relationship among countries, but moves the raw data onto a linear scale, more suitable for the averaging technique used in the EVI.
5. Refitting of the transformed (if necessary) data onto a scale from 1-7 to begin the process of setting levels for EVI scoring for the indicator.
6. Proposal of an EVI scale for an indicator. This is partially based on the maximum and minimum observed values and the underlying distribution detected for the data. The most important component of the proposed scaling is concerned with information on how different values for an indicator might relate to environmental vulnerability. In some cases, values may be mapped on a simple evenly-spaced scale that extends from the lowest to highest values because it is thought that vulnerability increases in direct proportion with the value of the indicator. In others,

scoring may be discontinuous, folded back on themselves (i.e. a binomial distribution in which very high or very low values are considered risky, while intermediate values represent the lowest vulnerability), or be set with varying intervals.

Sustainable conditions tend to be found near one end of the world's range for any one indicator. For most indicators we do not know the true cut-off values of sustainability. Where information does exist to support a level that would be considered 'sustainable' (e.g. protected areas should be 20% of the land or sea area), these values were used in the vulnerability scoring. Where values are not known, we scaled the values to spread them (logarithmically, see below) across global conditions, often clumping extremely low or high values.

Most of the countries are forced into a clump at low values by the presence of just a few (sometimes only one or two countries) with extremely high values. Use of a logarithmic scale for many of the indicators helps us to distinguish between countries at the lower end of the scale where differences are smaller, shifts in values are likely to be relatively easy to achieve (improvements) and the level for sustainability is more likely to be located. Countries near the upper end of any indicator scale are not only very vulnerable, but also in a difficult position to effect improvements. They are often several orders of magnitude greater in value than most countries.

3.3 Criteria for testing the EVI

In keeping with the recommendations made at the EVI Think Tank in 1999 (Kaly et al. 1999b), final testing of the EVI requires that the following three criteria be met:

1. That there are no redundant indicators using data from at least 15 countries;
2. That EVI scores do spread throughout the range of conditions found, and cluster countries according to known similarities for at least 15 countries around the globe (see standard statistical text for explanation of cluster analysis); and
3. That the EVI is validated through independent assessments made in at least 5 countries.

These three criteria were developed to provide guidance to experts, funding agencies and the international community on when the EVI would be technically ready for use. The criteria were also developed to allow for the development of appropriate milestones and so that a completed EVI could be identified in relation to the funding required to complete the work. These criteria do not eliminate the need for additional testing on sensitivity, effects of errors in data and other aspects of the index and the data needed to evaluate it, but provide an independent 'finishing line' for the index.

The first two of these criteria were examined as part of Phase III of the project, partial results for which are given in this report. Funding for the third criterion has not yet been secured and will be examined in Phase IV.

3.3.1 Criterion 1: Test for redundant indicators

Data needed to be collected so that any redundancy among indicators could be identified. It was agreed during the Think Tank that at least 15 countries with widely-ranging characteristics would need to be included in this test. Any indicator with a high correlation with one or more other indicators would at this stage be dropped or merged. In this case, the easiest indicator to be evaluated out of a correlating group would be the one kept in the model. The final list of indicators would then only consist of those which bring significantly

new information into the EVI value. Any weighting of indicators could only be examined after redundancies in the model had been eliminated, though at this stage there has been no defendable argument for any weighting in the final model.

Test for Criterion 1: When the correlation coefficient between two indicators for 15+ countries is non-significant in a standard statistical test.

3.3.2 Criterion 2: Scoring for indicators is global

The EVI scores needed to be evaluated for at least 15 countries across the globe with widely ranging characteristics to examine how well the model provides the spread required to distinguish them. The countries included in this test (same as for criterion 1) were to include small islands, large continental masses, highly-fragmented countries, land-locked countries, tropical, cold climate countries, deserts low-lying and high countries. It was considered that the EVI should be able to cluster similar countries together and provide spread among countries which are very different. The response scale for each of the indicators (i.e. the EVI score 1-7 is the mechanism in the EVI which provides the spread) would be finalised when data for these 15 test countries are available.

Test for Criterion 2: When the spread in EVI values among the 15+ test countries occupies much of the 1-7 range expected and countries considered *a priori* to be 'similar' cluster closer together than 'dissimilar' countries.

3.3.3 Criterion 3: Validation

The purpose of constructing an EVI is to simplify the task of categorising countries according to their relative environmental vulnerabilities. If personnel, funding and time were unlimited, this could be done by sending several independent teams of evaluators to each country and commissioning them to carry out a vulnerability assessment for each. The replicate assessments for each country could then be used to classify countries in terms of their vulnerability and provide recommendations for each for corrective actions. This procedure would of course be extremely expensive. It is one of the aims of the EVI to simplify this process.

The only independent means of assessing the effectiveness of the EVI in carrying out this task in a simplified way, is to compare the results of the EVI with a full assessment for a small number of, say 5, countries on a once-off basis. Several teams of experts would have to be mobilised in each of the test countries to provide a 'mean assessment' for each. The consultants involved should be unaware of the mechanics of the EVI to ensure that they do not unintentionally bring bias into the results. The assessments could then be compared with the EVI scores obtained.

Test for Criterion 3: When the difference between the value obtained by the EVI and the mean of the assessments provided for a country by several experts (who are unaware of the workings of the EVI) is about the same, or less than, the spread found among the assessments of the experts. This test should be performed for about 5 countries.

4 RESULTS FOR THE DEMONSTRATION EVI

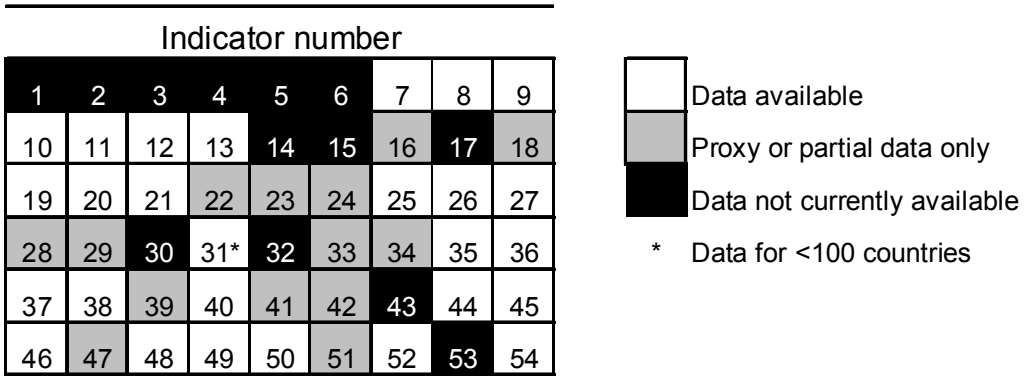
4.1 Collaborators and status of the Global EVI Database

A shortage of relevant and/or accessible environmental data was the single largest technical problem encountered whilst developing and testing the EVI. Although collaborators were cooperative and generally attempted to provide the data we requested, they were often unable to do so. Despite the great recent advances in global data collections for environmental treaties, most data are still oriented towards economic and human development needs, or where suitable environmental data may be found, they are focused on present state of the environment (SOE) rather than on measures of potential for future damage (vulnerability). Both of these types of data are required for planning for sustainability.

4.1.1 Overall data for the Demonstration EVI and setting scores for indicators

The Demonstration EVI and the scoring levels for indicators were largely based on values for 235 test countries derived from a range of public databases (actual sources and references used are provided in the test sheet for each indicator – see Appendix 7.4). Public data sets were unavailable for 13 of the 54 indicators, which as a result had to be excluded from the Demonstration EVI because there would be insufficient values for setting the indicator's levels (Figure 2). This means that in general, none of the countries would be able to achieve a valid EVI score because only a maximum of 76% of the data could be collected from such sources. It is a condition of the EVI that at least 80% of the indicators must be evaluated for a valid EVI score (see Kaly et al. 1999b).

Figure 2: Status of the EVI database used for setting levels of indicators and producing the Demonstration EVI.



4.1.2 Average data returns on a country-by-country basis

Data for most countries of the 235 included in this test were derived from a range of public data sources, including but not limited to World Resources Institute, CIA factfiles, UN sources, Eurostat and the US and British Geological Surveys. Although it was originally intended that data from our 32 collaborating countries would ensure at least the 80% data minimum would be met for those countries, in practice sufficient data were not available within countries. In some cases, although our collaborators did provide data, we had to disregard them because either:

- there were errors in the units used;
- no data was held by the country;

- there was vast (sometimes several orders-of-magnitude) difference between values given by collaborators and in public datasets; or
- it was necessary to work with a proxy because data of the form requested were generally not available, making the data collected by the collaborators no longer compatible with the bulk of data available for an indicator.

Where datasets were compatible, collaborator data were used in conjunction with public data to provide maximum possible returns for each country. In cases where both public and in-country data were available for an indicator, we selected the use of one or the other on a case-by-case basis, with all sources of data considered and the choices made recorded on the individual electronic indicator databases held by us.

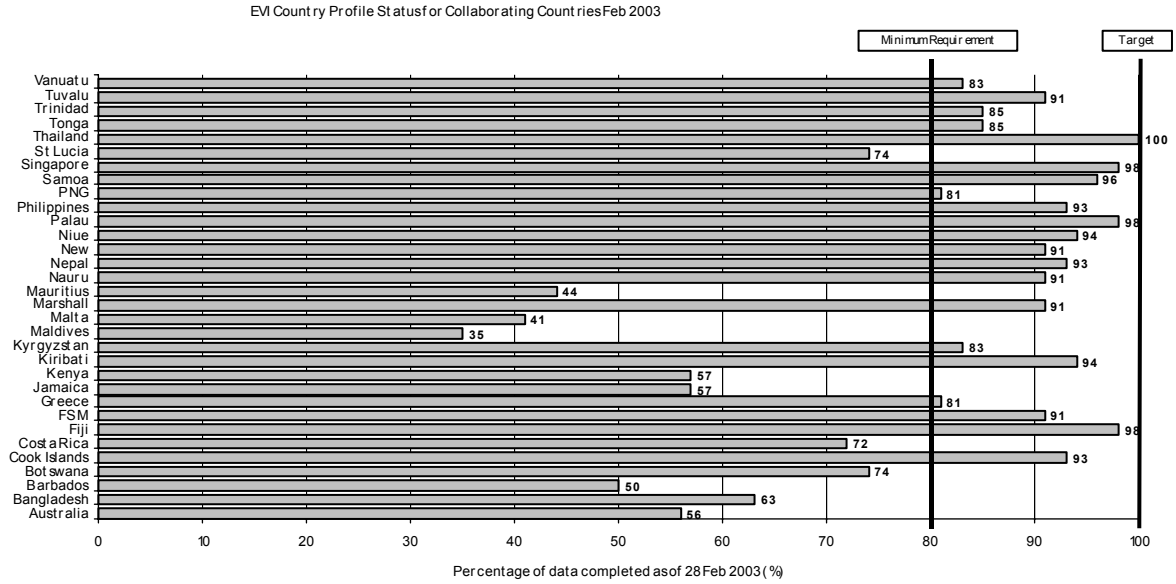
Given all of these considerations, the average number of indicators evaluated across the entire 235 country database was 31 of the 54, or around 60%. The maximum data return for any one country was 76% for Thailand (a collaborator) and the minimum 19% for Vatican City. Even the maximum value for Thailand was below the 80% minimum level set for a valid EVI. The regions with the best data returns were the Middle East & North Africa and South America (65%), with the worst data returns for Antarctica and the Antarctic Islands (23%) (Table 3).

Table 3: Summary of mean data returns by region.

Region	Number of countries	Mean number Indicators evaluated	Mean Percentage of indicators
Antarctica	4	12	23%
Asia	35	32	60%
Central America & Caribbean	32	26	48%
Europe	48	32	59%
Middle East & North Africa	21	35	65%
North America	3	31	58%
Oceania	26	26	49%
South America	14	35	65%
Sub-Saharan Africa	51	32	60%

4.1.3 Data from collaborators

Figure 3: Data returns for 32 collaborating countries at February 2003.



4.2 Natural distributions and EVI scoring for individual indicators

Investigations of the underlying global distributions of the EVI data were made and scaling levels set for 41 of the 54 indicators (these are summarised in Table 4, and full test sheets provided in Appendix 7.4).

4.2.1 Indicators not applicable to some countries

Five of the 54 indicators were considered not applicable (NA) to all countries. These were indicators 1, 9, 15, 25 and 53 that are concerned with coastal or shoreline conditions and changes in ice cover. As an example, it was considered impossible that landlocked countries would demonstrate environmental vulnerabilities due to the characteristics of a coastline. Countries for which an indicator was considered NA attract an EVI=1 score for that indicator. Although a condition may not currently occur in a country, it was considered at least potentially possible that it might occur in the future. For example, the number of volcanoes and earthquakes may be zero for a country, but these would not be considered an inapplicable risk and the value given in this case for the EVI would be EVI=1, or the lowest level of vulnerability.

4.2.2 Indicators correlated with country size

The majority of tested indicators displayed a strong correlation with country size (63%, or 25 of 40 tested indicators excluding Indicator 10 which would be a self-correlation). Most indicators were thus expressed as spatial densities to remove the signal of overall country size from the measure taken and provide a common denominator for comparison among countries. That is, land area, and sometimes length of coastline were used to *remove* the signal of country size from indicators so that relative vulnerabilities could be compared in large and small countries by focusing on the amount of pressure per unit of area. For example, the number of endangered species in Indicator 20 was expressed as the number of species rated as ‘endangered’ per 1000 sq km. It is already expected that the total

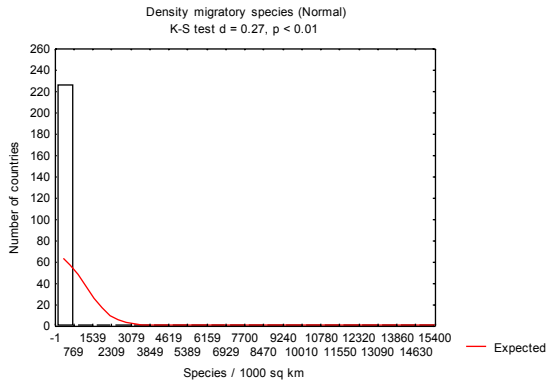
number of species present in countries is related to overall country size and the differentiation of large numbers of habitats. Comparing the number of endangered species in a very large country with those in a small country would be misleading because of the large difference in absolute number of species we would expect in each. By expressing the results as a spatial density a common basis for comparison was possible.

4.2.3 Indicators on a natural logarithm scale

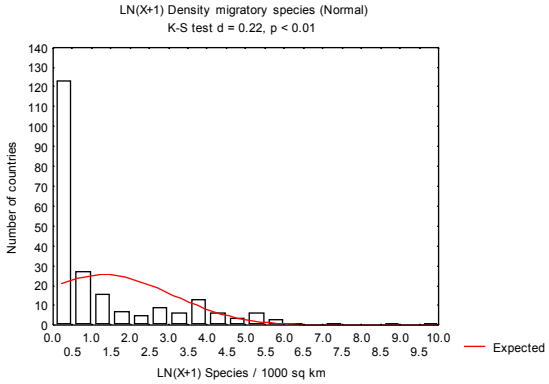
Half of all indicators tested were transformed to a logarithmic scale after their global frequency distributions were examined. This was done because for most indicators not expressed as percentages, the usual form of the distribution was highly clustered at the low end of the scale, with a spread of very few countries forming a long distributional tail at high values (Figure 4a). This distributional shape is common for bio-physical characteristics of the natural environment. When these data are transformed to their natural logarithms (either as LN(X) or LN(X+1) where zeros are present) data are spread more evenly along the horizontal scale, allowing for better differentiation among countries at the low end of the scale for that indicator (Figure 4b) and clumping at the high end of the scale where conditions are usually not sustainable and need correction.

Figure 4: Frequency distribution of EVI data for Indicator 52 showing (a) the highly clustered nature of the data and (b) the effect of logarithmic transformation.

(a)



(b)



4.2.4 Mapping on 1 – 7 Scale

The application of an EVI scale to the transformed data was done on an indicator-by-indicator basis and was structured either on known trigger levels, by spreading values evenly on the range from lowest to highest observed globally, or by biasing such a spread in favour of known better conditions where specific trigger levels are not known.

In some cases, the setting of levels included the omission of certain EVI scores where a sharp contrast between good and bad conditions was indicated (5 indicators). For example, Indicators 44 and 45 on reserved areas of land and sea were set using the globally acknowledged level that suggests that 20% or more of the area of a country should be set aside as reserves (see IUCN recommendations). The purpose of these areas is to build resilience and resource levels overall, including the overflow of resources from reserves into adjacent utilised areas. The 20% figure was used to define EVI=1, and all departures down from this figure were assigned increasingly higher vulnerability scores, but on a discontinuous scale. For most indicators the cut-off levels are inclusive of infinity at high values to allow for conditions better or worse than currently recognised in the countries included in the analysis. In all cases, it is expected that the part of the observed scale built into the EVI scoring for that indicator is the functional part, with values above and below the levels defined encompassing either exceptionally good or bad conditions not worth further differentiation.

For most indicators, the levels set are approximate and semi-arbitrary because sustainability triggers are simply unknown at present. It is expected that with use of the EVI supportable trigger levels will be found.

Table 4: Summary information on the levels set for indicators in the Demonstration EVI.
For each indicator is given the sub-index and factor it relates to, whether the levels have been set (Funct?), whether a proxy has been used (Proxy) because data were unavailable for the original form of the indicator and a summary of major sources of data. Specific information on the scaling is also given, including whether values are correlated with size of country, expressed as a spatial density function (%, by land area or length of coastline), whether data were on a linear scale, transformed to natural logarithms, and whether EVI scoring on the 1-7 scale was done evenly within the world range, unevenly or discontinuously. NA and ND show whether for that indicator entries could be either NA=not applicable; or ND=no data available. The values in the right side of the table are limits for each of the EVI scores on the indicated scale. Values given in columns labelled EVI = 1 to EVI = 7 are relative scales for each indicator included here to indicate the mapping set for each indicator.

#	Short name	Sub-Index	Factor	Funct?	Proxy?	Data sources	Corr Land	Spatial density?	EVI Scale	NA	ND	EVI=1	EVI=2	EVI=3	EVI=4	EVI=5	EVI=6	EVI=7
1	Sea temperature	REI	Met	×	No	Data on SST is not available by country		No		✓	✓							
2	High winds	REI	Met	×	No	Data exists but not in useable form		No		×	✓							
3	Dry periods	REI	Met	×	No	Data exists but not in useable form		No		×	✓							
4	Wet periods	REI	Met	×	No	Data exists but not in useable form		No		×	✓							
5	Heat spells	REI	Met	×	No	Data exists but not in useable form		No		×	✓							
6	Cold spells	REI	Met	×	No	Data exists but not in useable form		No		×	✓							
7	Volcanos	REI	G	✓	No	NOAA, In-country	Y	No	Linear, uneven	×	✓	0	1≤X<5	5≤X<10	10≤X<15	15≤X<20	20≤X<35	35≤X
8	Earthquakes	REI	G	✓	No	NOAA, In-country	Y	No	Linear, even	×	✓	0≤X<1	1≤X<2	2≤X<3	3≤X<4	4≤X<5	5≤X<6	6≤X
9	Tsunamis	REI	G	✓	No	NOAA, In-country	Y	Coastline	Linear, uneven	✓	✓	X=0, NA	0<X≤1	1<X≤2	2<X≤5	5<X≤10	10<X≤15	X>15
10	Land area	IRI	CC	✓	No	WRI, CIA, In-country	-	No	LN, even	×	✓	X>14	12<X≤14	10<X≤12	8<X≤10	6<X≤8	4<X≤6	X<4
11	Fragmentation	IRI	CC	✓	No	WRI, CIA, In-country	N	Land area	LN, even	×	✓	X≤2	2<X≤3	3<X≤4	4<X≤5	5<X≤6	6<X≤7	X>7
12	Isolation	IRI	CC	✓	No	Times World Atlas, In-country	Y	No	Linear, uneven	×	✓	X≤0	0<X≤50	50<X≤100	100<X≤400	400<X≤800	800<X≤1600	X>1600
13	Relief	IRI	CC	✓	No	CIA, In-country	Y	No	Linear, uneven	×	✓	50<X<1500	1500≤X<3000	3000≤X<4500	4500≤X<6000	6000≤X<7000	7000≤X<8000	X≤10, 8000≤X
14	Lowlands	IRI	CC	×	No	Data exists but not in useable form		%		×	✓							
15	Coastal vulnerability	IRI	CC	×	No	Data exists but not in useable form		%		✓	✓							
16	Endemics	IRI	CC	✓	No	WRI, In-country	Y	Land area	LN(X+1), uneven	×	✓	0≤X	0<X≤2.5	2.5<X≤5	5<X≤7.5	7.5<X≤10	10<X≤12.5	12.5<X
17	Pathogens	REI	B	×	No	Data unavailable		Land area		×	✓							
18	Potential introductions	REI	B	✓	Yes	WRI, In-country	Y	Land area	LN, even	×	✓	X≤1	1<X≤1.5	1.5<X≤2	2<X≤2.5	2.5<X≤3	3<X≤3.5	X>3.5
19	Introductions	EDI	B	✓	No	In-country, FAO	Y	Land area	LN, even	×	✓	X=0	0<X≤1	1<X≤1.5	1.5<X≤2	2<X≤2.5	2.5<X≤3	X>3

#	Short name	Sub-Index	Factor	Funct?	Proxy?	Data sources	Corr Land	Spatial density?	EVI Scale	NA	ND	EVI=1	EVI=2	EVI=3	EVI=4	EVI=5	EVI=6	EVI=7
20	Endangered species	EDI	B	✓	No	IUCN, In-country	Y	Land area	Linear, even	×	✓	X=0	0<X≤1	1<X≤2	2<X≤3	3<X≤4	4<X≤5	X>5
21	Extinctions	EDI	B	✓	No	IUCN, In-country	Y	Land area	Linear, even	×	✓	X=0	0<X≤0.25	0.25<X≤0.5	0.5<X≤0.75	0.75<X≤1	1<X≤1.25	X>1.25
22	Natural Vegetation	EDI	B	✓	Yes	WRI, FAO, In-country	Y	%	Linear, even	×	✓	X>80	60<X≤80	40<X≤60	20<X≤40	10<X≤20	0<X≤10	X=0
23	Intensive farming	EDI	B	✓	Yes	FAO, In-country	Y	Land area	LN(X+1), even	×	✓	X≤2	2<X≤3	3<X≤4	4<X≤5	5<X≤6	6<X≤7	X>7
24	Fisheries	EDI	B	✓	Yes	FAO, In-country	Y	Coastline	LN(X+1), even	×	✓	X≤1	1<X≤2	2<X≤3	3<X≤4	4<X≤5	5<X≤6	X>6
25	Coastal settlements	EDI	A	✓	No	WRI, CIA, In-country	N	Land area	LN(X+1), even	✓	✓	X<3	3<X≤3.5	3.5<X≤4	4<X≤4.5	4.5<X≤5	5<X≤5.5	X>5.5
26	Population density	REI	A	✓	No	WRI, CIA, In-country	N	Land area	LN(X+1), even	×	✓	X<4	3<X≤3.6	3.5<X≤5	4<X≤4.6	4.5<X≤6	5<X≤5.6	X>5.6
27	Population growth	REI	A	✓	No	WRI, US Bureau of Census, In-country	N	No	Linear, uneven	×	✓	X<-2	-2≤X<-1	-1≤X<1	1≤X<3	3≤X<5	5≤X<7	7≤X
28	Loss of natural cover	REI	A	✓	Yes	WRI, FAO, In-country	N	%	Linear, discontinuous	×	✓	X>0	No score	No score	X=0	-1≤X<0	-2≤X<-1	X<-2
29	Tourists	REI	A	✓	Yes	WTO, In-country	Y	Land area	LN(X+1), even	×	✓	X<3	3<X≤3.5	3.5<X≤4	4<X≤4.5	4.5<X≤5	5<X≤5.5	X>5.5
30	Wastewater	REI	A	×	No	Data unavailable	Y	Land area		×	✓							
31	Production wastes	REI	A	✓	No	Range of sources, In-country	N	Land area	LN(X+1), even	×	✓	X≤1	1<X≤2	2<X≤3	3<X≤4	4<X≤5	5<X≤6	X>6
32	Waste treatment	REI	A	×	No	Data unavailable		Land area		×	✓							
33	Oil spills	REI	A	✓	No	ITOPF, SPILLS, CRED, In-country	N	Land area	Linear, even	×	✓	X=0	0<X≤50	50<X≤100	100<X≤150	150<X≤200	200<X≤250	X>250
34	Toxic industries	REI	A	✓	Yes	WRI, World Nuclear Assoc, In-country	Y	Land area	Linear, even	×	✓	X≤5	5<X≤10	10<X≤20	20<X≤50	50<X≤100	100<X≤200	X>200
35	Vehicles	REI	A	✓	No	WRI, OECD, In-country	Y	Land area	Linear, even	×	✓	X<=1	1<X≤1.5	1.5<X≤2	2<X≤2.5	2.5<X≤3	3<X≤3.5	X>3.5
36	SO_2	REI	A	✓	Yes	GEO3, WRI, WDI, OECD, HDR, In-country	Y	Land area	LN(X+1), uneven	×	✓	X≤0.25	0.25<X≤0.5	0.5<X≤0.75	0.75<X≤1	1<X≤1.5	1.5<X≤2	X>2
37	Fertilisers	REI	A	✓	No	WRI, OECD, In-country	Y	Land area	LN(X+1), uneven	×	✓	X≤2	2<X≤4	4<X≤6	6<X≤7	7<X≤8	8<X≤9	X>9
38	Pesticides	REI	A	✓	No	WRI, OECD, In-country	Y	Land area	LN(X+1), uneven	×	✓	X=0	0<X≤0.5	0.5<X≤1	1<X≤2	2<X≤3	3<X≤4	X>4
39	Fishing pressure	REI	A	✓	Yes	FAO, WRI, In-country	Y	Coastline	LN(X+1), uneven	×	✓	X≤2	2<X≤2.5	2.5<X≤3	3<X≤3.5	3.5<X≤4	4<X≤4.5	X>4.5
40	Degradation	EDI	A	✓	No	FAO, In-country	N	%	Linear, uneven	×	✓	X≤5	5<X≤10	10<X≤15	15<X≤20	20<X≤25	25<X≤50	X>50
41	Water	EDI	A	✓	Yes	WRI, Worldwater, In-country	N	No	Linear, uneven	×	✓	X≤10	10<X≤20	20<X≤40	40<X≤60	60<X≤80	80<X≤100	X>100
42	Deep mining	EDI	A	✓	Yes	USGS, other sources	N	Land area	LN(X+1), even	×	✓	X=0	0<X≤1	1<X≤2	2<X≤3	3<X≤4	4<X≤5	X>5
43	Surface mining	EDI	A	×	No	Data not segregated surface vs deep	N	Land area		×	✓							

#	Short name	Sub-Index	Factor	Funct?	Proxy?	Data sources	Corr Land	Spatial density?	EVI Scale	NA	ND	EVI=1	EVI=2	EVI=3	EVI=4	EVI=5	EVI=6	EVI=7
44	Terrestrial Reserves	EDI	A	✓	No	WRI, In-country	N	%	Linear, discontinuous	×	✓	20≤X	15<X<20	10<X≤15	5<X≤10	0<X≤5	No score	X=0
45	Marine Reserves	EDI	A	✓	No	WCMC, WRI, In-country	N	%	Linear, discontinuous	×	✓	20≤X	15<X<20	10<X≤16	5<X≤11	0<X≤6	No score	X=0
46	Conflicts	EDI	A	✓	No	EMDAT, In-country	N	No	Linear, discontinuous	×	✓	X=0	No score	No score	No score	0<X<=2	2<X≤5	X>5
47	Legislation	EDI	A	✓	Yes	SEDAC / CIESIN, In-country	N	No	Linear, even	×	✓	X>60	50<X≤60	40<X≤50	30<X≤40	20<X≤30	10<X≤20	X≤10
48	Sanitation	EDI	A	✓	Yes	WRI, In-country	Y	Land area	LN(X+1), even	×	✓	X<1.5	1.5<X≤2	2<X≤2.5	2.5<X≤3	3<X≤3.5	3.5<X≤4	X>4
49	GMOs	EDI	A	✓	Yes	ISAAA, BINAS, OECD, In-country	Y	Land area	Linear, discontinuous	×	✓	X=0	No score	No score	No score	0<X≤20	20<X≤50	X>50
50	Shared Borders	IRI	CC	✓	No	CIA, Encarta, In-country	Y	No	Linear, even	×	✓	X=0	0<X≤2	2<X≤4	4<X≤6	6<X≤8	8<X≤10	X>10
51	Fragmentation of vegetation	EDI	A	✓	No	World Bank, In-country	Y	Land area	LN(X+1), even	×	✓	X<0.2	0.2<X≤0.4	0.4<X≤0.6	0.6<X≤0.8	0.8<X≤1.0	1.0<X≤1.2	X>1.2
52	Migratory Species	REI	B	✓	No	GROMS, In-country	Y	Land area	LN(X+1), even	×	✓	X<=1	1<X≤1.5	1.5<X≤2	2<X≤2.5	2.5<X≤3	3<X≤3.5	X>3.5
53	Ice	EDI	G	×	No	Data unavailable		%		✓	✓							
54	Slides	REI	G	✓	No	EMDAT, In-country	Y	Land area	LN(X+1), even	×	✓	X=0	0<X≤0.5	0.5<X≤1	1<X≤1.5	1.5<X≤2	2<X≤2.5	X>2.5

4.3 Results for Criterion 1: Redundant indicators

Many of the indicators included in the EVI correlated with each other (Figure 5), and if Criterion 1 was applied strictly to the data, the EVI would be left with no more than 5-6 indicators (Table 5). We did not begin the process of culling indicators with the Demonstration EVI because indicators are missing from the model and because some of the indicators used in the model are proxies and can be improved before we examine their interactions with others.

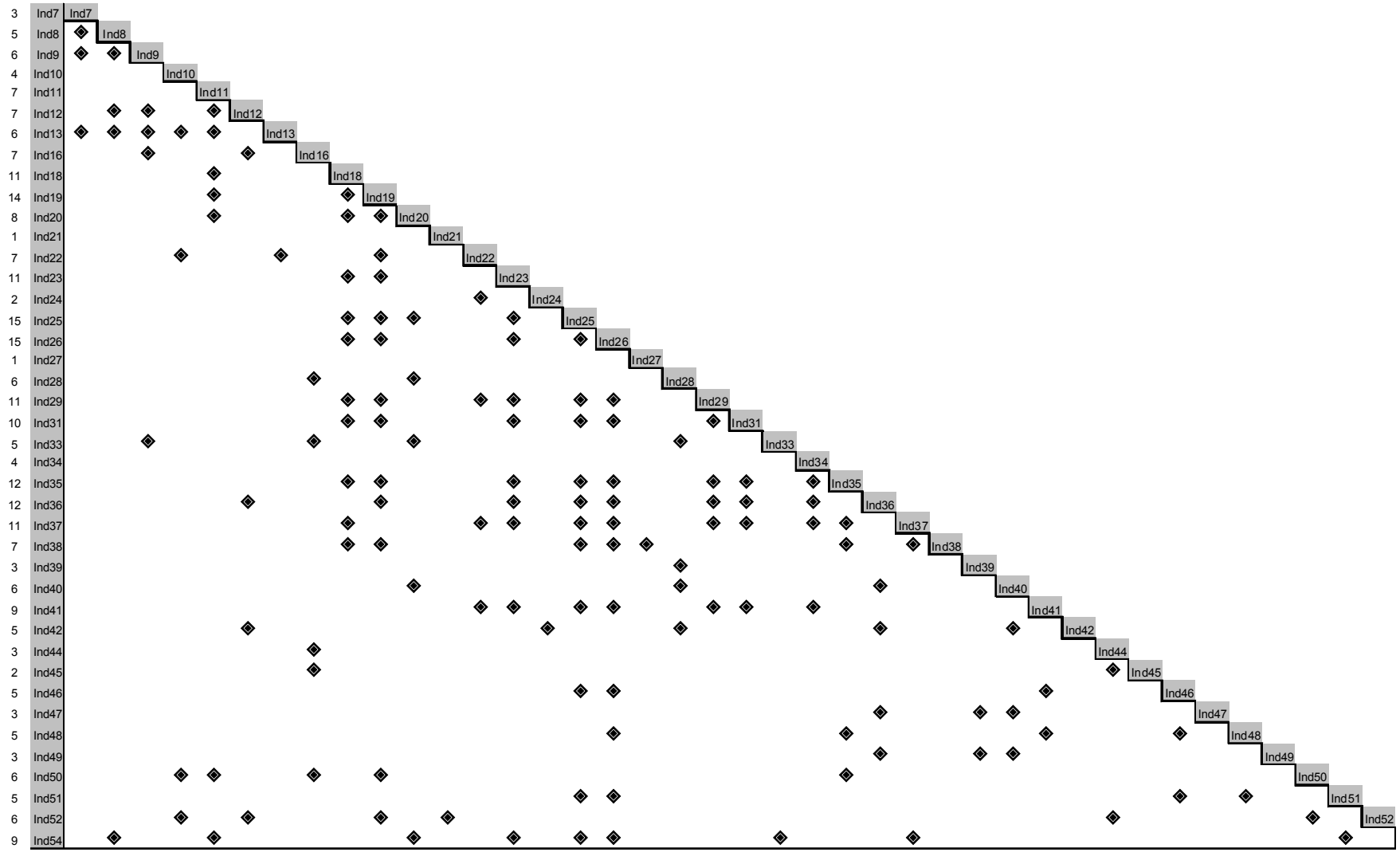
We suggest that Criterion 1 should be applied critically when data have been collected for the remaining indicators and be focused only on those indicators that are correlated with a large number of other indicators. Further, we suggest that even if indicators are removed this should occur only in the overall index and sub-indices where the overlap between two indicators occurs. That is, the profiles should include all present indicators because this will give us the most information for management, focusing in on issues that might need to be addressed rather than simply meeting the requirements of mathematical independence (required for the accumulated scores). For example in Table 5, Indicator 35 (Vehicles) and Indicator 25 (Coastal settlements) could probably be represented by Indicator 26 (Population density) for purposes of the overall EVI, though all would be evaluated for the EVI Profiles. Indicators appearing lower on the ranked list in Table 5 such as Indicator 27 (Population Growth and Indicator 21 (Extinctions) do not correlate with many other indicators and probably are providing new information in the overall EVI and can be retained in all levels of EVI reporting.

Table 5: Ranked list of correlations among indicators.

Number of Correlations	Indicator	Short name	Correlates with
15	25	Coastal Settlements	Potential Introductions, Introductions, Endangered spp., Intensive Farming, Population Density, Tourists, Waste, Vehicles, SO2, Fertilisers, Pesticides, Water, Conflicts, Habitat Fragmentation, Slides
15	26	Population Density	Potential Introductions, Introductions, Intensive Farming, Coastal Settlements, Tourists, Waste, Vehicles, SO2, Fertilisers, Pesticides, Water, Conflicts, Sanitation, Habitat Fragmentation, Slides
14	19	Introductions	Country Fragmentation, Potential Introductions, Endangered spp., Natural Vegetation, Intensive Farming, Coastal Settlements, Population Density, Tourists, Waste, Vehicles, SO2, Pesticides, Shared Borders, Migratory spp.
12	35	Vehicles	Potential Introductions, Introductions, Intensive Farming, Coastal Settlements, Population Density, Tourists, Waste, Industry, Fertilisers, Pesticides, Sanitation, Shared Borders
12	36	SO2	Isolation, Introductions, Intensive Farming, Coastal Settlements, Population Density, Tourists, Waste, Industry, Degradation, Mining, Legislation, GMOs
11	18	Potential for Introductions	Country Fragmentation, Introductions, Endangered spp., Intensive Farming, Coastal Settlements, Population Density, Tourists, Waste, Vehicles, Fertilisers, Pesticides
11	23	Intensive Farming	Potential Introductions, Introductions, Coastal Settlements, Population Density, Tourists, Waste, Vehicles, SO2, Fertilisers, Water, Slides
11	29	Tourists	Potential Introductions, Introductions, Natural Vegetation, Intensive Farming, Coastal Settlements, Population Density, Waste, Vehicles, SO2, Fertilisers, Water
11	37	Fertilisers	Potential Introductions, Natural Vegetation, Intensive Farming, Coastal Settlements, Population Density, Tourists, Waste, Industry, Vehicles, Pesticides, Slides
10	31	Waste Production	Potential Introductions, Introductions, Intensive Farming, Coastal Settlements, Population Density, Tourists, Vehicles, SO2, Fertilisers, Water
9	41	Water	Natural Vegetation, Intensive Farming, Coastal Settlements, Population Density, Tourists, Waste, Industry, Conflicts, Sanitation

Number of Correlations	Indicator	Short name	Correlates with
9	54	Slides	Earthquakes, Country Fragmentation, Endangered spp., Intensive Farming, Coastal Settlements, Population Density, Oil spills, Fertilisers, Habitat Fragmentation
8	20	Endangered spp.	Country Fragmentation, Potential Introductions, Introductions, Coastal Settlements, Loss Natural Cover, Oil spills, Degradation, Slides
7	11	Country Fragmentation	Isolation, Vertical Relief, Potential Introductions, Introductions, Endangered spp., Shared Borders, Slides
7	12	Isolation	Earthquakes, Tsunamis, Country Fragmentation, Endemics, SO2, Mining, Migratory spp.
7	16	Endemics	Tsunamis, Isolation, Loss Natural Cover, Oil spills, Terrestrial Reserves, Marine Reserves, Shared Borders
7	22	Natural Vegetation	Land Area, Vertical Relief, Introductions, Ecological Overfishing, Tourists, Fertilisers, Water
7	38	Pesticides	Potential Introductions, Introductions, Coastal Settlements, Population Density, Population Growth, Vehicles, Fertilisers
6	9	Tsunamis	Volcanoes, Earthquakes, Isolation, Vertical Relief, Endemics, Oil spills
6	13	Vertical Relief	Volcanoes, Earthquakes, Tsunamis, Land Area, Country Fragmentation, Natural Vegetation
6	28	Loss Natural Cover	Endemics, Endangered spp., Oil spills, Fisheries Effort, Degradation, Mining
6	40	Degradation	Endangered spp., Loss Natural Cover, SO2, Mining, Legislation, GMOs
6	50	Shared Borders	Land Area, Country Fragmentation, Endemics, Introductions, Vehicles, Migratory spp.
6	52	Migratory spp.	Land Area, Isolation, Introductions, Extinctions, Terrestrial Reserves, Shared Borders
5	8	Earthquakes	Volcanoes, Tsunamis, Isolation, Vertical Relief, Slides
5	33	Oil spills	Tsunamis, Endemics, Endangered spp., Loss Natural Cover, Slides
5	42	Mining	Isolation, Ecological Overfishing, Loss Natural Cover, SO2, Degradation
5	46	Conflicts	Coastal Settlements, Population Density, Water, Sanitation, Habitat Fragmentation
5	48	Sanitation	Population Density, Vehicles, Water, Conflicts, Habitat Fragmentation
5	51	Habitat Fragmentation	Coastal Settlements, Population Density, Conflicts, Sanitation, Slides
4	10	Land Area	Vertical Relief, Natural Vegetation, Shared Borders, Migratory spp.
4	34	Industry	Vehicles, SO2, Fertilisers, Water
3	7	Volcanoes	Earthquakes, Tsunamis, Vertical Relief
3	39	Fisheries effort	Loss Natural Cover, Legislation, GMOs
3	44	Terrestrial Reserves	Endemics, Marine Reserves, Migratory spp.
3	47	Legislation	SO2, Fisheries Effort, Degradation
3	49	GMOs	SO2, Fisheries Effort, Degradation
2	24	Ecological Overfishing	Natural Vegetation, Mining
2	45	Marine Reserves	Endemics, Terrestrial Reserves
1	21	Extinctions	Migratory spp.
1	27	Population Growth	Pesticides

Figure 5: Correlation matrix for 41 indicators showing other indicators with which each is correlated.
Spearman rank correlation is tested at p=0.05. The diamond symbol marks only significant correlations. The left hand column in the table shows the total number of other indicators each indicator correlates with.



4.4 Results for Criterion 2: Scoring is inclusive of world-wide conditions and similar countries cluster together on the EVI scale

The first part of this requirement has been fully met for 41 of the EVI indicators in the Demonstration EVI. All of the completed indicators, except Indicator 31 (51 countries), were set with a minimum of data from 100 countries, and most with greater than 200. The countries used to set the scoring levels for these indicators were from all continents and regions around the world, including those of all sizes, socio-economic conditions and bioregions. In all cases, indicator scoring was set so that data from previously unevaluated countries will be able to be placed on the EVI scale when their data become available. The task now remains to complete this work for the 13 indicators for which global data could not be obtained for the Demonstration EVI.

Cluster analyses to examine whether the EVI produces results that tend to cluster together countries considered *a priori* to be 'similar' and separate countries considered *a priori* to be most different could not be carried out for this Demonstration EVI. The reason for this is that there were too many gaps in the data across the entire 235 countries x 54 indicators matrix to carry out a valid analysis. When data for the remaining indicators has been collected and gaps for particular countries filled, this analysis is expected to produce results that will allow us to examine this question in detail.

4.5 EVI scores for 235 countries (including collaborators)

4.5.1 EVI values and patterns among countries and regions

A complete listing of ranked global EVI scores, and the scores obtained for sub-indices (REI=Risk Exposure sub-index, IRI=Intrinsic Resilience Sub-index, EDI=Environmental Degradation sub-index, Met=Meteorological factors, Geo=Geological factors, Bio=Biological factors, CC=Country Characteristics-IRI, and Anthro=Anthropological factors) is given in Appendix 7.5 Table 8 in the summary section of this report. The scores given there are not final because they are based on incomplete data, with no country qualifying for a valid EVI since the highest percentage of data returned was 76% (Thailand) which is short of the 80% minimum requirement. All results given in the following text should therefore be read as provisional and be used only for demonstration of the capabilities of the EVI. Although the values given are as accurate as possible, results are likely to change when all indicators can be included and data gaps are filled.

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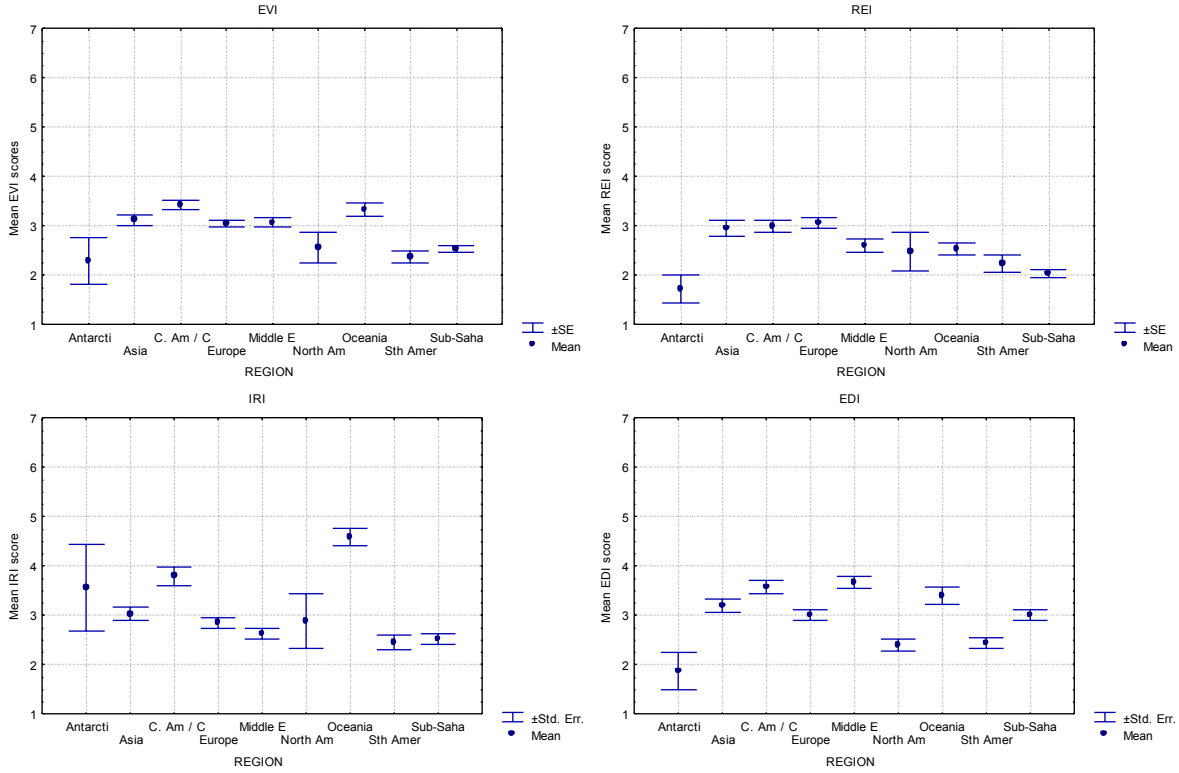
EVI values ranged between scores of 4.37 for American Samoa (35% data) to 1.20 for Western Sahara (28% data). The range of these scores did not span the entire EVI range of 1-7, but tended to be more centrally positioned. This result is to be expected, and when full data are available, we do not expect any country to score either a 1 or a 7 for the overall index, even though for individual indicators this occurs commonly.

The three most environmentally vulnerable countries were American Samoa, Singapore and Guam, and the three least environmentally vulnerable were Western Sahara, Antarctica and French Guiana. The result for Singapore EVI=4.33 is likely to be the most accurate of these because it is based on 67% of indicators, while the remaining countries are based on only 20-37% of indicators, half at best. Generally, the lower the data availability for a country, the more likely the results will change once gaps in the data have been filled.

At the scale of regions, some patterns did emerge. The Antarctic countries / territories generally had the lowest environmental vulnerability around the globe, but we also know the least about them, with data returns ranging only between 20-26%. There was, however, a large variance in the IRI scores among the 4 countries examined (Figure 6).

The regions with the greatest overall vulnerability were Central America / Caribbean and Oceania, with most of their vulnerability derived from intrinsic country characteristics (Figure 6). These countries, along with the Middle East also have high levels of environmental degradation (past damage) to their environments. All of these results are likely to shift as data on meteorological aspects become available (there are none included at present) and data gaps are filled.

Figure 6: Plots of mean EVI, REI, IRI and EDI scores for 9 regions around the globe.
Values are means for all countries included in each region, +/- Standard Errors for Antarctica (4 countries), Asia (35), Central America & Caribbean (32), Europe (48), Middle East (21), North America (3), Oceania (26), South America (14) and Sub-Saharan Africa (52).



Cluster analyses of countries within regions were carried out for Asia, Oceania and South America / Caribbean (Figure 7, Figure 8, Figure 9). The interpretation of these is typically difficult but offers some insights into the validity of the EVI (Note for Criterion 2 we would do similar analyses, but not grouped into regions, and not based only on the values for the 3 main sub-indices, but on all indicator scores). For example, within Asia, there are several clusters evident that group the continental Asian countries, parts of SE Asia, and India with Pakistan, show large differences between the clusters and the small islands and Mongolia (Figure 7). In Oceania, there are 4 main groups represented by (i) Guam / American Samoa, (ii) Australia, (iii) Marshall Islands and (iv) the remaining countries. A few sub-groupings are also evident, the clearest one of which covers most of Melanesia (Figure 8).

Figure 7: Cluster analysis for all Asian countries included in the Demonstration EVI.
Countries linked together towards the left hand side of the graph are more similar than linkages made on the right hand side of the graph. The cluster analysis was made on REI, IRI and EDI values using single linkage and Euclidean distances.

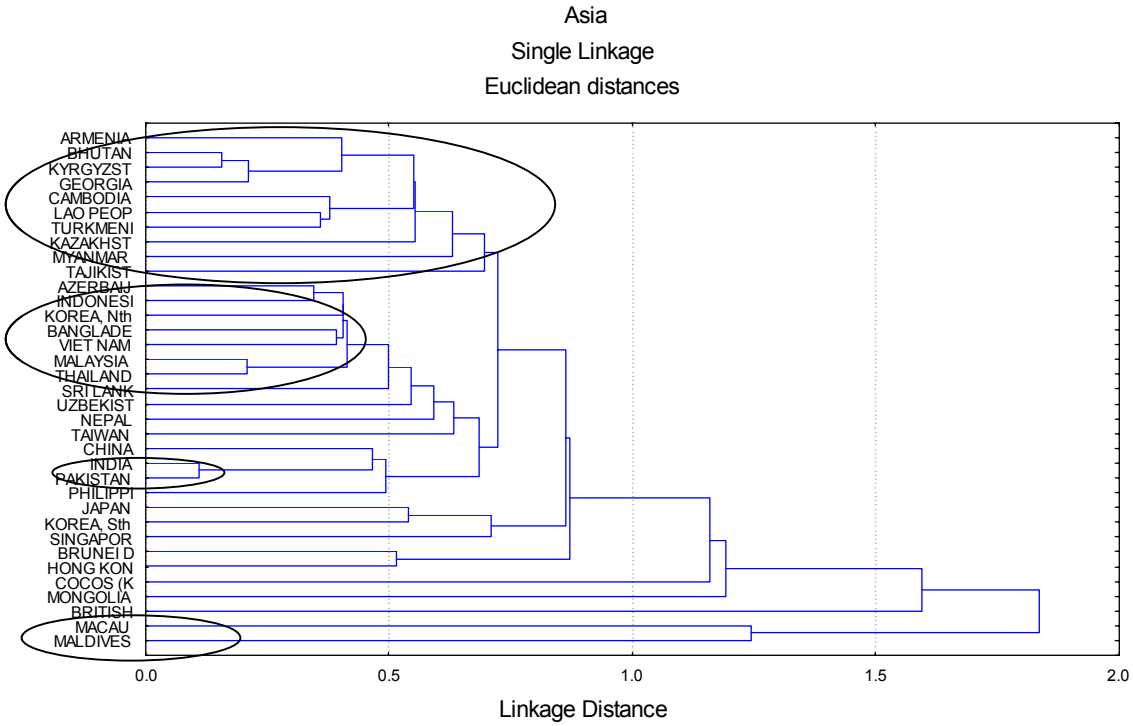


Figure 8: Cluster analysis for all Oceania countries included in the Demonstration EVI.
Countries linked together towards the left hand side of the graph are more similar than linkages made on the right hand side of the graph. The cluster analysis was made on REI, IRI and EDI values using single linkage and Euclidean distances.

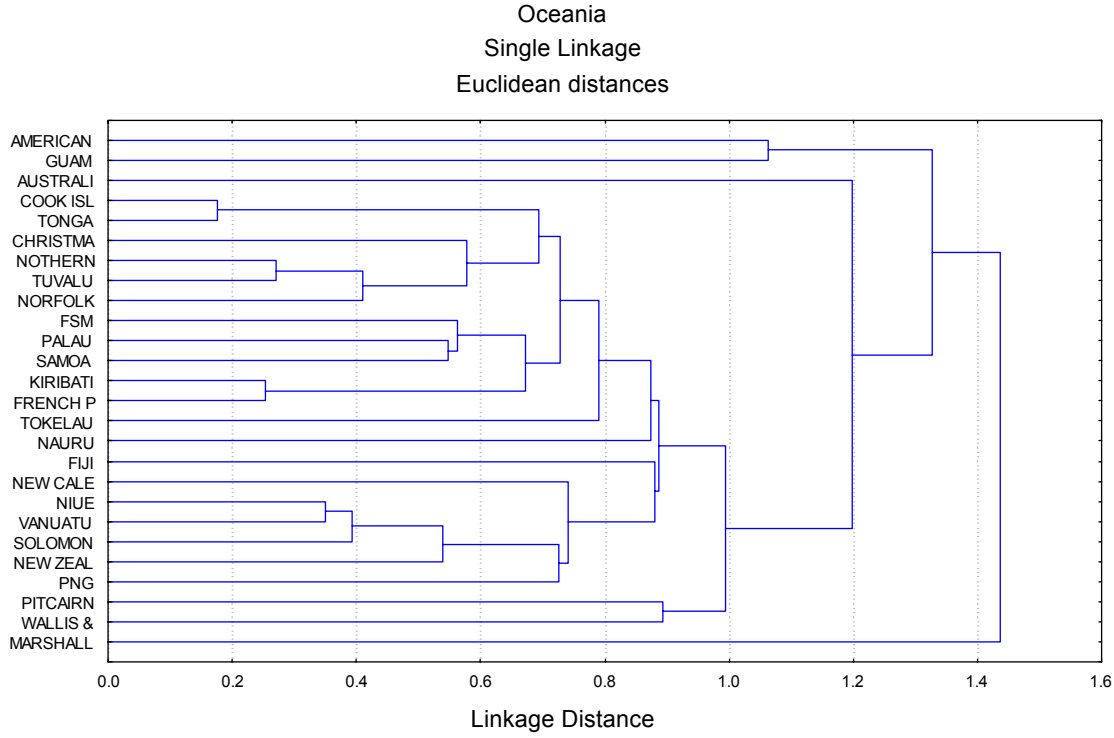
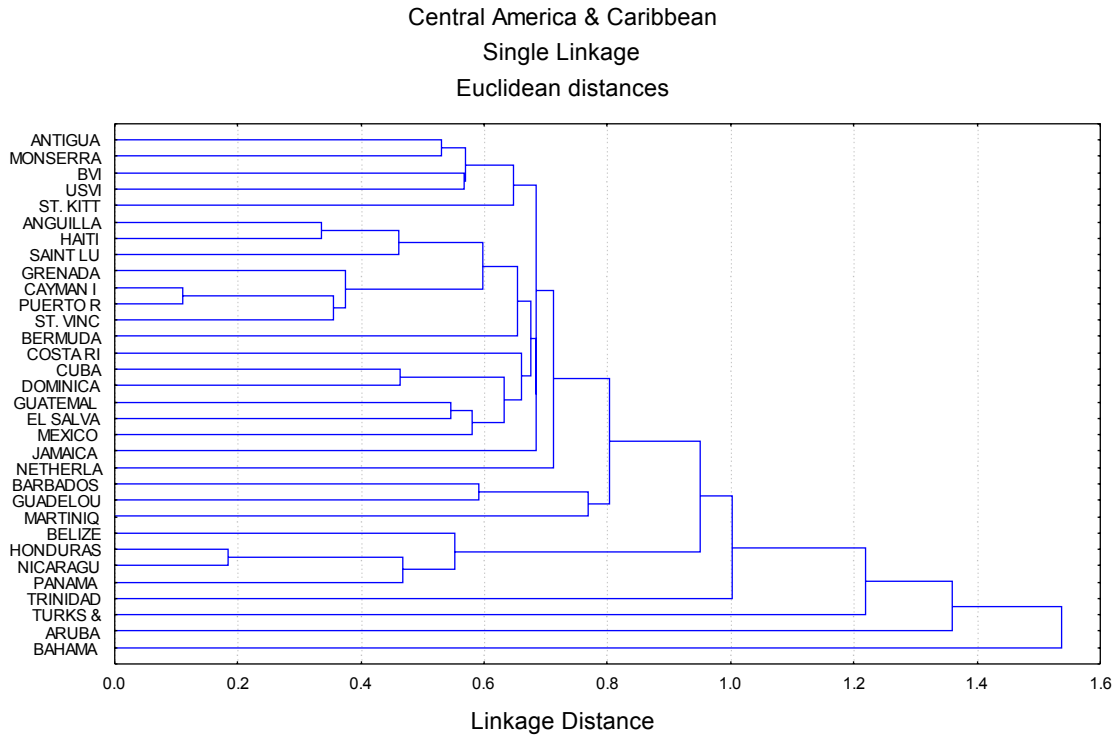


Figure 9: Cluster analysis for all South American and Caribbean countries included in the Demonstration EVI. *Countries linked together towards the left hand side of the graph are more similar than linkages made on the right hand side of the graph. The cluster analysis was made on REI, IRI and EDI values using single linkage and Euclidean distances.*



4.5.2 EVI profiles and country sheets

Full EVI profiles were produced for 32 countries to provide overall EVI scores, data deficiencies, values for all sub-indices, and profiles (see Executive Summary). The profiles also identify the main vulnerability issues for a country, and its main areas of resilience based on the EVI scores obtained for the sub-indices and individual indicators. These profiles are presented in the form of a single page 'report card' with at-a-glance access to the main results obtained for each country.

EVI profiles identify the main vulnerability issues for a country, and its main areas of resilience based on the EVI scores obtained for the sub-indices and individual indicators. These profiles are presented in the form of a single page 'report card' with at-a-glance access to the main results obtained for each country.

For example, for Singapore, with EVI=4.33 (67% data) most of its vulnerability is derived from high exposure to hazards and environmental degradation. The main environmental vulnerability issues centred around loss of biodiversity and habitat fragmentation, intensive land use, dense human populations and pollution. Its areas of environmental resilience include low vulnerability to geological events, mining, conflicts, problems with sanitation and genetically modified organisms.

5 CONCLUSIONS, FUTURE STEPS & RECOMMENDATIONS

5.1 Conclusions drawn from the Demonstration EVI

The results of this Demonstration EVI clearly show that collecting data, evaluating the index, sub-indices and profiles and interpreting the results of the EVI is possible. All of our collaborating countries (32 from around the globe) have been able to gather the required data, and we have been able to evaluate an EVI score for 235 countries. All of the required data are being collected, and most countries will be able to get at least 80% of their data to complete an EVI. To ensure this, we have allowed some flexibility in our data utilisation by allowing for the substitution of proxies where data for the original form of an indicator were difficult to obtain. The remaining difficulties now arise in cooperation among data agencies and streamlining of data collections. The main reasons for missing data for 13 of our indicators were:

- lack of cooperation from agencies that hold the data;
- data being available only as archived disparate files which would require processing to be in a useable form;
- the requirement of some agencies for cost recovery before releasing data and therefore the need to develop agreements or to access funding for that purpose;
- inefficient data collection mechanisms meaning that data are incomplete, discontinuous and not yet part of the normal requirements for managing countries.

The application of the Think Tank criteria for testing could not be fully applied on the Demonstration EVI because of missing data, although some indications of how the model may be finalised are given in this report. As expected, many of the indicators were correlated with each other (Criterion 1). We would expect this to occur in a large dataset with many observations and tests being applied, and would expect around 5% error in the testing. That is, statistically, it is expected that 5% of the correlation tests we used will have detected significant correlations among indicators where none exist (α=5%). This is not an error in technique or data, but a consequence of the use of statistics. We suggest that Criterion 1 should be applied as follows:

- only after data have been collected for all indicators, and all proxies used in the Demonstration EVI have been finalised;
- only to remove redundant indicators from the overall EVI and sub-indices where there is a possibility of redundancy (i.e. if indicators 12 and 22 correlate, they can still both be used separately in the IRI and EDI sub-indices; but one of two correlating indicators *within* a sub-index would be culled);
- Criterion 1 should only be applied to indicators correlated with many other indicators, and not to those with few correlations; and
- the EVI's profiles should retain all indicators to ensure that issues can be identified.

Correlations among indicators are expected because the EVI is being applied to a complex interactive system. This is it central purpose, and the reason for the approach used. Within such a system (the natural environment of a country) correlations and interactions among indicators are not only expected, but part of the reason for the need to develop an index to characterise conditions. Providing coverage for the wide range of ecosystems, species, hazards, diversity and energy flows in a country gives us the opportunity to pinpoint where problems are arising. If habitat fragmentation is leading to extinctions, the EVI would be most helpful if at least through the use of profiles it could assist in the identification of the nature of the problem. In this capacity, the EVI would not provide cause-and-effect information, but correlations between the two indicators that characterise these aspects of the environment would provide an efficient starting point.

The first part of Criterion 2 (EVI representative of global conditions) was fully met by definition in the Demonstration EVI for the 41 indicators we were able to evaluate, test and set EVI scoring. This task is not difficult and there is no expectation that the EVI will be difficult to finalise for the remaining 13 indicators for which data for at least 100 countries is still to be collected when sources can be found. When these data gaps are filled, it is also expected that the second part of Criterion 2 (clustering of countries considered *a priori* to be similar in characteristics) can be formally tested.

5.2 Future directions – steps to completion

5.2.1 The need for data: Moving from 'Demonstration' to 'Final' EVI

Completion of the EVI itself is dependent largely on the procurement of data, with evidence of few other technical difficulties. It is now necessary to set up partnerships with institutions; review and update data collected by national collaborators and establish mechanisms for obtaining data that are either not yet in useable form or that needs to be purchased. This is likely to require support at all levels of the international community and other stakeholders. The collection of information for environmental management purposes has progressed far in the past decade, but is still inefficient and incomplete.

5.2.2 Establishing permanent data-collection mechanisms & interactive database

A collaborative effort is required to establish permanent, efficient and streamlined global data collections for environmental purposes, including the EVI. Most of the international treaties currently in force around the globe require some form of data collection, and there are many disparate groups separately collecting data for a range of purposes (e.g. Dashboard of Sustainability, WRI, State of the Environment Reporting, to name just a few). A collaborative effort is now needed to simplify this process and improve its efficiency.

5.2.3 Testing with a full data-set

All aspects of testing the EVI, except for the setting of levels for the indicators completed here, will need to be retested when the final data requirements for the EVI are met. This focuses on the procurement of data for the 13 remaining indicators, updating data from collaborators (so that they align with adjustments made to some indicators), and the filling of data gaps so that the 80% data requirement can be met by most countries. Overall, the EVI database is probably more than 75% completed (i.e. to 80% data requirements, not to 100%), so this target is not unreachable. With these data in hand, tests of robustness and sensitivity of the EVI, and Criteria 1 and 2 will be possible.

5.2.4 Criterion 3: The final test

The final test before operationalisation of the EVI will be to compare valid EVI results with independent assessments made in-country on an *ad hoc* basis. This is the basis of Criterion 3, or the final test of the utility of the EVI as set at the Think Tank 1999. Funding has not yet been procured for this final test of the EVI.

5.2.5 Timeline to completion

We estimate that approximately one year of support is required to complete the EVI, formalise all links with collaborators, fill data gaps and prepare for presentation at Barbados+10. This will necessarily include retesting of the final index once all data have been collected, since the results obtained to date and presented here may change as the gaps in the data are filled. It will also be necessary to expose the EVI to a final formal review through another Think Tank, which we have scheduled for November 2003.

Table 6: Timeline for completion of final EVI to meet requirements of Barbados+10.
Note: this timeline is contingent on timely funding and cooperation for completion of data collection processes. There is still a question of the exact timing for Barbados+10.

	2003								2004								
Tasks	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
Presentation of Demonstration EVI																	
Solomon Is. country mission																	
Demonstration brochure / kit																	
Data revision with collaborators																	
Data collection from public sources																	
Permanent data mechanisms																	
SOPAC Annual Session																	
Think Tank II																	
Retesting final EVI																	
Development of interactive database																	
Presentation at CSD 12																	
Barbados+10 (incl Regional review)																?	?

5.3 Recommendations

The general recommendations arising from the development of the Demonstration EVI are centred around cooperation among stakeholders to ensure that the requirements of BPoA on vulnerability are met in time for Barbados+10. They are:

1. The Barbados Programme of Action 1994 called for the development and operationalisation of a fully tested EVI, a move supported by the WSSD in 2002. This Demonstration EVI largely completes the development phase for the index, except that it is missing 13 (of 54) indicators needed for finalisation. In order to meet the deadline for the review of the Barbados Programme of Action (Barbados+10) in 2004, it is necessary to complete all data collection, retest the EVI and finalise it. Support for this is needed.
2. It has been demonstrated here that the EVI is technically feasible. Full testing and production of a final EVI will be possible when the final data are collected. The EVI should now be finalised.
3. To complete all data requirements for finalising the EVI it is now necessary that all stakeholders actively contribute to completing the EVI database by the end of 2003. This requires a coordinated effort with countries, international organisations and other stakeholders to ensure this deadline is met.
4. UNEP / GEF should consider funding and hosting a global collaborative project to streamline data collection for sustainability, including state of the environment (SOE) and vulnerability (EVI) data collections in all countries. This would include UNEP, WRI, Dashboard, SOPAC, SPREP and other global and regional organisations.
5. The international scientific community should now as a priority develop sustainability thresholds for indicators already developed. This includes EVI, SOE and Ecological footprint indicators. It is important that indicators should not just measure conditions, but should be associated with trigger levels for when conditions are no longer sustainable.

Specific recommendations focused on the indicators of the EVI are:

- The World Meteorological Organisation (WMO) should consider organising its meteorological datasets so that they are in a form useable by the EVI and other environmental users.
- Satellite data on productivity and sea temperatures should be masked to allow for extraction of information separately for the EEZs and territorial waters of countries.
- Collaborating countries will need to revisit their databases to bring them in line with changes in the EVI resulting from this work. This will require recollection of some data in line with the requirements of revised indicators, and completing the data collection process for indicators not evaluated so far.

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7 APPENDICES

7.1 EVI Definitions

Damage: Similar to "Shock" though usually used by Environmental Scientists. Refers to the loss of diversity, extent, quality and function of responders (environment, economic, social systems).

EDI: Environmental Degradation sub-index, or acquired; see Extrinsic Resilience

External shock: Refers to economic or social vulnerability to hazards which originate outside of the country.

Extrinsic resilience: Acquired vulnerability of a country. This concept relates to features of a country that are under direct human control, e.g. state of the environment. Can be expressed as a sub-index, the ERI = Extrinsic Resilience sub-Index

Hazard: A factor or process, which has the potential to cause damage to a responder. For example, thinness is a hazard to the economic system.

Index: A set of aggregated or weighted indicators.

Indicator: Any variable or measure which characterises the level of risk, resilience or responder degradation in a country. A value which points to, provides information about, describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value. The term "indicator" originates from the Latin verb 'indicare' meaning to disclose or to point out. Indicators provide a means of communicating information about progress towards sustainable development in a significant and simplified manner. They focus and condense information about complex issues for management, monitoring and reporting, principally for decision-making. An indicator will provide a signal to an issue of greater importance or make more evident a trend or phenomenon that is not immediately detectable. In this regard an indicator's relevance extends beyond what is actually being measured to large issue of interest.

Indicators of sustainable development: Central to monitoring and report of progress towards sustainable development. They are also powerful tools which can help focus public attention on what sustainable development means and to give a broad overview of whether we are achieving "a better quality of life for everyone, now and for generations to come". They cover the three pillars of sustainable development – social progress, economic growth and environmental protection.

Internal shock: Refers to economic or social vulnerability to hazards which originate within the country.

Intrinsic resilience: The natural or innate sensitivity or ability of a country to resist damage due to the action of hazards. This concept relates to features of a country that are part of its inherent conditions, e.g. size. Can be expressed as a sub-index, the IRI = Intrinsic Resilience sub-Index

IRI: Intrinsic Resilience sub-Index; see Intrinsic Resilience

Likelihood: How likely it is that a specific hazard will occur within a given time frame (could be expressed as probability)

Naming of a vulnerability index: This should be done on the basis of the responders and not the hazards. That is, an Economic Vulnerability Index is concerned with the vulnerability of the economic system in a country and looks at the risks of damage to that system by any hazards (natural, social, political, economic, etc.).

Natural Environment: Includes those biophysical systems that can be sustained without human support. Does not include the built environment

REI: Risk Exposure sub-Index; see Risk Exposure

Resilience: The converse of vulnerability. This is the extent to which the environment, economy or social system (the responder) is able to resist damage / degradation by hazards.

Responder: The system that is being impacted by hazards. For example, the environment, social system or economic system of a country.

Risk (level of): Likelihood of harmful consequences arising from the interaction of hazards, vulnerable elements and the responder

Risk Exposure: Expression or consideration of the amount of risk to a hazard or group of hazards. Can be expressed as a sub-index, the REI = Risk Exposure sub-Index

Shock: Similar to “Damage” though usually used by Economists and suggests a short time frame. Immediate change / response to the action of a hazard (may be positive or negative)

Smart indicator: An end-point indicator, which captures a large number of elements in a complex interactive system, while simultaneously showing how the value obtained compares to some ideal or agreed-upon condition.

Sub-index: Partial index that highlights a specified component of vulnerability

Vulnerability Index: Summarised, dimensionless measure of vulnerability to be used as a tool for monitoring and expressing the degree of vulnerability. This may be an aggregated measure of all indicators (or subsets of them arranged as sub-indices), to give a measure of the environmental, economic, social or composite vulnerability of a country

Vulnerability: The extent to which the environment, economy or social system (the responder) is prone to damage / degradation by hazards.

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7.3 Information sheets for other environmental indicators and indices

7.3.1 State of Environment – Environmental Indicators

1. EUROSTAT – Environmental Pressure Indicators

Year(s) developed: 1997 -
Hazard(s): Human activities and indirect pressures (particularly in the following sectors: agriculture, energy, fisheries, households by consumers, industry, tourism, transport
Responder(s): State of Environment
Organisation(s): EUROSTAT - the Statistical Office of the European Communities
Number of Indicators: 60 pressure indicators

Purpose of the Indicators: Aims to describe human activities that are harmful to the environment in a comprehensive, systematic and comparable way using 60 – 100 pressure indicators. Through a process of experience with the use of "real" indicators in the policy process, the feasibility and usefulness of a detailed and systematic description of the pressures on the environment will be gained. Feedback through this process will ensure refinement and improvement in the selection of indicators.

Types of data required: Indicators are designed to monitor 10 policy areas: air pollution, biodiversity loss, climate change, marine environment & coastal zones, ozone layer depletion, resource depletion, dispersion of toxins, urban environmental problems, waste, water pollution & water resources

How are data processed in the indicator/index (organisation and mathematical approach)? Several core indicators have been developed in each policy area. Indicators are aggregated and weighted depending on their relevance and importance.

2. Environmental Indicators – National State of the Environment Reporting - Australia

Year(s) developed: 1996 – 2002 +
Hazard(s): Natural stressors and anthropogenic pressure
Responder(s): Natural resources and environmental quality
Organisation(s): Australian State of the Environment Committee, Environment Australia
Number of Indicators: 75 SoE indicators

Purpose of Indicators: To provide in depth reporting on the state of Australia's environment (SoE) to support decision making at all levels of society and provide reliable information that can foster a more integrated and longer-term perspective to environmental management.

Types of data required: Environmental indicators are physical, chemical, biological or socio-economic measures used to assess natural resources and environmental integrity. They are categorised into the following broad areas: atmosphere, coasts and oceans, land, inland waters, biodiversity, natural and cultural heritage, human settlements.

Several key indicators have been developed to reflect the anthropogenic pressure, current condition and human response for each process. Most indicators rely on being able to obtain data from government sources although several novel indicators have been suggested for consideration and potential monitoring.

How are data processed in the indicator/index (organisation and mathematical approach)? The approach to SoE reporting in Australia is based on a modified version of the OECD's 'pressure-state-response' model. The model is based on the concept of causality: human activities exert pressures on the environment; these change its state or condition; society

responds by developing or implementing policies that influence those human activities, and so change the pressures. Australia has modified this model to include cultural aspects of the environment, to recognise the inherent variability and lack of knowledge about the Australian environment and to allow for an interactive rather than a linear model.

3. ANZECC - Core Environmental Indicators for Reporting State of the Environment

Year(s) developed: 1999 – 2000+
Hazard(s): Human activities
Responder(s): Environment – quality of environment and functioning of important environmental processes
Organisation(s): Australian and New Zealand Environment and Conservation Council (ANZECC)
Number of Indicators: 75 SoE indicators

Purpose of Indicators: Select set of environmental indicators aimed at improving the effectiveness and integration of environmental reporting.

Types of data required: Atmosphere – climate variability, enhanced greenhouse effect, stratospheric ozone, outdoor air quality. Biodiversity – threatening processes, loss of biodiversity, biodiversity conservation management. Land – land use and management, erosion, salinity, acidity, contamination. Inland waters – groundwater, surface water, aquatic habitats. Estuaries and the sea – marine habitat and biological resources, estuarine and marine water quality, global processes. Human settlements – energy, water, demographics, transport, waste, community attitudes and actions.

How are data processed in the indicator/index (organisation and mathematical approach)?
The condition-pressure-response framework – is important for organising and presenting information and defining the range of issues to be considered. Indicators are chosen on the basis of best available scientific understanding and can be placed in a number of alternative frameworks to present and organise information.
Although the core indicators are linked the issue of relationships and causality between indicators is often complex.

4. South Africa - State of Environment Indicators

Year(s) developed: 1999 – 2001 –
Hazard(s): Human activities
Responder(s): Natural and human environment
Organisation(s): Department of Environmental Affairs and Tourism (DEAT)
Number of Indicators: 102 SoE indicators

Purpose of Indicators: To develop a core set of environmental indicators for State of Environment Reporting in South Africa in order to enhance existing tools for decision-making at all levels to facilitate management of progress towards sustainability. Indicators provide simple measures that will help in increasing awareness and understanding of environmental trends and conditions, their causes and consequences. It also aims to eliminate duplication with other national and international reporting obligations such as reporting on the progress of implementation of multilateral treaties and conventions.

Types of data required: For each theme area appropriate indicators have been selected to monitor and report on associated issues: atmosphere and climate, climate change, stratospheric ozone, air quality, biodiversity & natural heritage, species diversity, habitat change, resource value, natural heritage resources, environmental management, environmental management, human well-being, human settlements, vulnerability, land use, land use, land condition, coastal & estuarine, resource management, resource quality, waste management, waste generation, waste reduction, inland water, water quantity, water quality, freshwater ecosystem integrity.

How are data processed in the indicator/index (organisation and mathematical approach)? The 'Driving Force-Pressure-State-Impact-Response' (DPSIR) framework is utilised to structure indicators in a coherent way for use. The development of indicators involved a process of consultation and 8 key themes of sustainable development were prioritised - atmosphere and climate, biodiversity & natural heritage, environmental management, human well-being, land use, coastal & estuarine, waste management and inland water. Each theme forms a component of an Environmental Sustainability Index. Sub-indices for each theme include: marine, coastal and estuarine environment indicator, air quality index, inland water index, biodiversity index.

5. United Kingdom - State of Environment Indicators

Year(s) developed: 1999 –
Hazard(s): Human activities
Responder(s): Economic, social and environmental systems
Organisation(s): Department for Environment, Food and Rural Affairs
Number of Indicators: 15 headline indicators

Purpose of Indicators: In order 'to provide a high level overview of progress, and be a powerful tool for simplifying and communicating the main messages for the public' a set of 15 headline indicators have been developed – a quality of life barometer.

Types of data required: Economic output, investment, employment, poverty and social exclusion, education, health, housing, crime, climate change, air quality, road traffic, water quality, wildlife, land use, waste.

How are data processed in the indicator/index (organisation and mathematical approach)? Summary data are tabulated with progress and indication of trends. Progress is determined using the following criteria - Significant change, in direction of meeting objective, no significant change, significant change, in direction away from meeting objective and insufficient or no comparable data

6. Treaties (Stratospheric Ozone Depletion, Biological Diversity, Global Climate Change and Trade and Environment), Environmental Indicators and National Responses

Year(s) developed: 1997 – 2003
Hazard(s): Human activities
Responder(s): Human systems and natural environments
Organisation(s): CIESIN Columbia University
Number of Indicators: 20+

Purpose of Indicators: To provide access to an electronic database of information on a set of key issues related to the human dimensions of global change. Indicators presented provide measures of the problem, information on the environmental treaties developed to address the problem and resultant measures of the performance of national responses.

Types of data required: Data is collated in the following key areas: stratospheric ozone depletion, biological diversity, global climate change, trade and environment

How are data processed in the indicator/index (organisation and mathematical approach)? A modified Pressure-State-Response framework has been used to explain linkages between environmental treaties, key indicators (including those derived mostly from remotely sensed data) and national response strategies. Relevant indicators, data and data sources, international treaties and national level response strategies have been developed in 4 key areas - stratospheric ozone depletion, biological diversity, global climate change and trade and environment.

7. Index of Leading Environmental Indicators

Year(s) developed: 1994 – 2002 + (produced annually)
Hazard(s): Anthropogenic pressures
Responder(s): Natural resources and environmental quality
Organisation(s): Pacific Research Institute
Number of Indicators: variable ~16 indicators

Purpose of Index: To provide policymakers and interested citizens with an annual check-up on key environmental trends in the United States

Types of data required: Data ranges over a variety of themes: air quality, water quality, toxic chemicals, erosion, biodiversity. Data is compiled for both state and national levels.

How are data processed in the indicator/index (organisation and mathematical approach)? Several indicators are used to test a hypothesis (common perception). Discussion is then presented with graphs to illustrate whether the hypothesis is valid or refuted by the data presented.

8. Water Poverty Index (WPI)

Year(s) developed: 2001 +
Hazard(s): environmental degradation, impacts on water resources from human activities
Responder(s): community access to clean safe freshwater
Organisation(s): Centre for Ecology and Hydrology, Wallingford, UK
Number of Indicators: index calculated from 4 indicators

Purpose of Index: To produce an integrated assessment of water stress and scarcity, linking physical estimates of water availability with socio-economic variables that reflect poverty

Types of data required: Key elements of the composite WPI include: water availability, access to safe water, clean sanitation, time taken to collect domestic water.

How are data processed in the indicator/index (organisation and mathematical approach)? WPI is calculated by measuring: water availability through the assessment of ground and surface water availability related to ecological water requirements, plus all other domestic demands, as well as demands from agriculture and industry; adding population access to safe water and sanitation; combining it with the time and effort taken to collect water for the household (e.g., from proportion of population having access in or near the home and can be modified to take account of gender and child labour issues.

9. Pesticide Impact Ranking Index - PIRI

Year(s) developed: 2001
Hazard(s): Pesticides
Responder(s): Water resources
Organisation(s): Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Number of Indicators: index calculated from 3 variables each estimated from several indicators

Purpose of Index: To minimise the impact of agricultural pesticides on rivers, lakes (surface) and groundwater by assessing contamination potential of pesticides, providing a systematic means of improving the understanding of risk to surface and groundwater and a tool for (semi)quantitative basis for comparing risks

Types of data required: In-built into the database is pesticide fate data - KOC, half life, LC50 - actual, modelled or default; pesticide use - dosages, frequency, active ingredient, area,

fraction farm used; soil data - slope, depth, fOC, cover, texture, loss; rainfall/irrigation, recharge rate; droplet size; buffer zone width

How are data processed in the indicator/index (organisation and mathematical approach)? PIRI is based on three components: the value of the asset (water resources threatened); the source(s) of threat to the asset (pesticide use); the pathway through which the threat is released to the asset. The detriment to the surface or groundwater in a catchment area is calculated as the product of these three components = VLT Detriment = Value x Toxic load x Transport where Value (=score) of water body (Human health, Ecological etc) Toxic load (amount applied x toxicity) Transport Groundwater Surface water (Erosion, Run off, Drift).

10. Index of Watershed Indicators - IWI

Year(s) developed: 1997 – 2002+
Hazard(s): Human activities including urban pollution, agricultural pollution, fish consumption, erosion, development modifications to watercourses, population change.
Responder(s): Water resources quality and watershed habitat condition
Organisation(s): US Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds.
Number of Indicators: 15 indicators

Purpose of Index: To provide a watershed-level assessment of the condition and vulnerability of the water resources in order to allow the EPA to better target programme resources to address watersheds at risk.

Types of data required: Data is required on several aspects of the state of watersheds and its vulnerability. Data includes information on: the condition of aquatic resources; the conditions or activities that may place stress on the resources.

How are data processed in the indicator/index (organisation and mathematical approach)? Index of Watershed Indicators – uses 15 indicators – referred to as data layers. These were selected on appropriateness to IWI and their availability across the nation as well as the ability to depict them on an eight-digit Hydrologic Unit Code (HUC) scale. 7 indicators – relate to the condition of aquatic resources – appropriate basis to describe the aquatic resources within the watershed as having good quality, fewer problems or more problems. 8 indicators – related to vulnerability – conditions or activities that may place stress on the resources through perhaps not to the point that its values or functions are currently impaired. Values that were considered to appropriately differentiate “lower” from “higher” vulnerability were selected. Additional indicators to provide a more complete picture on watershed health such as biological integrity, terrestrial condition, ground water and air deposition are being developed.

11. Reefs at Risk – Map-based Indicator of Threats to the World’s Coral Reefs

Year(s) developed: 1998
Hazard(s): Coastal development, marine-based pollution, pollution and sedimentation from inland sources, overexploitation of coral resources
Responder(s): Coral reefs
Organisation(s): World Resources Institute (WRI)
Number of Indicators: at least 10 indicators aggregated into 4 threat factors

Purpose of Index: To develop a series of globally consistent indicators of human pressure on coral reefs. These indicators evaluate pressure from coastal development, marine-based pollution, pollution and sedimentation from inland sources, and overexploitation of coral resources. The indicator draws on 14 data sets (including maps of land cover, ports, settlements and shipping lanes), information on 800 sites known to be degraded by people and scientific expertise in model areas where reef degradation is predicted to occur given existing human pressures on these areas. Results are an indicator of potential threat (risk),

not a measure of actual condition. In some areas where there is good management is practiced, reefs may be at risk but remain relatively healthy while in others the indicator underestimates the degree to which reefs are threatened and degraded.

Types of data required: The Reefs at Risk analysis is driven by data sets reflecting population density, human population centres, airports and military bases, mines, tourist resorts, embayments, ports, oil-related threats, shipping related threats, overfishing, destructive fishing practices and derived estimates of threats from inland pollution and sedimentation.

How are data processed in the indicator/index (organisation and mathematical approach)? Reefs at risk is a global assessment of likely threats to coral reefs from several key human activities. Zones of high, medium and low threat were estimated for each threat factor and were combined through spatial overlay analysis with a data set reflecting the location of coral reefs. The resolution of data on coal reefs is a four-kilometre resolution (55,168 cells).

7.3.2 Ecological Footprint

12. Living Planet Report

Year(s) developed: 2000
Hazard(s): Human activities
Responder(s): Animal species
Organisation(s): World Wide Fund for Nature
Number of Indicators: 8 indexes with variable numbers of indicators

Purpose of Index: To quantify changes in the state of the Earth's natural ecosystems over time and to measure the human pressures on the natural environment arising from the consumption of renewable resources and pollution, and analyse the geographic patterns arising in those pressures.

Types of data required: Population data on forest, freshwater, marine species data from 1970 – 1999.

How are data processed in the indicator/index (organisation and mathematical approach)? The Living Planet Index (LPI) is a measure of the natural wealth of the Earth's forests, freshwater ecosystems and oceans and coasts. The LPI is the average of three indices which monitor the changes over time in populations of animal species in forest, freshwater and marine ecosystems respectively. Each separate index is set at 100 in 1970 and given equal weighting. Ecological Footprint is a conservative estimate of human pressure on global ecosystems. The analysis measures the amount of the globe's biological productivity an individual or a country occupies in a given year. It represents the biologically productive area required to produce the food and wood people consume, to give room for infrastructure and to absorb the CO2 emitted from burning fossil fuels, which is the primary cause of climate change. The Ecological Footprint is expressed in "area units" where each unit corresponds to one hectare of biologically productive space with "world average productivity".

13. Ecological Footprint – Revisiting Carrying Capacity: Area-Based Indicators of Sustainability

Year(s) developed: 1996
Hazard(s): Human economy – human activities
Responder(s): Environment – capital stocks, physical flows and corresponding ecosystem areas required to support the economy
Organisation(s): University of British Columbia
Number of Indicators: index calculated from variable number of indicators

Purpose of Index: To assess the capital stocks, physical flows and corresponding ecosystem areas required to support economy.

Types of data required: Population statistics, consumption figures for major items e.g. clothing, furniture

How are data processed in the indicator/index (organisation and mathematical approach)? Calculating the ecological footprint of a study population is to estimate the per capita land area appropriated (aa) for the production of each major consumption item 'i'. This is done by dividing the average annual consumption of that item ('c', in kg/capital) by its average annual productivity or yield ('p', in kg/ha) per hectare: aai = ci / pi. The total per capita ecological footprint ('ef') is then calculated by summing all the ecosystem areas appropriated by individual items in the annual shopping basket of consumption goods and services ef = ∑ aai. Thus the ecological footprint (efp) of a study population is the per capita footprint multiplied by the population size (N): EFp = N(ef)

7.3.3 Indicators of Sustainable Development

14. OECD State of Environment Indicators

Year(s) developed: 1991 – 1994 – 1998 – 2001+
Hazard(s): Human activities and indirect pressures
Responder(s): Environmental conditions ("State")
Organisation(s): Organisation for Economic Cooperation and Development (OECD)
Number of Indicators: 121 indicators

Purpose of Indicators: To provide a cost-effective and powerful tool for tracking and charting environmental progress and measuring environmental performance through the use of a selection of agreed environmental indicators.

Types of data required: Data for environmental indicators are collected on several major environmental issues: climate change, ozone layer depletion, eutrophication, acidification, toxic contamination, urban environmental quality, biodiversity, cultural landscapes, waste, water resources, forest resources, fish resources, soil degradation (desertification, erosion), socio-economic, sectoral and background indicators

How are data processed in the indicator/index (organisation and mathematical approach)? The Pressure – State – Response (PSR) Model – considers that human activities exert pressures on the environment and affect its quality and quantity of natural resources ("state"); society responds to these changes through environmental, general, economic and sectoral policies and through changes in awareness and behaviour ("societal response"). The PSR model has the advantage of highlighting these links and helping decision-makers and the public see environmental and other issues as interconnected (although this should not obscure the view of more complex relationships in ecosystems and in environment-economy and environmental-societal interactions).

A Core Set of Environmental Indicators has been selected to provide decision makers and the general public an overview of environmental issues as well as measure of performance and directions for future progress. Ten key environmental indicators focused on several important environmental issues have been compiled to address the need for timely information on important environmental issues. These indicators include: pollution issues, climate change, ozone layer, air quality, waste generation, freshwater quality, natural resources & assets, freshwater, forest, fish, energy, biodiversity.

15. Well-being of Nations / Barometer of Sustainability

Year(s) developed: 1997 – 1999
Hazard(s): Human activities
Responder(s): Human and natural systems.
Organisation(s): IUCN & Canada's International Development Research Centre (IDRC)
Number of Indicators: 36 socio-economic indicators, 51 state of the environment indicators

Purpose of Index: To provide a coherent way of measuring and communicating the well-being and progress toward sustainable development. It provides a systematic way of organising and combining indicators so that users can draw conclusions about the conditions of people and the ecosystem and the effects of people-ecosystem interactions. It presents those conclusions visually, providing anyone with an immediate picture of human and ecosystem well-being.

Types of data required: Key information on the ecosystem and people. Information for the measurement of the well-being of people and ecosystems are organised into two sub-systems with five components each: people – health and population, wealth, knowledge and culture, community and equity and ecosystem – land, water, air, species and genes, resource use.

How are data processed in the index/index (organisation and mathematical approach)? The Well-being of Nations – combines indicators into four indices and has equal treatment of people and the ecosystem – scale based on two axes, one for human well-being and the other for ecosystem well-being. This ensures that an improvement in human well-being does not mask a decline in ecosystem well-being or vice versa. The Human Well-being Index (HWI) – distils 36 socio-economic indicators which provide a more comprehensive approach than the Human Development Index and the narrow monetary indicators such as GDP. The Ecosystem Well-being Index (EWI) – synthesises 51 indicators of the state of the environment that encompasses systematically and fully national environmental conditions. The Well-being / Stress Index (ESI) – measures how much harm each country does to the environment for the level of development it achieves. The WSD and WI below break new ground in measuring people and the ecosystem together to compare their status and show the impact on one another and highlight the improvements in both. The Well-being Index (WI) combines the HWI and EWI on the Barometer of Sustainability – a graphic scale that shows how far each country is from the goal of high levels of human and ecosystem well-being.

16. World Bank – Measuring the Wealth of Nations

Year(s) developed: 1995 – 1996
Hazard(s): Human activities – including ranging from the use of resources, industrial development to institutional
Responder(s): Natural resources, produced assets and human resources
Organisation(s): World Bank
Number of Indicators: several economic indicators are utilised to provide measures of produced assets, natural capital and human resources in order to give an overall index of a country's wealth.

Purpose of Index: To measure sustainable development through assessment of the wealth of nations

Types of data required: Measuring the wealth of nations is a structured approach with aggregated monetary values made on natural capital, man-made capital and human capital

How are data processed in the indicator/index (organisation and mathematical approach)? The World Bank has determined the dollar value of natural capital, produced assets and human resources. The method is based on the concept of genuine saving as an indicator to

explore the dynamics of creating and maintaining wealth. Genuine saving is “the true rate of saving of a nation after accounting for the depreciation of produced assets, depletion of natural resources, investments in human capital and value of global damages from carbon emissions. Negative rates of genuine saving must lead eventually to declining well-being” (World Bank 1997). It is actually the evolution of gross saving and net saving to include natural and social parameters in order to keep in touch with the sustainability concept aiming to an aggregate measure for progress report.

17. CSD – Indicators of Sustainable Development

Year(s) developed: 1995 – 2000
Hazard(s): Human activities
Responder(s): Economic, social and environmental systems
Organisation(s): Commission on Sustainable Development
Number of Indicators: 58 indicators

Purpose of Indicators: To assist decision makers at all levels focus on sustainable development. Indicators will by provide decision makers with information on where they are at the moment, developing trends and pressure points and where interventions or policies could be useful. Feedback on the effectiveness of policies and their performance is key, in providing guidance on achievements or failures of interventions. Indicators offer an opportunity to simplify complex relationships in a concise way thus monitoring progress towards sustainable development. The development of indicators as key policy instruments will enhance national policies and help in the achievement of policy targets.

Types of data required: 58 indicators have been selected and placed into the following thematic framework: Social – equity, health, education, housing, security, population; Environmental – atmosphere, land, oceans, seas & coasts, freshwater, biodiversity; Economic – economic structure, consumption & production patterns; Institutional - institutional framework, institutional capacity

How are data processed in the indicator/index (organisation and mathematical approach)? Driving Force-State-Response (DSR) framework has been adapted from the Pressure-State-Response model. The DSR matrix incorporates three types of indicators horizontally and the different dimensions of sustainable development vertically. ‘Driving Force’ indicators comprise human activities, processes and patterns that impact on sustainable development. ‘State’ indicators measure the ‘state’ of sustainable development while ‘Response’ indicators highlight policy options and other responses to changes in the state of sustainable development.

18. Environmental Sustainability Index

Year(s) developed: 2000 – 2001 – 2002
Hazard(s): Multi – dimensional model – includes environmental hazards, anthropogenic activities, political institutions, environmental management
Responder(s): Social, economic and institutional systems and the natural environment
Organisation(s): World Economic Forum (Yale Centre for Environmental Law and Policy, Yale University Centre for International Earth Science Information Network, Columbia University).
Number of Indicators: 66 indicators

Purpose of Index: To provide a measure of factors that compromise environmental sustainability. The components describe the current environmental systems, stresses to those systems, the vulnerability of human populations to environmental disturbances and disasters, the social and institutional capacity to respond to environmental problems (including governance systems) and global stewardship or the degree to which an economy behaves responsibly with respect to other economies (through its consumption patterns and efforts to manage common environmental problems).

Types of data required: The ESI is based upon five components with 22 associated sub-indices – Environmental systems (with sub-indices air quality, water quality, biodiversity and terrestrial systems); Reducing stress (air pollution, water stress, ecosystem stress, waste & consumption pressures, population pressure); Reducing human vulnerability (basic human sustenance, environmental health); Social and institutional capacity (science/technology, capacity for debate, regulation and management, private sector responsiveness, environmental information, eco-efficiency, reducing public choice distortions); Global stewardship (international commitment, global-scale funding/participation, protecting international commons)

How are data processed in the indicator/index (organisation and mathematical approach)? All indicators were first adjusted to make them comparable by dividing by population, income or the percentage of a country's territory that was populated by 5 or more persons per square kilometre where necessary. ESI calculated by averaging 22 indicators and calculating standard normal percentile (5 components calculated in same way)

19. Sustainable Development Index (SDI)

Year(s) developed: 2002
Hazard(s): Human activities
Responder(s): Economic, environment and social systems
Organisation(s): Competencia de Estudios Ambientales, Instituto Mexicano del Petróleo
Number of Indicators: 22 indicators

Purpose of Index: To identify and prioritise the most urgent problems that need to be solved in order to obtain an improvement in the development of the municipalities in accordance with sustainable and resource mgmt criteria.

Types of data required: Human activities, GDP, electricity intensity, employment rate, potable water and sewerage availability, environmental assets consumption, soil use, environment and social status, hydrologic balance, water quality, air quality, soil use, erosion, poverty, health, endangered species, environmental and economic agents, water and garbage treatment and disposal, education, protected areas, reforestation

How are data processed in the indicator/index (organisation and mathematical approach)? The DSR model is based on a logic and holistic framework of action-response relationships between economy, society and environment. This study recommended flexibility on the number of core indicators and that the number should be determined in accordance with the level of information and the specific situation of the region under study as well as country's conditions. To integrate the indicators a modified multi-attribute decision theory methodology was used. Within the philosophy a tree was formed with 21 indicators representing production of social and natural systems of the studied region (main branches or general attributes). The number of indicators was defined by the availability of data and by their potential to represent an important characteristic of the region.

20. Sustainable Development Index (SDI)

Year(s) developed: 1995 –
Hazard(s): Human activities
Responder(s): Human, social and environmental systems
Organisation(s): IISDnet – Consultative Group on Sustainable Development Indicators (CGSDI)
Number of Indicators: variable - selection of indicators dependent on user. Index provides graphical approach to summarising indicators

Purpose of Index: To communicate problem areas to decision-makers quickly and accurately. Visual models of these indices must provide signals, in particular, warning

signals of unsustainability that flag for decision-makers those areas requiring management action.

Types of data required: Options for clusters of sustainable development indicators:
Two clusters – human well-being and environmental well-being
Three cluster - environmental, societal and economic well-being
Four cluster – material wealth and economic development, equity and social aspects, environment and nature, democracy and human rights

How are data processed in the indicator/index (organisation and mathematical approach)?
Dashboard of sustainability – three clusters of indicators. Four-sided pyramid, elliptical indicator cluster & compass of sustainability – four cluster approach to sustainable development indices.

21. Compass Index of Sustainability

Year(s) developed: 2000 -
Hazard(s): Human activities
Responder(s): Four aspects of sustainable development – nature, economy, society and well-being
Organisation(s): AtKisson & Associates Inc. Copyright.
Number of Indicators: variable – dependent on user selection

Purpose of Index: To provide a comprehensive measure of sustainability that is accessible, useful and attractive to decision makers and the general public. The Index is aimed at guiding policy developers and decision-makers towards sustainable development.

Types of data required: Data is required in the four categories of measurement – nature, economy, society and well-being of individuals. Examples of data required include: Nature - air quality, ecosystem health, energy use, environmental ethic, land consumption, waste and recycling, water quality; Economy - cost of living, housing, mobility, poverty, unemployment, wages; Society - crime, graduation rates, internet access, social capital, voting; Well-being - general health, infant health, mental health

How are data processed in the indicator/index (organisation and mathematical approach)?
To create the Compass Point sub-indices for N, E, S, and W, a simple average is used, leaving out those items where data is deemed insufficient. The Sustainability Index is the average of the four Compass Point sub-indices. Each Compass Point therefore receives a 25 percent weighting factor in the Sustainability Index. Each individual indicator receives an equal weight within its Compass Point sub-index. Other weighting decisions could certainly be applied. The decision to weight will be dependent upon the user and its application. Each Compass Point, or sub-index is calculated on a 0-100 scale. Normative decisions based on both scientific and social values determine the conversion formula for each indicator. The four indices are the aggregated to produce and the overall SDI.

22. Redefining Progress – Genuine Progress Indicator

Year(s) developed: 1994 –
Hazard(s): Human activities
Responder(s): Human systems
Organisation(s): Redefining Progress
Number of Indicators: 1 indicator which is adjusted for 24 variables

Purpose of Index: To provide a comprehensive accurate measure of the nation's progress. GPI includes the economic contributions of household and volunteer work while subtracting factors like crime, pollution and family breakdown.

Types of data required: Economic values for human activities - personal consumption, income distribution index, personal consumption adjusted for income inequality, value of household work and parenting, value of volunteer work, services of household capital, services of highways and streets, cost of crime, cost of family breakdown, loss of leisure time, cost of underemployment, cost of consumer durables, cost of commuting, cost of household pollution abatement, cost of automobile accidents, cost of water pollution, cost of air pollution, cost of noise pollution, loss of wetlands, loss of farmland, depletion of non-renewable resources, long-term environmental damage, cost of ozone depletion, loss of old-growth forests, net capital investment, net foreign lending or borrowing, the genuine progress indicator (GPI), per capita GPI, gross domestic product (GDP), per capita GDP

How are data processed in the indicator/index (organisation and mathematical approach)? The GPI is designed to indicate genuine progress in people's quality of life, the GPI begins with the personal consumption component of the Gross Domestic Product (GDP), including capital investment, government spending, and net exports. Beyond these general economic measures, the GPI factors in social, environmental and economic phenomena that diminish or enhance quality of life. Many of these factors are not generally measured in monetary terms or included in typical economic analyses. The GPI considers who benefits from economic growth by including measures of social progress or decline, such as distribution of income and rates of underemployment. The GPI also tracks other indicators of the quality of social life —such as costs of crime and family breakdown, contributions made by unpaid housework and childcare—and even considers time to enjoy the benefits of economic growth by counting hours spent commuting or enjoying leisure. The GPI is designed to extract significant long-term trends from short-term accounting fluctuations. Some data are averaged over five years, as year-to-year fluctuations of a single value would distort understanding of long term progressions.

23. Human Development Index (HDI)

Year(s) developed: 1990 – 2002 –
Hazard(s): Human activities
Responder(s): Human systems
Organisation(s): United Nations Development Programme (UNDP)
Number of Indicators: HDI consists of 3 indices comprising of 16 indicators

Purpose of Index: To measure the average achievement in three basic dimensions of human development – a long and healthy life, knowledge and a decent standard of living. The HDI allows comparisons across countries and over time.

Types of data required: The HDI is a summary measure of human development. It measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, as measured by life expectancy at birth; knowledge, as measured by the adult literacy rate (with two-thirds weight) and the combined primary, secondary and tertiary gross enrolment ratio (with one-third weight); a decent standard of living, as measured by GDP per capita (PPP US$).

How are data processed in the indicator/index (organisation and mathematical approach)? The HDI is an average aggregation of three sub-indices: Life expectancy index – measures the relative achievement of a country in life expectancy at birth; Education index – measures a country's relative achievement in both adult literacy and combined primary, secondary and tertiary gross enrolment. First an index for adult literacy and one for combined gross enrolment are calculated. Then these two indices are combined to create the education index, with two-thirds weight given to adult literacy and one third to combined gross enrolment. GDP index – is calculated using adjusted GDP per capita (PPP US$). In the HDI income serves as a surrogate for all the dimensions of human development not reflected in a long and health life and in knowledge. Income is adjusted because achieving a respectable

level of human development does not require unlimited income accordingly a logarithm of income is used.

24. Index of Environmental Friendliness

Year(s) developed:
Hazard(s): Direct and indirect pressures from economic activities
Responder(s): Environment
Organisation(s): Statistics Finland
Number of Indicators: ~ 23 indicators

Purpose of Index: The Index of Environmental Friendliness combines ecological information on problem-specific impacts and societal valuation thus providing a comprehensive assessment of each economic activity. The separate aggregation of pressures to problem indices and the subjective valuation of environmental concerns makes the model steps more transparent and applicable for various users. The applicability of the Index is dependent upon the representativeness of the set of problems selected for the index.

Types of data required: Test data included industry related environmental data on the following issues greenhouse effect, ozone depletion, acidification, eutrophication, ecotoxicological effect and resource depletion. Also the most important indirect emissions of electricity and heat consumption, waste and waste water treatment were attributed to the data evaluation in proportion to their purchases.

How are data processed in the indicator/index (organisation and mathematical approach)? The model for the Index of Environmental Friendliness is a general model for the aggregation of direct and indirect pressure data to problem indices and further to an overall index. The core assumption of the model is that environmental problems are the most feasible basis for a comprehensive assessment. The model gathers both direct and indirect and total pressures of economic activities, the assessment of environmental pressures associated with both. This provides a complete picture of the environmental impact coupled with each economic activity. It also makes internal services and treatment operations comparable to those procured at the expense of the environment.

7.3.4 Vulnerability Indices

25. Economic Vulnerability Index

Year(s) developed: 1992 – 1997+
Hazard(s): Exposure to external economic factors
Responder(s): Economy
Organisation(s): Islands and Small States Institute, Malta
Number of Indicators: 5 indicators

Purpose of Index: To highlight the reality that economic success of many small states often hides their underlying economic fragility. The economic vulnerability index measures the precariousness of states, arising from their economic exposure, lack of protection and peripherality.

Types of data required: Data on trade openness (export, imports or both as a ratio of GDP); export concentration; peripherality (transport and freight costs in relation to foreign trade); energy dependence (imported energy as a ratio of energy consumed); financial dependence (aid or international debt as a ratio of GDP)

How are data processed in the indicator/index (organisation and mathematical approach)? The method to compute the index involves the “normalisation” of the index data components restricting the values between 0 and 1, with each observation adjusted to take a value within

this range. The standardised variables for each country are then summed by assigning equal weights to each component.

26. Coral Reef "Vulnerability Index" of Exposure to Climate Change

Year(s) developed: 2000
Hazard(s): Climate change, population pressure, human activities
Responder(s): Coral reefs
Organisation(s): Greenpeace
Number of Indicators: 36 indicators

Purpose of Index: To provide a measure of vulnerability of coral reefs to human activities and climate change

Types of data required: GDP, demographic statistics, country characteristics, foreign aid, fisheries activities, tourism, political status

How are data processed in the indicator/index (organisation and mathematical approach)? The overall risk assessment is mapped onto a vulnerability scale where 5 is extreme and 0 is no risk. Assessment of vulnerability was based upon the following:
Physical exposure from extreme = 5 to low = 1; Outer islands (vulnerable in socio-political terms as well as physically) Many or all = 5; few = 1 (Nauru special case = 3); Population density/pressure from very high = 5 to low = 1; Foreign aid per head from very high = 5 to low = 2 and none = 1; Subsistence activities in fisheries and agriculture most = 4 and some not = 2. As the range of factors act in different ways on each country and due to the limitation of the simple ranking approach each measure is weighed equally in the overall total score.

27. Vulnerability assessment to climate change and sea-level rise

Year(s) developed: 1995
Hazard(s): Climate change, sea-level rise
Responder(s): Natural – physical & biological systems, human, infrastructural, institutional, economic, cultural systems.
Leading author(s): Kazuhito Yamada, Patrick Nunn, Nobu Mimura, Satoshi Machida, Mitsuhiro Yamamoto
Number of Indicators: 20 indicators

Purpose of Index: To develop an index that assessed vulnerability to sea-level rise and climate change in the South Pacific which was based on methodology that was flexible and did not depend so much on data referring to natural and social conditions and can introduce indigenous characteristics of countries.

Types of data required: Data on natural systems – physical and biological, human systems, infrastructure, institutional, economic and cultural systems.

How are data processed in the indicator/index (organisation and mathematical approach)? The concept of vulnerability and resilience were used to assess the weakness and strength of each system for the external and/or internal stresses. Vulnerability as defined is the susceptibility of the system to absorb the impacts of hazardous events on it without significant or adverse response. A range of scores from –3 to +3 are assigned to the degrees of vulnerability and resilience – indicative of the strength or weakness of the system. The difference of scores is combined into an index termed Sustainable Capacity Index (SCI) which is regarded as a measure of the system's overall ability to cope with external and internal stresses. A judgement method was used to evaluate the vulnerability and resilience of each sub-system by assigning scores in a semi-quantitative way where the degrees of vulnerability ranged from 0 to –3 and the resilience scores from 0 to +3 with +3

being the most resilient. Scenarios were also scored to determine potential future conditions and options for management.

28. Key Indicators for Global Vulnerability Mapping

Year(s) developed: 2002
Hazard(s): Natural hazards – tectonic, climatic, bio and human-induced hazards
Responder(s): Human environments
Organisation(s): United Nations Environment Programme (UNEP)
Number of Indicators: under development

Purpose of Index: To help decision makers prioritise populations facing greater threats through the use of a graphic mapping tool.

Types of data required: Information on each type of hazard and population at risk. The frequency – expected (or average) number of events per time period, population – number of exposed population and vulnerability – expected percentage of population loss due to socio-economical context are the key data required.

How are data processed in the indicator/index (organisation and mathematical approach)? The evaluation of risk is approximated as the total risk of various populations that are exposed to particular hazards and with associated vulnerability.

29. Composite human vulnerability index

Year(s) developed: 2001
Hazard(s): Climate change, extreme events and environmental change
Responder(s): Human and economic systems
Organisation(s): Indian Institute of Technology, Bombay
Number of Indicators: 19 indicators

Purpose of Index: To measure human vulnerability to environmental change and natural hazards using GIS.

Types of data required: Data is required for the following factors that affect human vulnerability: health, economic losses, poverty, loss of natural heritage, loss of IPR, conflicts, extreme events/climate change impacts

How are data processed in the indicator/index (organisation and mathematical approach)? Human vulnerability is defined as the exposure to hazard by external activity (e.g. climate change) and coping capacity of the people to reduce risk at a particular point in time. Therefore vulnerability is a function of exposure to hazard, population density and coping capacity over time. The HVI combines the exposure indicators using equal weightings and divided by the coping indicators. The exposure index only combines the total exposure indicators without dividing by the coping capacity indicator.

30. Island Indicators

Year(s) developed: 1998 –
Hazard(s): Natural and anthropogenic activities
Responder(s): Island ecosystems
Organisation(s): United Nations Earthwatch
Number of Indicators: ~ 15 indicators

Purpose of Index: To classify islands by various criteria so that comparisons between islands or areas as a basis for facilitating inter-island cooperation and sharing of solutions, and identifying conservation importance.

Types of data required: Indicators have been developed for the nature and isolation of the island, for features of conservation interest, for risks to that conservation interest and for the feasibility of conservation action. Indicators include: coastal index, sea-level rise index, isolation, threat, natural protection, ecosystem richness, species richness, endemism, special features, invasive species, urbanisation, human threat, economic pressure, protected area coverage, reliability of data.

How are data processed in the indicator/index (organisation and mathematical approach)? Data for each island are summarised in three aggregated indices to give an overall evaluation and to allow comparisons and rankings. Human Impact (HI) measures the overall human pressure or impact on the island and potential threat to remaining natural areas or endemic species. Terrestrial Conservation Importance (CI-T) gives an overall numerical evaluation of the significance of the land area of the island for the conservation of nature. It consists of the sum of a series of measures of conservation interest weighted for their relative importance. Both measure of biological importance and measures of their natural conservation status have been included since both are important for successful conservation action although biological factors are given higher weighting. The index formula reflects the evaluation process made by a conservation planner or protected area manager in selecting a protected area. Marine Conservation Importance (CI-M) provides an equivalent measure to the CI-T index but is adapted to the special characteristics of island marine environments down to 100 metres in depth. As there is limited data it is not always possible to calculate a viable marine indicator for many islands but it is included here to highlight the information needed.

Table 7: Summary of 30 environmental indicators and vulnerability indices currently being used or developed around the globe.

ENVIRONMENTAL	D-P-S-I-R	Density	Density	Density	Percentage	Number	Scale	Eurostat	Australia SoE	South Africa SoE	UK SoE	ENTRI System	Index of Leading Environmental Indicators	Living Planet Report	Ecological Footprint	Water Poverty Index	Pesticide Impact Ranking Index	Index of Watershed Indicators	Reefs at Risk	OECD	Sustainability Barometer	WB Measuring the Wealth of Nations	CSD SD Indicators	Environmental Sustainability Index	IISDnet – Consultative Group on Sustainable Development Indicators (examples)	Compass of Sustainability	Redefining Progress	Human Development Report	Finland - Index of Environmental Friendliness	Pacific in Peril	Methodology for the Assessment of Vulnerability of South Pacific Island Countries to Sea-Level Rise and Climate Change	Assessing Human Vulnerability due to Environmental Change: Concepts and Assessment Methodologies	UN System-Wide Earthwatch - Island Directory
INDICATORS	Framework	density / area (d/a)	density / capita (d/c)	density / time (d/t)	%	#	National/Local	1999	2001	2002	2002	2002	2002	2002	1996	2002	2001	2002	1998	2002	1999	1996	2001	2001		2000	2001	2002		2000	1995	2001	1998
AIR POLLUTION / CLIMATE CHANGE																																	
Emissions of greenhouse gases (CO_2, N_2O, CH_4, HFCs, PFC, SF_6)	P / S		1	1	1	1	N	d/t	d/t	d/t	d/t / %	d/t								d/t	d/c		d/t	d/a			d/t / %		d/t			d/t / #	
Emissions of nitrogen oxides (NQ)	P	1		1	1		N	d/t	d/t	d/t			d/t / %							d/t				d/a					d/t				
Emissions of volatile organic compounds (VOCs)	P	1		1			N	d/t	d/t											d/t				d/a									
Emissions of sulphur dioxides (SQ)	P	1		1	1		N	d/t	d/t	d/t			d/t / %							d/t				d/a	d/t				d/t				
Emissions of particles	P			1	1		N	d/t	d/t				d/t / %							d/t							d/t							
pH loading	S			1			N													d/t									d/t				
Technology to reduce emissions	R				1		N													%													
Ambient air quality	S			1	1		N														d/t / %						d/t						
Consumption of hydrocarbons / energy	P		1	1			N	d/c / d/t		d/t			d/t							d/t	d/c		d/c	d/c / %						d/c / d/t			
Energy generation from primary sources	P		1	1	1		N	d/t		d/t										d/c / d/t / %	d/t / %		d/t	d/c / %			d/t						
Renewable energy generation/improved efficiency	R				1		N													%			%										
Carbon Monoxide	S			1			N		d/t				d/t												d/t									
Emissions of chlorofluorocarbons (CFCs) / bromofluorocarbons / hydrochlorofluorocarbons / methylbromide / halons	P		1	1			N	d/t	d/t			d/t								d/t				d/c			d/t		d/t				
Recovery & destruction of ozone depleting substances	R						N																										
Emissions ozone depleting substances	P / S		1	1			N / L		d/t	d/t	d/t	d/t	d/t							d/t	d/c		d/t				d/t		d/t				
Heavy metals emissions	P			1			N	d/t	d/t				d/t							d/t													
Exceedences of heavy metals emissions	S			1			N																										
Emissions of aerosols	P			1			N		d/t																								
Size of carbon sink	P		1	1			N		d/c / d/t	d/t																							
Ambient temperature	S			1			N		d/t	d/t										d/t													
Temperature extremes	S	1		1	1		N		d/a / %																					d/t			
Precipitation	S			1	1		N		d/t / %								d/t			d/t													
Rainfall extremes	S	1			1		N		d/a / %																								
Evaporation rate	S			1			N		d/t																								
Southern Oscillation Index	S			1			N		d/t																								
Tropical Cyclones	S			1			N		d/t																								
Cost of Natural Disasters	R			1			N			d/t										d/t													
Vehicles in use / infrastructure development	P	1	1	1	1															d/a / d/c / d/t / %													
LAND & WATER POLLUTION																																	
Consumption of pesticides	P			1			N	d/t									d/t			d/t			d/t										
Pesticide loading	P	1		1			N	d/a	d/t				d/t				d/a			d/t													
Nutrient use (nitrogen, phosphorous)	S	1		1			N	d/a	d/t											d/t	d/a		d/t										
Eutrophication loading (nitrogen, phosphorous)	P	1		1			N	d/t	d/t									d/t		d/t				d/a					d/t				
Emissions of persistent organic pollutants (POPs) / halogenated organic compounds	P	1		1			N	d/t		d/t														d/a									
Consumption of hazardous chemicals	P			1			N	d/t																									
Heavy metals emissions	P			1			N	d/t																									
Concentration of heavy metals	S						N																										
Emissions of radioactive material	P			1			N	d/t																					d/t				
Emissions of organic matter (BOD)	P			1			N	d/t																									
Shipping & impacts	S			1			N		d/t																								
Oil pollution / maritime pollution / release of toxics to waterways	P			1			N	d/t	d/t	d/t								d/t	d/t	d/t													
Wastewater treatment	P / R		1	1	1		N / L	%	d/t / %										d/c / %	d/c / d/t / %	d/c		%										
Wastewater point source discharge	P			1			N / L		d/t																								
Wastewater recycled	R			1	1		N / L	%												d/t / %													
Polluter Pays Principle	R			1			N		d/t											d/t													
WASTE MANAGEMENT																																	
Waste landfilled	P / S			1			N	d/t	d/t	d/t	d/t									d/t													
Waste incinerated	P			1			N	d/t												d/t													
Hazardous waste	P			1			N	d/t		d/t	d/t									d/t			d/t										
Hazardous waste treatment	S			1	1		N			d/t / %	d/t									d/t													
Municipal waste generation	P		1	1	1		N	d/t / %		d/c / d/t	d/t									d/c / d/t			d/c / d/t		d/c / d/t							
Industrial waste	P			1			N	d/t		d/t	d/t									d/t			d/c / d/t										
Waste recycled / material recovered	P / R			1	1		N	d/t		d/t / %	d/t / %									d/t			d/t										
RESOURCE DEPLETION / BIODIVERSITY LOSS																																	
Water consumption (groundwater abstraction, surface)	P	1	1	1	1		N	d/c / d/t	d/t / %	d/t / %										d/a / d/c / d/t	%		d/t	d/c									
Freshwater availability	S		1	1	1		N		d/t / % / #	d/c						%				d/c / d/t / %			d/c							%			
Environmental flows objectives	R					1	N / L		#									#															
Water tables depths	S			1			N		d/t																								
Freshwater quality (nutrient, loading, salinisation, microbiology, toxics)	S / I			1	1		N		d/t	d/t / %			d/t					d/t		d/t			d/t	d/t	d/t / %					d/t			
Loss of vegetation/ forests / mangroves / logging	P			1	1	1	N	d/t / %	d/t / % / #	d/t / %		d/t / %								d/t / %	d/t		d/t / %	d/t / %	d/t / %		d/t / %			%		%	
Area of vegetation / forest & health	S	d/a	1	1	1		N	d/t	d/t / %	d/t / %										d/c / d/t / %	d/t		d/a / d/t / %									
Fragmentation of forests and landscapes	P / S			1	1		N	%	d/t / %																								
Riparian vegetation loss	S	1		1	1		N		%	d/a / d/t / %																							
Revegetation	S			1	1		N													d/t / %													
Wetland (freshwater, saline) loss	P	1			1		N	%										%									d/a						
Extent & condition of wetlands (freshwater, saline)	S					1	N		#																								
Aquatic / coastal habitat loss	P			1	1		N	d/t / %	%									d/t	d/t		d/t												
Extent & condition of aquatic / coastal habitat	S	1		1			N / L		d/t	d/a / d/t	d/t										d/t												
Aquatic macroinvertebrate composition health	S	1			1		N / L			d/a / %																							
Beaches and dunes extent & condition	S			1	1		N		d/t / %																								
Coral reefs extent & condition	S			1	1		N		d/t / %										d/t														
Terrestrial Protected/conservation areas	S / R	1	1	1	1		N		#	d/t / %		d/t								d/a / d/c / d/t	%		d/a / %		d/a / %						d/a	d/a / %	
Marine and coastal protected areas	S / R	1				1	N		#																							d/a	d/a / %	
Fragmentation of protected areas	P				1		N	%																									
Legislation - threatened species recovery plan	R																																
Landuse / coastal use change	P / R			1	1	1	N	d/t / % / #	d/t / % / #	d/t / %	d/t / %	d/t / %	d/t / %							d/t	d/t / %		d/t / %		%		d/t		d/t				
Erosion	P			1		1	N		d/t / #								d/t	d/t	d/t		d/t												
Intensive agriculture	P	1			1	1	N	%	% / #											d/a / d/t / %	d/a / %												
Grazing pressure	R	1					N		d/a																								
Arable & permanent cropland, soil health	P	1		1			N	d/a	d/t / %	d/t / %				d/t / %	d/t / %		d/a			d/t / %	d/t / %		d/t						%				
Land degradation (soil desertification, loss, salinisation, acidification)	P			1	1		N		%	d/t / %											d/t / %		d/t	d/t	d/t / %		d/t						
Land area affected by soil desertification, loss, salinisation, acidification.	S			1	1		N			d/t / %																							
Mining activities	P	1					N												d/a														
Endemic species	P / S	1		1	1	1	N		#	#											d/t / % / #										d/a / #	d/t	
Introduced species	P / S				1	1	N		#	% / #																						d/t / #	
Pest control	R					1			#																								
Threatened & extinct species	S				1	1	N		#	% / #								#		% / #	d/t / %			d/t / % / #	% / #							
Bioaccumulation of toxics	S			1		1	N		d/t / #	d/t																							
Species outbreaks / algal blooms / fish kills	P / S				1	1	N / L		% / #																								
Population density change	S	1		1	1	1	N			d/a				d/t / %																		d/t	
Population of target species - genetic diversity	S			1		1	N		#		d/t / #												d/t / #										
No. of species / ecosystem diversity	S			1	1	1	N		% / #												d/t / %											#	
Species abundance/distribution change	S			1	1		N		%	d/t																							
Biodiversity Index (Peters Biodiversity Index - summary of endemism, habitat diversity, abundance)	S						N																										
Composite species indices	S			1			N							d/t																			
Fish catches / overfishing	P	1	1	1	1		N	#	d/t / %	d/t / %									d/t	d/c / d/t / %	d/a / d/t		d/t		d/t								
Fish community health	S	1			1	1	N / L		% / #	d/a / %																							#	
Aquaculture production	S					1	N		#																									
Concentration of Algae in coastal waters	S			1			L																d/t										
Human Population density / dynamics / distribution	P / S	1		1	1	1	N		% / #	d/a		d/a		d/t	d/t			d/t	d/a	d/a / d/t / %			d/a / d/t / %	d/t / %						d/a / d/t / %	d/a / d/t	d/a / d/t / %	d/a / d/t
Tourism intensity	P / R	1	1		1	1	N	d/a	% / #										d/a	%										d/a / d/c			
Flood & droughts	P / S			1		1	N		d/t	d/t / #										d/t													
Sea-level rise	S			1			N		d/t																							d/t		d/t
Sea-surface temperature	S			1			N		d/t																									
Extractive industries (quarrying, mining)	P				1		N		%																									
Permits for flora / fauna extraction	P					1	N		#																									
Management plans for extraction	R					1	N		#																									
FOOTPRINTS																																	
Cropland footprint - area required to produce all crops that a country consumes		1												d/a	d/t																		
Grazing land footprint - consumption of meat, dairy products, hides and wool that come from livestock and not crop-fed but occupy permanent pastures		1												d/a	d/t																		
Forest footprint - area required to produce the forest products which a nation consumes		1												d/a	d/t																		
Fishing ground footprint - area required to produce the fish and seafood products the country consumes		1												d/a	d/t																		
Energy footprint - area required to sustain its energy consumption		1												d/a	d/t																		
Water withdrawals				1			N							d/t																			
Ecological deficit		1					N																	d/a										

7.4 Selected test results sheets for individual indicators

EVI INDICATOR TEST SHEET

18

Indicator Summary

Indicator number:	18	
Indicator short name:	Freight imports	
Sub-index	REI	
Categorisation	Biological / anthropogenic	
Indicator text:	Total tonnage of freight imported per year by any means / sq km land area	
Signals captured:	This indicator captures the risk of damage to a country through the importation of foreign materials (physical, chemical and biological) by land, air or sea through the large volumes of freight that move around the globe annually. Countries with large amounts of freight moving into them are considered more at risk of inadvertent introductions of diseases, species and genetically modified organisms, than those with lower levels of freight movements. The likelihood of such introductions negatively affecting a country's resilience would be especially important if there are many endangered species, sensitive ecosystems that could be affected by key species, and interactions with on-going human impacts. Freight imports may also be a mechanism for the introduction of pollution risks not normally found in a country – e.g. the import of radioactive substances, oil, chemicals.	
Notes on this indicator:	Data on tonnages were provided by 14 of the 32 collaborators, but were not available from public sources. The public data available are expressed in $ values of freight imports and are not averages over 5 years, but are limited to 1997 (WRI 2000-2001).	
Are suitable data available?	No public databases found in the correct units; substitute data used in units of $ rather than tonnes	
Sources of data:	WRI 2000-2001 In-country	
No. countries included in test:	235	
Temporary modifications to data or indicator, if applicable:	Data used are freight in 1000s $ per sq km of land area because data on tonnages are generally not publicly available Data are from a single year (1997) and are not averages 1996-2000 (not available) Data from in-country sources, where available, were provided as tonnes / sq km, but could not be used to supplement the public source because units could not be converted from tonnes to $ (contents of the freight are not provided).	
Notes on data age, completeness and quality:	14 of the 32 collaborating countries returned data for this indicator. Age, completeness and quality of the in-country data were generally considered good (> value of 2/3 for age, completeness and quality).	
Basic units:	Freight density as X = thousands of dollars of freight moved into the country per sq km of land.	
Recommended transforms:	• Data transformed to the natural logarithm of freight density LN(USD 1000s / sq km)	
Proposed EVI Scale	EVI Score = 1	X<=1
	EVI Score = 2	1<X<=1.5
	EVI Score = 3	1.5<X<=2
	EVI Score = 4	2<X<=2.5
	EVI Score = 5	2.5<X<=3
	EVI Score = 6	3<X<=3.5
	EVI Score = 7	X>3.5
	NA (not applicable)	☒ May not be used
	ND (no data)	☑ May be used
Future work on this indicator:	Sources of yearly data on tonnages imported are needed.	

1. Description of raw data

The raw data for this indicator are comprised of the freight movements into a country expressed as millions of USD for a single year (1997) (WRI 2000-2001). Of the 235 countries examined, data were available for 145.

The total USD value of freight imports to countries in 1997 varied between 107 million recorded in Guinea-Bissau and 1,043,477 million in the USA. The mean value of imports across the globe in 1997 was 43,370 million USD, which is close to the values for Portugal and Poland. Half of the countries examined imported 4,681 million worth of goods or less in 1997 (the median), indicating that the distribution of import millions is heavily skewed, with relatively few countries importing very large amounts (Table 1). Variance among countries is high, with a standard deviation which is around 2.7 times the mean.

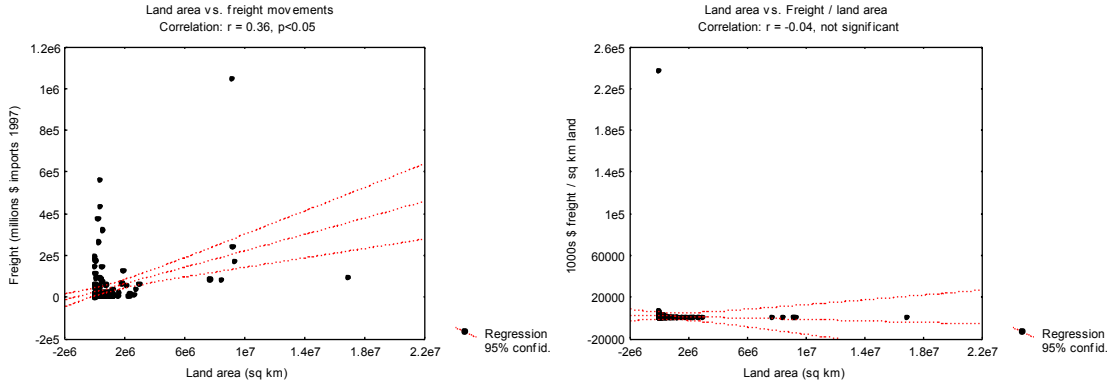
The value of freight imports is correlated with the size of a country (see significant correlation coefficient in Figure 1). There is also, however, a range of import values found among the smaller countries, with some smaller countries having large import values in 1997 (e.g. Singapore).

The risks associated with imports from an environmental perspective are related to the area of land over which exposure can occur and damage can be attenuated. This means that this indicator needs to be divided by total land area in a country to examine the amount of exposure to freight over the land area (or 'freight density'). When the freight density is, in turn, tested against country size, this correlation disappears (Figure 1b). The maximum freight density observed was in Singapore, with 236,341 USD imported per sq km of land in 1997.

Table 1: Basic statistics for freight movements in 235 countries. Data are from WRI 2000-2001 and cover only the year 1997.

Statistic	Freight imports USD millions (1997)	Freight density USD 1000s / sq km	LN Freight density LN USD 1000 / sq km)
Mean	43,370.37	1877.38	1.46
Median	4,681	23.81	1.38
Valid n	145	145	145
Min	107	0.34	-0.47
Max	1,043,477	236,341.00	5.37
SD	116,738.30	19621.25	0.98
SE	9,694.59	1629.46	0.08
Skewness	5.65	12.01	0.61
SE Skewness	0.20	0.20	0.20
Kurtosis	40.46	144.55	0.97
SE Kurtosis	0.40	0.40	0.40

Figure 1: **Graphs of freight imports vs. size of countries. (a) Freight in US Millions $ vs. size of country (sq km); and (b) Freight density (1000s $ / sq km land) vs. size of country (sq km). The correlation is significant in (a) and not significant in (b).**



2. Distributional characteristics of the indicator data

The freight density of countries was plotted as frequency distributions in 20 evenly-spaced categories to identify underlying patterns (Figure 2). This resulted in a distribution in which all countries except Singapore were clustered in the first category (0-13,000 USD,000 / sq km) (Figure 2). We excluded Singapore from the analysis to examine the world distribution of freight density, creating a better spread among countries. The four classes of distributions examined were normal (distributed around some average), rectangular (evenly distributed), exponential (power function) and lognormal (logarithmic function). Kolmogorov-Smirnov (K-S) tests were used to test the null-hypothesis of no difference between the observed frequency distributions (bars) and the expected ones (lines), if the distribution against which the data were being tested was a good fit.

A significant difference between observed and expected values was found in all tests except the lognormal distribution (Figure 3). This suggests that the values observed are distributed according to some logarithmic function and that transforming the values to their natural logarithm might provide a better scale for comparison.

Figure 2: **Frequency distribution for freight density of all examined countries spread over 20 categories.**

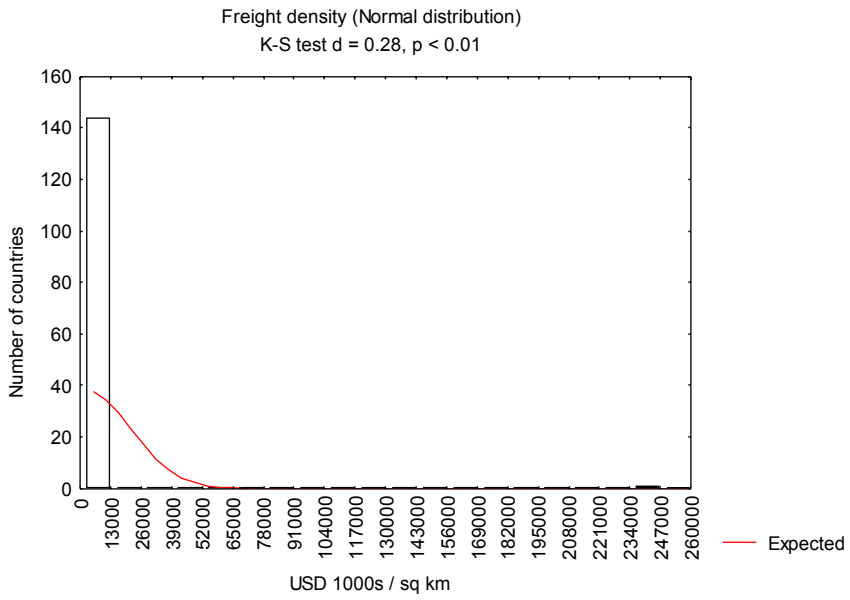
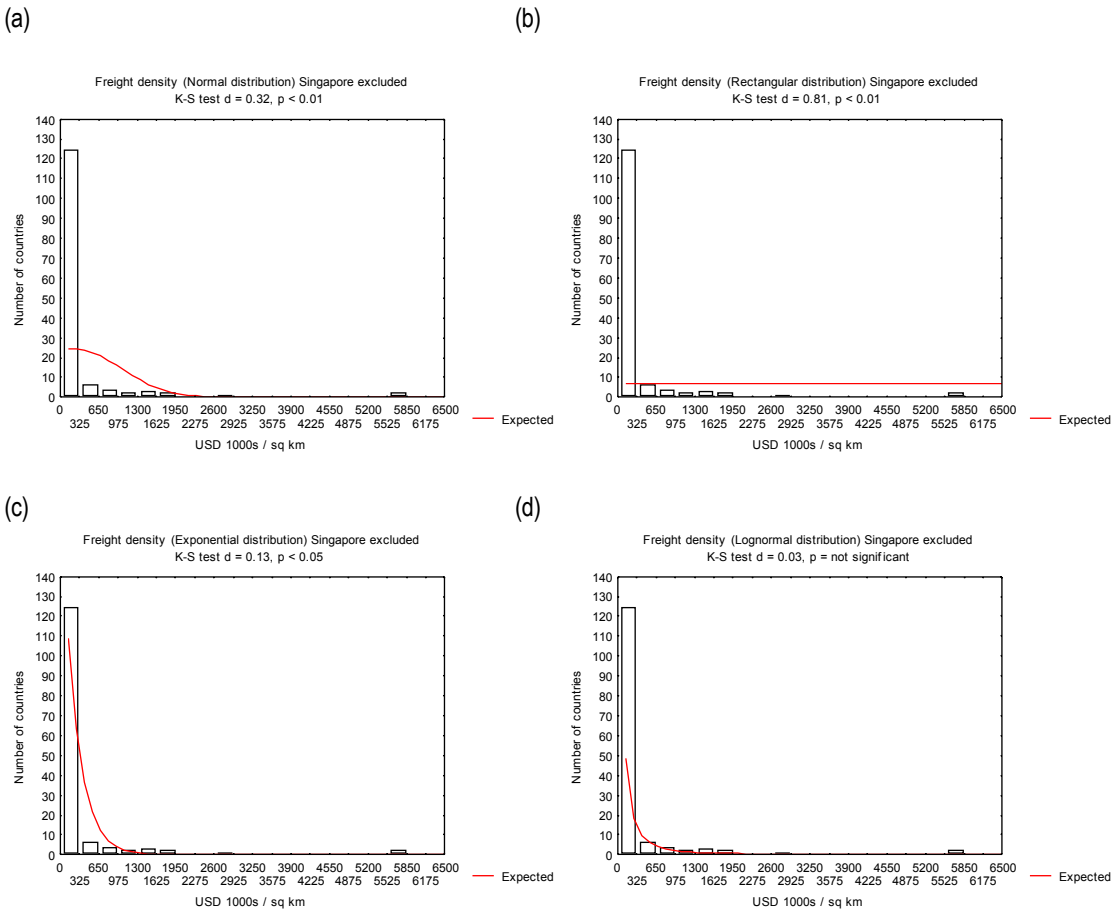


Figure 3: **Kolmogorov-Smirnov goodness-of-fit tests for freight density of countries (except Singapore) spread over 20 categories (bars) and compared with (a) normal, (b) rectangular, (c) exponential and (d) lognormal distributions (lines). Each observed distribution was compared with the expected line using a K-S test for goodness of fit. The lognormal distribution was the best fit of the observed data.**



3. Proposed EVI scaling and distribution of the data on this scale

Countries varied in freight density by six orders of magnitude, and there was a strong clumping of countries at the lower end of the scale. We propose that the data be transformed to their natural logarithms (LN) for this indicator to provide better spread among the countries and compress the scale to between –0.47 and 5.37, with countries having the greatest import densities being considered more vulnerable and attracting a higher EVI score. We identified those countries with ≤ 1 on the transformed (LN freight density) scale as likely to be the least at risk of environmental damage because the amount of imports is small in relation to the area of land available to absorb / attenuate any damage (less than $2,720 per sq km land, EVI score = 1). Countries with > 3.5 were considered the most vulnerable (EVI score =7) – these are the countries that in 1997 imported more than $33,000 of freight per sq km of their land area. The country values between these extremes were spaced evenly to form the EVI scale (Figure 4, Tables 2 and 3).

Figure 4: **Frequency distribution of LN Freight densities in even and uneven categories and the EVI scale. (a) Frequency distribution of LN Freight density in 20 even categories, showing that the transformed data are a good fit to the normal distribution. (b) is the same distribution compressed to a 7 category (even) scale. (c) Is the distribution of LN Freight density in seven uneven categories which clump countries with low and high freight densities. (d) The proposed EVI scale.**

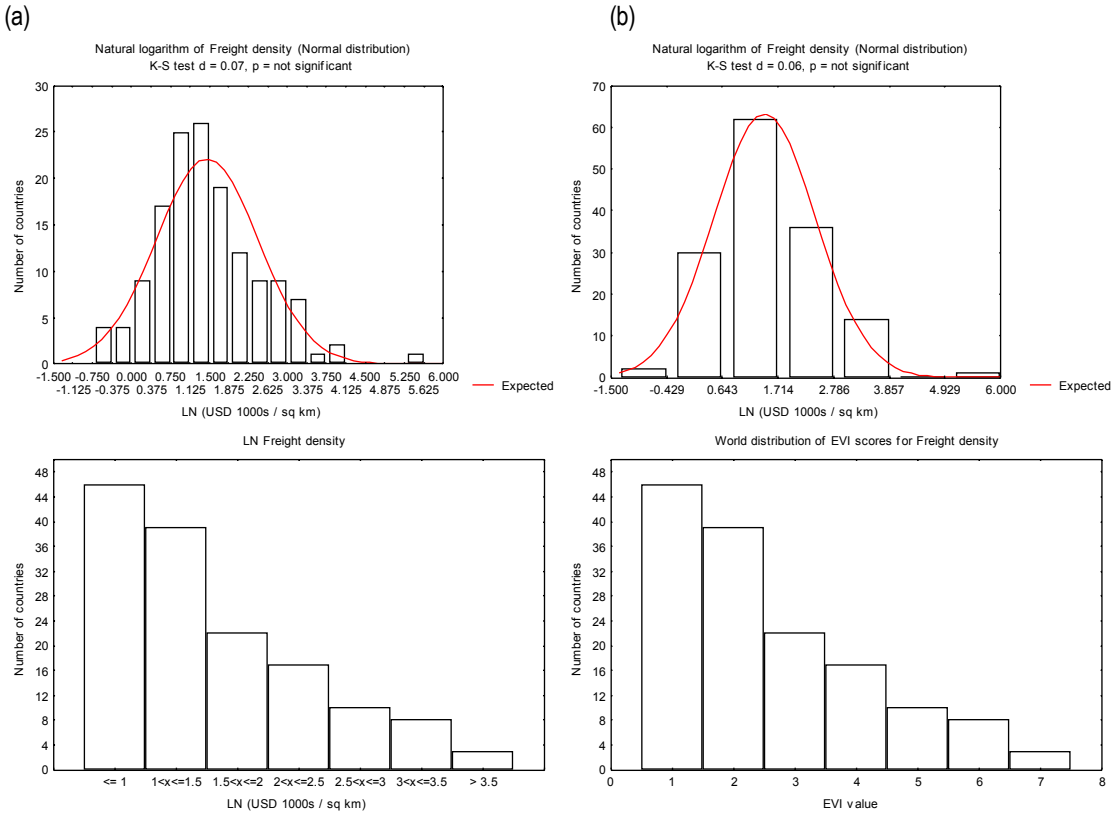


Table 2: **Proposed EVI scaling for freight density showing the number and % of countries falling in each EVI scoring category. NA=Not applicable in a country; ND=No data currently available.**

EVI Scale	Range of values (LN)	Observed # countries	Observed % of countries
1	X<=1	46	31.72
2	1<X<=1.5	39	26.90
3	1.5<X<=2	22	15.17
4	2<X<=2.5	17	11.72
5	2.5<X<=3	10	6.90
6	3<X<=3.5	8	5.52
7	X>3.5	3	2.07
No data		90	62.07
NA		☒ May not be used	
ND		☑ May be used (results in no score)	

Table 3: Proposed EVI scaling for Indicator 18 on freight density showing equivalence on the LN and untransformed scales and examples of countries that fit into each of the EVI scores.

Score	Scale for LN Freight density	Equivalent scale in USD 1000s / sq km	Examples
EVI=1	X<=1	X <= 2.72	Angola, Cameroon, Kazakhstan,
EVI=2	1<X<=1.5	2.72 < X <= 4.48	India, Nigeria, Syria
EVI=3	1.5<X<=2	4.48 < X <= 7.34	Indonesia, Mexico, Vietnam
EVI=4	2<X<=2.5	7.34 < X <= 12.18	Finland, Greece, Sri Lanka
EVI=5	2.5<X<=3	12.18 < X <= 20.09	Ireland, Kuwait, Portugal
EVI=6	3<X<=3.5	20.09 < X <= 33.12	Switzerland, UK, Japan
EVI=7	X>3.5	X > 33.12	Belgium, Netherlands, Singapore

4. Correlations with other indicators

Correlations with other indicators are to be assessed at a later date when scales have been set for all indicators.

5. Age, completeness and quality of the data

The data obtained for this indicator were from WRI 2000-2001 and from in-country sources. The two sources could not be merged to extend the number of countries with data because they were given in different scales (WRI in USD and in-country in tonnes). Data were expected to be averages over 5 years (1996-2000) but those provided by WRI were from a single year (1997).

Although the dollar freight import values provide a proxy for the risks to the natural environment from imports, it is likely that tonnage of freight would be a better measure. Dollar values will bias the data towards high value goods that as freight imports might not be of significance to the environment (except as waste). These might include finished metals and electronic goods. The higher weight / volume goods of lower dollar value may be of more significance from and environmental perspective, including food, genetically modified organisms, agricultural chemicals, ores etc.

In-country data were available for 14 of the 32 collaborating countries, with data being of good age, completeness and quality (all >2 of 3) (Table 4).

Table 4: Characteristics of age, completeness and quality of the data obtained for earthquakes in 238 countries.

Characteristic	Age	Completeness	Quality
Value of 3	Most recent data are <2 years old	Data are complete and relevant for the time frame required	Data are well supported by publications, records or other documentation and are considered accurate.
Value of 2	Most recent data are from between 1995 and 1999	Partial data are available for some regions and/or some years	Data are based on incomplete information and/or are completed through statistical projections (interpolation or extrapolation)
Value of 1	Most recent data are older than 1995	Data are not available for this indicator for the country	Data are based on best guesses
In-country score	2.36	2.50	2.79
Valid n (in-country)	14	14	14
SD (in-country)	0.50	0.65	0.58
SE (in-country)	0.13	0.17	0.15

6. Variations among sources of data

Alternative appropriate sources of data are not at present available for this indicator.

7. ISO Codes of countries used in this analysis

AD, AE, AF, AG, AI, AL, AM, AN, AO, AQ, AR, AS, AT, AU, AW, AZ, BA, BB, BD, BE, BF, BG, BH, BI, BJ, BM, BN, BO, BR, BS, BT, BV, BW, BY, BZ, CA, CC, CF, CG, CH, CI, CK, CL, CM, CN, CO, CR, CU, CV, CX, CY, CZ, DE, DJ, DK, DO, DZ, EC, EE, EG, EH, ER, ES, ET, FI, FJ, FK, FM, FO, FR, GA, GB, GD, GE, GF, GH, GI, GL, GM, GN, GP, GQ, GR, GS, GT, GU, GW, GY, HK, HM, HN, HR, HT, HU, ID, IE, IL, IN, IO, IQ, IR, IS, IT, Jan Mayen, JM, JO, JP, KE, KG, KH, KI, KM, KN, KP, KR, KW, KY, KZ, LA, LB, LC, LI, LK, LR, LS, LT, LU, LV, LY, MA, Macedonia, MC, MD, MG, MH, MI, MM, MN, MO, MP, MQ, MR, MS, MT, MU, MV, MW, MX, MY, MZ, NA, NC, NE, NF, NG, NI, NL, NO, NP, NR, NU, NZ, OM, PA, PE, PF, PG, PH, PK, PL, PM, PN, PR, PT, PW, PY, QA, RE, RO, RU, RW, SA, SB, SC, SD, SE, SG, SH, SI, SJ, SK, SL, SM, SN, SO, SR, ST, SV, SY, SZ, TC, TD, TG, TH, TJ, TK, TM, TN, TO, TR, TT, TV, TW, TZ, UA, UG, US, UY, UZ, VA, VC, VE, VG, VI, VN, VU, WF, WS, YE, YT, YU, ZA, ZM, ZR, ZW.

7.5 Demonstration EVI Scores for 235 Countries

In the pages that follow we present rank order Demonstration EVI values for 235 countries. The rank order is given here, as a means of organising the results, but is not the key message of the EVI. Of more importance are the relative scores attributable to risk exposure (REI), intrinsic resilience (IRI) and acquired vulnerability (EDI), in addition to how these values change through time. For any particular country vulnerability may increase or decrease through time, and it is here that policies, economic, social and cultural behaviours at the scale of the country are likely to have the most impact.

Table 8: Demonstration EVI scores for 235 countries.

Countries are ranked according to their overall EVI values, from most to least vulnerable of those examined. Note that this is a **Demonstration EVI** only. The country values given here are fully functional but lack data for at least 13 indicators (of 54) for which we could not find public data sources. They may also lack data on an individual basis for other indicators. This means that we were unable to reach the 80% data requirement threshold for a valid EVI for any country (highest value was 74%). Values given are overall EVI; the REI, IRI and EDI sub-indices; and values for indicators grouped into environmental sectors each followed by the number and/or percent of indicators over which they were calculated. EVI=Environmental Vulnerability Index (54 indicators); REI=Risk Exposure Sub-Index (27 indicators); IRI=Intrinsic Resilience Sub-Index (8 indicators); EDI=Environmental Degradation Sub-Index (19 indicators); Met=Meteorological (6) indicators; Geo=Geological (5) indicators; Bio=Biological (9) indicators; CC=Country Characteristics (=IRI); Anthro=Anthropogenic (26) indicators.

Rank	ISO	Country	EVI	#	%	REI	%	IRI	%	EDI	%	Met	%Met	Geo	%G	Bio	%B	CC	%CC	Anthro	%A
1	AS	American Samoa	4.37	19	35%	3.86	26%	4.80	63%	4.57	37%	-	0	3.00	0.6	6.00	0.67	4.80	63%	2.80	19%
2	SG	Singapore	* 4.33	36	67%	4.93	56%	3.17	75%	4.20	79%	-	0	1.00	0.6	5.75	0.89	3.17	75%	4.63	73%
3	GU	Guam	4.25	20	37%	3.25	30%	4.40	63%	5.29	37%	-	0	1.00	0.6	5.67	0.67	4.40	63%	4.33	23%
4	MV	Maldives	* 4.21	19	35%	4.14	26%	5.60	63%	3.29	37%	-	0	1.00	0.6	4.80	0.56	5.60	63%	4.17	23%
5	NR	Nauru	* 4.18	28	52%	3.67	33%	4.17	75%	4.54	68%	-	0	1.00	0.6	5.29	0.78	4.17	75%	4.33	46%
6	BB	Barbados	* 4.17	24	44%	3.75	30%	3.50	75%	4.90	53%	-	0	1.00	0.6	5.83	0.67	3.50	75%	4.56	35%
7	VG	British Virgin Islands	4.07	15	28%	3.50	22%	5.75	50%	3.40	26%	-	0	1.00	0.6	5.00	0.33	5.75	50%	4.00	19%
8	PH	Philippines	* 4.03	39	72%	4.00	59%	3.00	75%	4.41	89%	-	0	4.75	0.8	3.75	0.89	3.00	75%	4.29	81%
9	VI	United States Virgin Islands	4.00	17	31%	4.00	22%	4.60	63%	3.50	32%	-	0	1.00	0.6	5.20	0.56	4.60	63%	4.00	15%
10	MT	Malta	* 4.00	23	43%	3.88	30%	4.00	63%	4.10	53%	-	0	1.00	0.6	5.00	0.67	4.00	63%	4.33	35%
11	MU	Mauritius	* 4.00	23	43%	3.38	30%	3.60	63%	4.70	53%	-	0	1.00	0.6	5.67	0.67	3.60	63%	4.11	35%
12	TK	Tokelau	4.00	20	37%	2.67	22%	6.40	63%	3.56	47%	-	0	1.00	0.6	4.17	0.67	6.40	63%	3.33	23%
13	KY	Cayman Islands	3.95	20	37%	2.86	26%	5.00	63%	4.25	42%	-	0	1.00	0.6	5.33	0.67	5.00	63%	3.17	23%
14	MO	Macau	3.94	17	31%	4.75	30%	3.80	63%	2.50	21%	-	0	1.00	0.6	5.00	0.33	3.80	63%	5.00	23%
15	JP	Japan	3.92	39	72%	4.47	63%	3.00	75%	3.69	84%	-	0	5.25	0.8	3.63	0.89	3.00	75%	4.05	81%
16	NL	Netherlands	3.92	39	72%	4.53	63%	2.17	75%	3.94	84%	-	0	1.00	0.6	4.13	0.89	2.17	75%	4.73	85%

Rank	ISO	Country		EVI	#	%	REI	%	IRI	%	EDI	%	Met	%Met	Geo	%G	Bio	%B	CC	%CC	Anthro	%A
17	LB	Lebanon		3.92	38	70%	3.88	59%	2.83	75%	4.38	84%	-	0	1.00	0.8	3.63	0.89	2.83	75%	4.95	77%
18	TT	Trinidad and Tobago	*	3.92	36	67%	4.25	59%	2.67	75%	4.07	74%	-	0	1.33	0.6	3.00	0.78	2.67	75%	5.00	77%
19	MQ	Martinique		3.89	19	35%	3.00	26%	3.60	63%	5.00	37%	-	0	1.00	0.8	5.33	0.67	3.60	63%	5.00	15%
20	IN	India		3.87	38	70%	3.53	56%	3.17	75%	4.41	89%	-	0	3.00	0.8	3.13	0.89	3.17	75%	4.55	77%
21	IT	Italy		3.85	40	74%	4.06	67%	3.33	75%	3.81	84%	-	0	3.25	0.8	3.50	0.89	3.33	75%	4.23	85%
22	JM	Jamaica	*	3.84	38	70%	3.50	59%	3.83	75%	4.19	84%	-	0	1.50	0.8	4.25	0.89	3.83	75%	4.15	77%
23	GP	Guadeloupe		3.83	18	33%	3.17	22%	3.00	63%	5.00	37%	-	0	1.00	0.6	5.33	0.67	3.00	63%	4.75	15%
24	RE	Réunion		3.79	19	35%	3.29	26%	4.00	63%	4.14	37%	-	0	1.00	0.6	4.83	0.67	4.00	63%	4.00	19%
25	KR	Korea, Rep		3.79	38	70%	4.56	59%	2.50	75%	3.50	84%	-	0	2.50	0.8	4.14	0.78	2.50	75%	4.29	81%
26	BE	Belgium		3.78	37	69%	4.00	59%	2.33	75%	4.13	79%	-	0	1.00	0.6	3.57	0.78	2.33	75%	4.67	81%
27	TO	Tonga	*	3.78	27	50%	3.30	37%	4.50	75%	3.82	58%	-	0	3.33	0.6	4.67	0.67	4.50	75%	3.08	46%
28	CK	Cook Islands	*	3.77	31	57%	3.25	44%	4.67	75%	3.85	68%	-	0	1.00	0.6	6.17	0.67	4.67	75%	3.06	62%
29	TV	Tuvalu	*	3.76	29	54%	2.82	41%	5.50	75%	3.75	63%	-	0	1.00	0.6	4.83	0.67	5.50	75%	3.14	54%
30	PK	Pakistan		3.75	36	67%	3.44	59%	3.17	75%	4.36	74%	-	0	2.25	0.8	3.00	0.78	3.17	75%	4.53	73%
31	FM	FSM	*	3.74	27	50%	2.56	33%	4.50	75%	4.25	63%	-	0	1.00	0.6	5.67	0.67	4.50	75%	3.08	46%
32	SC	Seychelles		3.73	22	41%	3.38	30%	3.60	63%	4.11	47%	-	0	1.00	0.6	5.67	0.67	3.60	63%	3.38	31%
33	IL	Israel		3.72	36	67%	3.73	56%	3.00	75%	4.00	79%	-	0	1.00	0.8	4.38	0.89	3.00	75%	4.28	69%
34	KI	Kiribati	*	3.70	30	56%	2.00	37%	4.83	75%	4.43	74%	-	0	1.00	0.6	4.43	0.78	4.83	75%	3.43	54%
35	MS	Monserrat		3.68	19	35%	3.29	26%	4.40	63%	3.57	37%	-	0	3.00	0.6	4.60	0.56	4.40	63%	2.67	23%
36	GB	United Kingdom		3.66	38	70%	4.06	63%	2.67	75%	3.60	79%	-	0	1.33	0.6	3.29	0.78	2.67	75%	4.36	85%
37	LC	Saint Lucia	*	3.64	22	41%	2.86	26%	3.60	63%	4.20	53%	-	0	1.00	0.6	6.00	0.67	3.60	63%	2.88	31%
38	BM	Bermuda		3.63	19	35%	3.57	26%	3.80	63%	3.57	37%	-	0	1.00	0.6	5.00	0.67	3.80	63%	3.40	19%
39	SI	Slovenia		3.63	38	70%	3.50	67%	2.83	75%	4.14	74%	-	0	1.00	0.8	4.00	0.78	2.83	75%	4.24	81%
40	KN	St. Kitts and Nevis		3.60	20	37%	2.71	26%	4.60	63%	3.75	42%	-	0	1.00	0.6	4.17	0.67	4.60	63%	3.50	23%
41	PR	Puerto Rico		3.59	22	41%	2.75	30%	3.80	63%	4.22	47%	-	0	2.25	0.8	4.33	0.67	3.80	63%	3.57	27%
42	MP	Nothern Mariana Islands		3.58	19	35%	2.88	30%	4.40	63%	3.83	32%	-	0	1.00	0.6	5.00	0.44	4.40	63%	3.29	27%
43	BD	Bangladesh	*	3.58	38	70%	3.63	59%	2.17	75%	4.06	84%	-	0	1.25	0.8	2.75	0.89	2.17	75%	4.80	77%
44	BH	Bahrain		3.57	21	39%	3.57	26%	3.20	63%	3.78	47%	-	0	1.00	0.6	3.67	0.67	3.20	63%	4.86	27%
45	GD	Grenada		3.57	21	39%	3.00	26%	3.80	63%	3.89	47%	-	0	1.00	0.6	4.83	0.67	3.80	63%	3.43	27%
46	NF	Norfolk Island		3.56	16	30%	2.50	22%	4.40	63%	4.00	26%	-	0	1.00	0.6	7.00	0.33	4.40	63%	2.20	19%
47	CN	China		3.55	38	70%	3.19	59%	3.33	75%	4.00	84%	-	0	2.25	0.8	3.38	0.89	3.33	75%	3.95	77%
48	PF	French Polynesia		3.55	20	37%	2.13	30%	4.40	63%	4.57	37%	-	0	1.67	0.6	4.67	0.67	4.40	63%	2.67	23%
49	AT	Austria		3.53	36	67%	4.00	59%	3.00	75%	3.21	74%	-	0	2.50	0.8	3.29	0.78	3.00	75%	4.00	73%
50	AG	Antigua & Barbuda		3.50	20	37%	3.43	26%	4.20	63%	3.13	42%	-	0	1.00	0.6	4.67	0.67	4.20	63%	3.00	23%

Rank	ISO	Country	EVI	#	%	REI	%	IRI	%	EDI	%	Met	%Met	Geo	%G	Bio	%B	CC	%CC	Anthro	%A
51	BN	Brunei Darussalam	3.50	22	41%	2.63	30%	4.00	50%	4.00	53%	-	0	1.00	0.6	3.50	0.67	4.00	50%	4.11	35%
52	VN	Viet Nam	3.49	35	65%	3.47	56%	2.50	75%	3.93	74%	-	0	2.50	0.8	2.83	0.67	2.50	75%	4.21	73%
53	AN	Netherlands Antilles	3.47	19	35%	3.67	22%	3.20	63%	3.50	42%	-	0	1.00	0.6	4.17	0.67	3.20	63%	4.40	19%
54	ES	Spain	3.46	39	72%	3.35	63%	2.67	75%	3.88	84%	-	0	2.25	0.8	3.63	0.89	2.67	75%	3.86	81%
55	MH	Marshall Islands *	3.45	29	54%	3.64	41%	5.17	75%	2.42	63%	-	0	1.00	0.6	2.83	0.67	5.17	75%	3.50	54%
56	SV	El Salvador	3.43	37	69%	3.27	56%	2.67	75%	3.88	84%	-	0	1.25	0.8	3.38	0.89	2.67	75%	4.16	73%
57	HU	Hungary	3.43	35	65%	3.80	56%	2.67	75%	3.36	74%	-	0	1.00	0.6	3.29	0.78	2.67	75%	4.11	73%
58	VC	St. Vincent & the Grenadines	3.41	22	41%	2.63	30%	3.80	63%	3.89	47%	-	0	1.00	0.8	5.00	0.67	3.80	63%	3.14	27%
59	CY	Cyprus	3.40	25	46%	2.60	37%	3.40	63%	4.20	53%	-	0	1.25	0.8	3.33	0.67	3.40	63%	4.30	38%
60	MC	Monaco	3.39	18	33%	4.33	33%	3.60	63%	1.00	21%	-	0	1.00	0.6	4.00	0.22	3.60	63%	4.00	31%
61	HT	Haiti	3.38	37	69%	2.40	56%	3.67	75%	4.19	84%	-	0	1.00	0.8	3.25	0.89	3.67	75%	3.84	73%
62	SY	Syrian Arab Rep	3.38	37	69%	2.60	56%	2.33	75%	4.50	84%	-	0	1.00	0.8	2.63	0.89	2.33	75%	4.53	73%
63	DE	Germany	3.38	40	74%	3.89	67%	2.67	75%	3.06	84%	-	0	1.00	0.8	2.88	0.89	2.67	75%	4.18	85%
64	DK	Denmark	3.36	39	72%	3.82	63%	2.33	75%	3.25	84%	-	0	1.00	0.6	3.88	0.89	2.33	75%	3.77	85%
65	LK	Sri Lanka	3.35	40	74%	3.00	67%	2.67	75%	4.00	84%	-	0	1.00	0.8	3.75	0.89	2.67	75%	3.82	85%
66	NG	Nigeria	3.34	38	70%	2.94	59%	2.00	75%	4.25	84%	-	0	2.50	0.8	3.00	0.89	2.00	75%	4.05	77%
67	AI	Anguilla	3.33	18	33%	2.43	26%	3.60	63%	4.17	32%	-	0	1.00	0.6	5.75	0.44	3.60	63%	2.67	23%
68	FR	France	3.33	40	74%	3.44	67%	2.83	75%	3.38	84%	-	0	2.50	0.8	3.63	0.89	2.83	75%	3.50	85%
69	TR	Turkey	3.32	38	70%	2.88	63%	3.17	75%	3.87	79%	-	0	2.00	0.8	2.71	0.78	3.17	75%	3.81	81%
70	GI	Gibraltar	3.31	16	30%	3.57	26%	3.60	63%	2.50	21%	-	0	1.00	0.6	5.00	0.33	3.60	63%	3.40	19%
71	HK	Hong Kong	3.31	16	30%	2.50	15%	3.50	50%	3.63	42%	-	0	1.00	0.6	4.67	0.33	3.50	50%	3.67	23%
72	YT	Mayotte	3.31	16	30%	3.00	22%	3.40	63%	3.60	26%	-	0	1.00	0.6	5.75	0.44	3.40	63%	2.50	15%
73	PW	Palau *	3.31	29	54%	2.42	44%	4.17	75%	3.82	58%	-	0	1.00	0.6	4.50	0.67	4.17	75%	2.93	54%
74	CR	Costa Rica *	3.31	39	72%	3.76	63%	2.50	75%	3.13	84%	-	0	3.25	0.8	3.00	0.89	2.50	75%	3.67	81%
75	CU	Cuba	3.31	36	67%	2.93	52%	3.17	75%	3.69	84%	-	0	1.00	0.8	3.14	0.78	3.17	75%	3.89	73%
76	ID	Indonesia	3.30	40	74%	3.44	67%	2.83	75%	3.31	84%	-	0	5.25	0.8	2.75	0.89	2.83	75%	3.27	85%
77	KW	Kuwait	3.30	37	69%	3.31	59%	2.33	75%	3.67	79%	-	0	1.00	0.6	2.88	0.89	2.33	75%	4.10	77%
78	IQ	Iraq	3.29	35	65%	2.31	48%	2.33	75%	4.44	84%	-	0	1.00	0.8	2.86	0.78	2.33	75%	4.28	69%
79	KP	Korea, Dem People's Rep	3.28	32	59%	3.36	41%	2.50	75%	3.53	79%	-	0	1.25	0.8	3.33	0.67	2.50	75%	4.06	62%
80	PL	Poland	3.27	37	69%	3.44	59%	2.33	75%	3.47	79%	-	0	1.00	0.6	3.38	0.89	2.33	75%	3.85	77%
81	IO	British Indian Ocean Territory	3.27	15	28%	1.83	22%	5.60	63%	2.50	21%	-	0	1.00	0.6	4.33	0.33	5.60	63%	1.25	15%
82	CX	Christmas Islands	3.25	16	30%	2.17	22%	4.20	63%	3.60	26%	-	0	1.00	0.6	7.00	0.33	4.20	63%	1.40	19%
83	YU	Yugoslavia	3.24	33	61%	3.07	56%	2.50	75%	3.83	63%	-	0	1.00	0.8	2.50	0.44	2.50	75%	4.11	73%
84	AZ	Azerbaijan	3.24	34	63%	3.15	48%	3.00	75%	3.40	79%	-	0	2.75	0.8	2.13	0.89	3.00	75%	4.00	62%

Rank	ISO	Country	EVI	#	%	REI	%	IRI	%	EDI	%	Met	%Met	Geo	%G	Bio	%B	CC	%CC	Anthro	%A
85	LI	Liechtenstein	3.23	22	41%	3.38	30%	3.40	63%	3.00	47%	-	0	1.00	0.8	5.60	0.56	3.40	63%	2.75	31%
86	RO	Romania	3.21	38	70%	3.67	67%	2.33	75%	3.00	74%	-	0	2.50	0.8	2.88	0.89	2.33	75%	3.75	77%
87	TW	Taiwan	3.21	19	35%	3.44	33%	3.25	50%	2.83	32%	-	0	1.25	0.8	2.25	0.44	3.25	50%	4.86	27%
88	TC	Turks & Caicos Islands	3.21	19	35%	2.43	26%	5.40	63%	2.43	37%	-	0	1.00	0.6	3.60	0.56	5.40	63%	2.17	23%
89	CH	Switzerland	3.18	38	70%	4.12	63%	2.67	75%	2.33	79%	-	0	2.50	0.8	3.29	0.78	2.67	75%	3.43	81%
90	PT	Portugal	3.18	40	74%	3.22	67%	2.33	75%	3.44	84%	-	0	1.00	0.8	3.88	0.89	2.33	75%	3.55	85%
91	SM	San Marino	3.17	18	33%	3.57	26%	3.20	63%	2.67	32%	-	0	1.00	0.6	5.00	0.33	3.20	63%	3.29	27%
92	WF	Wallis & Futuna Islands	3.17	18	33%	2.17	22%	4.80	63%	2.86	37%	-	0	1.00	0.6	3.80	0.56	4.80	63%	2.20	19%
93	HR	Croatia	3.16	37	69%	3.00	67%	2.50	75%	3.69	68%	-	0	1.00	0.8	2.86	0.78	2.50	75%	3.90	77%
94	ZA	South Africa	3.16	38	70%	2.75	59%	2.00	75%	4.00	84%	-	0	1.00	0.8	3.00	0.89	2.00	75%	4.00	77%
95	IR	Iran, Islamic Rep	3.15	39	72%	2.94	63%	2.67	75%	3.56	84%	-	0	2.75	0.8	2.50	0.89	2.67	75%	3.62	81%
96	MY	Malaysia	3.15	40	74%	3.44	67%	2.50	75%	3.06	84%	-	0	2.50	0.8	3.25	0.89	2.50	75%	3.41	85%
97	GT	Guatemala	3.13	38	70%	3.13	59%	2.50	75%	3.38	84%	-	0	3.00	0.8	2.88	0.89	2.50	75%	3.45	77%
98	MAC	Macedonia, FYR	3.10	29	54%	3.08	44%	2.17	75%	3.64	58%	-	0	1.00	0.8	2.50	0.67	2.17	75%	4.46	50%
99	JO	Jordan	3.10	39	72%	2.65	63%	2.17	75%	3.94	84%	-	0	1.00	0.8	2.63	0.89	2.17	75%	3.95	81%
100	GR	* Greece	3.10	40	74%	2.94	67%	3.00	75%	3.31	84%	-	0	1.50	0.8	3.00	0.89	3.00	75%	3.45	85%
101	DO	Dominican Rep	3.08	36	67%	2.71	52%	3.33	75%	3.31	84%	-	0	1.25	0.8	3.25	0.89	3.33	75%	3.33	69%
102	FJ	* Fiji	3.08	37	69%	2.93	56%	4.00	75%	2.88	84%	-	0	1.33	0.6	3.38	0.89	4.00	75%	2.95	77%
103	TG	Togo	3.08	37	69%	2.53	56%	2.17	75%	3.94	84%	-	0	1.00	0.6	2.63	0.89	2.17	75%	3.85	77%
104	LU	Luxembourg	3.08	25	46%	4.00	33%	2.80	63%	2.45	58%	-	0	1.00	0.6	3.25	0.44	2.80	63%	3.62	50%
105	BA	Boznia and Herzegovina	3.06	31	57%	2.64	52%	2.17	75%	4.09	58%	-	0	2.50	0.8	2.00	0.56	2.17	75%	3.88	62%
106	MD	Moldova, Rep	3.06	33	61%	2.80	56%	1.83	75%	4.00	63%	-	0	1.00	0.6	3.33	0.67	1.83	75%	3.72	69%
107	AW	Aruba	3.06	18	33%	3.57	26%	3.40	63%	2.17	32%	-	0	1.00	0.6	3.60	0.56	3.40	63%	3.40	19%
108	AL	Albania	3.05	38	70%	2.35	63%	3.33	75%	3.73	79%	-	0	1.00	0.8	2.38	0.89	3.33	75%	3.65	77%
109	TH	* Thailand	3.05	41	76%	3.33	67%	2.33	75%	3.00	89%	-	0	1.00	0.8	2.88	0.89	2.33	75%	3.65	88%
110	WS	* Samoa	3.03	30	56%	2.25	44%	3.83	75%	3.42	63%	-	0	2.00	0.8	3.71	0.78	3.83	75%	2.62	50%
111	AE	United Arab Emirates	3.03	35	65%	2.62	48%	2.33	75%	3.63	84%	-	0	1.00	0.6	2.57	0.78	2.33	75%	3.74	73%
112	SH	St. Helena	3.00	17	31%	2.00	22%	3.80	63%	3.33	32%	-	0	1.00	0.6	6.00	0.44	3.80	63%	1.00	19%
113	CZ	Czech Rep	3.00	32	59%	3.36	52%	2.00	75%	3.08	63%	-	0	1.00	0.8	3.00	0.67	2.00	75%	3.88	62%
114	EG	Egypt	3.00	39	72%	2.82	63%	2.33	75%	3.44	84%	-	0	1.00	0.8	2.63	0.89	2.33	75%	3.71	81%
115	TN	Tunisia	3.00	38	70%	2.88	59%	2.33	75%	3.38	84%	-	0	1.00	0.8	2.50	0.89	2.33	75%	3.80	77%
116	CC	Cocos (Keeling) Islands	3.00	13	24%	2.50	22%	4.40	63%	1.00	11%	-	0	1.33	0.6	7.00	0.11	4.40	63%	1.50	15%
117	BG	Bulgaria	2.97	39	72%	2.78	67%	2.67	75%	3.33	79%	-	0	1.00	0.8	3.00	0.89	2.67	75%	3.43	81%
118	IE	Ireland	2.97	39	72%	2.76	63%	2.67	75%	3.31	84%	-	0	1.00	0.6	3.75	0.89	2.67	75%	3.05	85%

Rank	ISO	Country	EVI	#	%	REI	%	IRI	%	EDI	%	Met	%Met	Geo	%G	Bio	%B	CC	%CC	Anthro	%A
119	LT	Lithuania	2.97	37	69%	2.81	59%	2.17	75%	3.47	79%	-	0	1.00	0.6	3.50	0.89	2.17	75%	3.30	77%
120	NP	* Nepal	2.97	36	67%	2.60	56%	3.17	75%	3.27	79%	-	0	2.25	0.8	2.57	0.78	3.17	75%	3.21	73%
121	FO	Faroe Islands	2.94	17	31%	2.00	22%	3.80	63%	3.17	32%	-	0	1.00	0.6	4.75	0.44	3.80	63%	1.80	19%
122	PM	St. Pierre & Miquelon	2.94	17	31%	3.00	26%	3.40	63%	2.40	26%	-	0	1.00	0.6	4.25	0.44	3.40	63%	2.60	19%
123	UZ	Uzbekistan	2.94	34	63%	2.86	52%	2.50	75%	3.21	74%	-	0	2.50	0.8	2.29	0.78	2.50	75%	3.47	65%
124	AF	Afghanistan	2.94	32	59%	2.42	44%	3.00	75%	3.36	74%	-	0	2.25	0.8	2.40	0.56	3.00	75%	3.24	65%
125	HM	Heard & McDonald Islands	2.93	14	26%	2.20	19%	4.00	63%	2.50	21%	-	0	1.00	0.6	5.00	0.33	4.00	63%	1.00	12%
126	CO	Colombia	2.92	39	72%	3.29	63%	2.67	75%	2.63	84%	-	0	3.75	0.8	2.63	0.89	2.67	75%	2.95	81%
127	KM	Comoros	2.91	22	41%	2.13	30%	4.00	63%	3.00	47%	-	0	1.00	0.8	3.00	0.67	4.00	63%	3.14	27%
128	VA	Vatican City State (Holy See)	2.90	10	19%	3.00	11%	4.25	50%	1.00	16%	-	0	1.00	0.4	-	0.00	4.25	50%	2.50	15%
129	MX	Mexico	2.89	38	70%	3.20	56%	2.33	75%	2.82	89%	-	0	3.00	0.8	2.88	0.89	2.33	75%	3.05	77%
130	BI	Burundi	2.88	34	63%	2.43	52%	2.33	75%	3.57	74%	-	0	1.00	0.8	2.57	0.78	2.33	75%	3.65	65%
131	PN	Pitcairn	2.88	16	30%	2.20	19%	4.60	63%	2.00	32%	-	0	1.00	0.6	4.00	0.44	4.60	63%	1.00	15%
132	MA	Morocco	2.87	39	72%	2.35	63%	2.50	75%	3.56	84%	-	0	1.00	0.8	2.63	0.89	2.50	75%	3.43	81%
133	BV	Bouvet Island	2.87	15	28%	2.17	22%	4.00	63%	2.50	21%	-	0	1.00	0.6	5.00	0.33	4.00	63%	1.25	15%
134	RW	Rwanda	2.85	34	63%	2.57	52%	2.67	75%	3.21	74%	-	0	1.00	0.8	2.71	0.78	2.67	75%	3.41	65%
135	GH	Ghana	2.82	38	70%	2.56	59%	1.83	75%	3.44	84%	-	0	1.00	0.6	2.75	0.89	1.83	75%	3.38	81%
136	PE	Peru	2.82	38	70%	2.44	59%	2.50	75%	3.31	84%	-	0	3.50	0.8	2.63	0.89	2.50	75%	2.85	77%
137	UA	Ukraine	2.82	38	70%	2.71	63%	2.17	75%	3.20	79%	-	0	1.00	0.8	2.57	0.78	2.17	75%	3.43	81%
138	SL	Sierra Leone	2.81	37	69%	2.00	56%	2.33	75%	3.75	84%	-	0	1.00	0.8	2.63	0.89	2.33	75%	3.42	73%
139	BJ	Benin	2.81	36	67%	2.27	56%	2.00	75%	3.67	79%	-	0	1.00	0.6	3.13	0.89	2.00	75%	3.21	73%
140	EC	Ecuador	2.79	39	72%	3.18	63%	2.67	75%	2.44	84%	-	0	3.75	0.8	2.88	0.89	2.67	75%	2.62	81%
141	VE	Venezuela	2.79	39	72%	2.88	63%	2.67	75%	2.75	84%	-	0	2.75	0.8	2.50	0.89	2.67	75%	2.95	81%
142	YE	Yemen	2.79	38	70%	1.63	59%	2.50	75%	4.06	84%	-	0	1.00	0.8	2.50	0.89	2.50	75%	3.35	77%
143	MM	Myanmar (ie Burma)	2.75	36	67%	1.93	56%	2.60	63%	3.56	84%	-	0	1.00	0.8	2.63	0.89	2.60	63%	3.21	73%
144	BR	Brazil	2.74	39	72%	2.75	59%	2.33	75%	2.88	89%	-	0	2.50	0.8	2.38	0.89	2.33	75%	3.05	81%
145	SD	Sudan	2.74	38	70%	1.88	59%	3.17	75%	3.44	84%	-	0	1.00	0.8	2.38	0.89	3.17	75%	3.10	77%
146	SN	Senegal	2.74	38	70%	2.13	59%	2.17	75%	3.56	84%	-	0	1.00	0.6	2.75	0.89	2.17	75%	3.14	81%
147	SK	Slovakia	2.74	34	63%	3.31	59%	2.67	75%	2.00	63%	-	0	1.00	0.8	2.83	0.67	2.67	75%	3.11	69%
148	ST	Sao Tome & Principe	2.73	22	41%	2.00	33%	3.60	63%	3.00	42%	-	0	1.00	0.8	3.50	0.67	3.60	63%	2.43	27%
149	ZR	Congo, Dem Rep	2.70	33	61%	1.62	48%	2.67	75%	3.71	74%	-	0	1.00	0.6	2.38	0.89	2.67	75%	3.19	62%
150	NU	* Niue	2.69	29	54%	1.80	37%	4.17	75%	2.69	68%	-	0	1.00	0.6	3.86	0.78	4.17	75%	1.77	50%
151	AD	Andorra	2.65	20	37%	2.38	30%	3.00	63%	2.71	37%	-	0	1.00	0.8	5.00	0.33	3.00	63%	2.38	31%
152	SE	Sweden	2.64	39	72%	2.41	63%	2.83	75%	2.81	84%	-	0	1.00	0.8	2.50	0.89	2.83	75%	2.95	81%

Rank	ISO	Country	EVI	#	%	REI	%	IRI	%	EDI	%	Met	%Met	Geo	%G	Bio	%B	CC	%CC	Anthro	%A
153	MG	Madagascar	2.63	38	70%	2.06	59%	2.33	75%	3.31	84%	-	0	1.00	0.8	2.88	0.89	2.33	75%	2.95	77%
154	US	United States of America	2.63	38	70%	2.71	63%	2.50	75%	2.60	79%	-	0	2.00	0.8	2.43	0.78	2.50	75%	2.86	81%
155	KH	Cambodia	2.63	35	65%	2.21	52%	2.17	75%	3.20	79%	-	0	1.00	0.8	2.63	0.89	2.17	75%	3.18	65%
156	CV	Cape Verde	2.63	24	44%	1.67	33%	3.80	63%	2.90	53%	-	0	1.00	0.8	3.00	0.67	3.80	63%	2.44	35%
157	GN	Guinea	2.62	37	69%	2.00	56%	2.33	75%	3.31	84%	-	0	1.00	0.8	2.75	0.89	2.33	75%	3.00	73%
158	GM	Gambia	2.62	37	69%	2.27	56%	2.33	75%	3.06	84%	-	0	1.00	0.6	2.50	0.89	2.33	75%	3.00	77%
159	SA	Saudi Arabia	2.62	37	69%	1.94	59%	2.50	75%	3.40	79%	-	0	1.00	0.8	2.71	0.78	2.50	75%	2.95	77%
160	Jan Mayen	Jan Mayen	2.62	13	24%	2.20	19%	4.00	63%	1.00	16%	-	0	1.00	0.6	7.00	0.11	4.00	63%	1.00	15%
161	RU	Russian Federation	2.62	39	72%	2.18	63%	2.83	75%	3.00	84%	-	0	2.50	0.8	2.25	0.89	2.83	75%	2.71	81%
162	SB	Solomon Islands	2.61	33	61%	2.15	48%	3.83	75%	2.50	74%	-	0	3.00	0.6	2.38	0.89	3.83	75%	2.19	62%
163	GW	Guinea-Bissau	2.60	35	65%	1.92	48%	2.33	75%	3.25	84%	-	0	1.00	0.6	2.38	0.89	2.33	75%	3.06	69%
164	NZ	New Zealand *	2.60	40	74%	2.29	63%	3.33	75%	2.65	89%	-	0	1.50	0.8	2.75	0.89	3.33	75%	2.55	85%
165	NI	Nicaragua	2.59	37	69%	2.27	56%	2.33	75%	3.00	84%	-	0	1.75	0.8	2.38	0.89	2.33	75%	2.95	73%
166	DZ	Algeria	2.59	39	72%	1.94	63%	2.33	75%	3.38	84%	-	0	1.00	0.8	2.38	0.89	2.33	75%	3.05	81%
167	HN	Honduras	2.58	36	67%	2.21	52%	2.50	75%	2.94	84%	-	0	1.25	0.8	2.75	0.89	2.50	75%	2.83	69%
168	OM	Oman	2.56	39	72%	2.06	67%	2.33	75%	3.27	79%	-	0	1.00	0.8	2.71	0.78	2.33	75%	2.86	85%
169	UG	Uganda	2.56	34	63%	2.07	56%	2.33	75%	3.23	68%	-	0	2.00	0.8	2.17	0.67	2.33	75%	2.89	69%
170	LR	Liberia	2.54	35	65%	2.00	48%	2.33	75%	3.06	84%	-	0	1.00	0.8	2.29	0.78	2.33	75%	3.06	69%
171	AR	Argentina	2.54	39	72%	2.12	63%	2.67	75%	2.94	84%	-	0	1.00	0.8	2.43	0.78	2.67	75%	2.82	85%
172	ET	Ethiopia	2.53	34	63%	2.07	52%	2.50	75%	3.00	74%	-	0	1.50	0.8	1.86	0.78	2.50	75%	3.06	65%
173	LS	Lesotho	2.51	35	65%	2.00	48%	2.17	75%	3.06	84%	-	0	1.00	0.8	2.75	0.89	2.17	75%	2.88	65%
174	CL	Chile	2.50	38	70%	2.47	63%	3.00	75%	2.33	79%	-	0	2.00	0.8	2.75	0.89	3.00	75%	2.35	77%
175	EE	Estonia	2.50	38	70%	2.59	63%	2.17	75%	2.53	79%	-	0	1.00	0.6	2.88	0.89	2.17	75%	2.67	81%
176	LV	Latvia	2.50	38	70%	2.12	63%	2.17	75%	3.07	79%	-	0	1.00	0.6	3.25	0.89	2.17	75%	2.52	81%
177	VU	Vanuatu *	2.50	30	56%	1.82	41%	4.00	75%	2.38	68%	-	0	3.33	0.6	2.50	0.67	4.00	75%	1.73	58%
178	MZ	Mozambique	2.49	35	65%	2.15	48%	2.33	75%	2.81	84%	-	0	2.50	0.8	2.25	0.89	2.33	75%	2.65	65%
179	CI	Cote d'Ivoire	2.47	36	67%	2.07	52%	2.17	75%	2.94	84%	-	0	1.00	0.6	3.29	0.78	2.17	75%	2.50	77%
180	GE	Georgia	2.46	35	65%	1.93	52%	3.00	75%	2.73	79%	-	0	1.00	0.8	1.88	0.89	3.00	75%	2.88	65%
181	AM	Armenia	2.45	33	61%	2.21	52%	2.67	75%	2.62	68%	-	0	1.25	0.8	2.17	0.67	2.67	75%	2.76	65%
182	NC	New Caledonia	2.45	20	37%	1.14	26%	4.00	63%	2.63	42%	-	0	1.00	0.6	3.17	0.67	4.00	63%	1.17	23%
183	KE	Kenya *	2.45	38	70%	1.81	59%	2.67	75%	3.00	84%	-	0	1.00	0.8	2.63	0.89	2.67	75%	2.60	77%
184	ER	Eritrea	2.44	34	63%	1.67	56%	2.50	75%	3.31	68%	-	0	1.00	0.8	1.33	0.67	2.50	75%	3.11	69%
185	BT	Bhutan	2.42	33	61%	2.00	44%	3.00	75%	2.53	79%	-	0	1.00	0.8	2.00	0.78	3.00	75%	2.75	62%
186	IS	Iceland	2.42	38	70%	1.76	63%	3.00	75%	2.93	79%	-	0	2.25	0.8	3.13	0.89	3.00	75%	2.00	77%

Rank	ISO	Country	EVI	#	%	REI	%	IRI	%	EDI	%	Met	%Met	Geo	%G	Bio	%B	CC	%CC	Anthro	%A
187	TM	Turkmenistan	2.41	32	59%	2.08	48%	2.17	75%	2.85	68%	-	0	1.25	0.8	2.33	0.67	2.17	75%	2.81	62%
188	TZ	Tanzania, United Rep	2.41	37	69%	1.80	56%	2.83	75%	2.81	84%	-	0	1.00	0.8	2.50	0.89	2.83	75%	2.53	73%
189	PA	Panama	2.39	38	70%	2.19	59%	2.67	75%	2.50	84%	-	0	1.00	0.8	3.00	0.89	2.67	75%	2.35	77%
190	SO	Somalia	2.39	31	57%	1.73	41%	2.17	75%	3.00	74%	-	0	1.00	0.8	2.33	0.67	2.17	75%	2.87	58%
191	TJ	Tajikistan	2.39	31	57%	2.42	44%	3.17	75%	2.00	68%	-	0	2.50	0.8	1.86	0.78	3.17	75%	2.29	54%
192	BS	Bahama	2.38	21	39%	1.29	26%	3.40	63%	2.67	47%	-	0	1.00	0.6	2.50	0.67	3.40	63%	2.14	27%
193	NO	Norway	2.38	40	74%	2.28	67%	2.67	75%	2.38	84%	-	0	1.00	0.8	2.63	0.89	2.67	75%	2.45	85%
194	MW	Malawi	2.36	36	67%	2.14	52%	2.50	75%	2.50	84%	-	0	1.00	0.8	2.75	0.89	2.50	75%	2.44	69%
195	UY	Uruguay	2.36	36	67%	2.38	59%	1.67	75%	2.64	74%	-	0	1.00	0.6	2.86	0.78	1.67	75%	2.60	77%
196	LY	Libyan Arab Jamahiriya	2.34	35	65%	1.46	48%	2.00	75%	3.19	84%	-	0	1.00	0.8	2.43	0.78	2.00	75%	2.72	69%
197	CM	Cameroon	2.33	39	72%	1.94	63%	2.50	75%	2.69	84%	-	0	1.00	0.8	2.50	0.89	2.50	75%	2.48	81%
198	KG	Kyrgyzstan *	2.31	35	65%	1.86	52%	3.00	75%	2.47	79%	-	0	1.00	0.8	2.14	0.78	3.00	75%	2.44	69%
199	FI	Finland	2.31	39	72%	2.35	63%	2.00	75%	2.38	84%	-	0	1.00	0.6	2.38	0.89	2.00	75%	2.55	85%
200	BO	Bolivia	2.27	37	69%	2.20	56%	2.67	75%	2.19	84%	-	0	2.50	0.8	2.14	0.78	2.67	75%	2.15	77%
201	BF	Burkina Faso	2.26	34	63%	1.92	48%	2.00	75%	2.67	79%	-	0	1.00	0.6	2.57	0.78	2.00	75%	2.44	69%
202	GQ	Equatorial Guinea	2.26	34	63%	1.69	48%	2.50	75%	2.67	79%	-	0	1.00	0.8	2.25	0.89	2.50	75%	2.50	62%
203	LA	Lao People's Dem Rep	2.26	34	63%	1.79	52%	2.33	75%	2.71	74%	-	0	1.00	0.8	2.43	0.78	2.33	75%	2.47	65%
204	AO	Angola	2.26	39	72%	1.76	63%	1.83	75%	2.94	84%	-	0	1.50	0.8	2.50	0.89	1.83	75%	2.43	81%
205	PG	PNG *	2.26	39	72%	2.25	59%	3.17	75%	1.94	89%	-	0	3.25	0.8	2.00	0.89	3.17	75%	1.90	81%
206	MR	Mauritania	2.25	36	67%	1.50	52%	1.67	75%	3.13	84%	-	0	1.00	0.6	2.38	0.89	1.67	75%	2.58	73%
207	QA	Qatar	2.24	21	39%	2.14	26%	2.40	63%	2.22	47%	-	0	1.00	0.6	1.80	0.56	2.40	63%	2.88	31%
208	PY	Paraguay	2.20	35	65%	2.21	52%	1.83	75%	2.33	79%	-	0	1.00	0.6	2.43	0.78	1.83	75%	2.42	73%
209	BY	Belarus	2.19	32	59%	2.38	48%	1.83	75%	2.15	68%	-	0	1.00	0.6	3.00	0.67	1.83	75%	2.24	65%
210	BZ	Belize	2.17	35	65%	2.23	48%	2.33	75%	2.06	84%	-	0	1.00	0.6	2.00	0.89	2.33	75%	2.39	69%
211	GS	Sth Georgia / Sth Sandwich Is.	2.17	12	22%	1.50	15%	3.50	50%	1.50	21%	-	0	1.00	0.4	2.33	0.33	3.50	50%	1.00	12%
212	MI	Mali	2.12	34	63%	1.69	48%	1.83	75%	2.60	79%	-	0	1.00	0.6	2.00	0.78	1.83	75%	2.44	69%
213	CG	Congo	2.11	37	69%	1.73	56%	2.17	75%	2.44	84%	-	0	1.00	0.6	2.13	0.89	2.17	75%	2.25	77%
214	NE	Niger	2.09	34	63%	1.62	48%	1.83	75%	2.60	79%	-	0	1.00	0.8	2.14	0.78	1.83	75%	2.41	65%
215	TD	Chad	2.09	35	65%	1.64	52%	2.00	75%	2.53	79%	-	0	1.00	0.8	2.00	0.78	2.00	75%	2.39	69%
216	GA	Gabon	2.06	35	65%	1.64	52%	2.00	75%	2.47	79%	-	0	1.00	0.6	2.00	0.89	2.00	75%	2.28	69%
217	AU	Australia *	2.03	39	72%	2.00	63%	2.00	75%	2.06	84%	-	0	2.25	0.8	2.00	0.89	2.00	75%	2.00	81%
218	KZ	Kazakhstan	2.00	37	69%	1.33	56%	2.50	75%	2.44	84%	-	0	1.00	0.8	2.13	0.89	2.50	75%	2.00	73%
219	CA	Canada	1.98	40	74%	1.72	67%	2.17	75%	2.19	84%	-	0	1.25	0.8	2.00	0.89	2.17	75%	2.05	85%
220	SR	Suriname	1.97	34	63%	1.77	48%	2.00	75%	2.13	79%	-	0	1.00	0.6	1.75	0.89	2.00	75%	2.24	65%

Rank	ISO	Country	EVI	#	%	REI	%	IRI	%	EDI	%	Met	%Met	Geo	%G	Bio	%B	CC	%CC	Anthro	%A
221	ZM	Zambia	1.94	35	65%	1.93	56%	2.33	75%	1.79	74%	-	0	1.00	0.8	1.50	0.67	2.33	75%	2.16	73%
222	ZW	Zimbabwe	1.94	34	63%	2.07	56%	2.00	75%	1.77	68%	-	0	1.00	0.8	1.60	0.56	2.00	75%	2.21	73%
223	DJ	Djibouti	1.91	22	41%	1.13	30%	2.60	63%	2.22	47%	-	0	1.00	0.8	1.40	0.56	2.60	63%	2.25	31%
224	CF	Central African Rep	1.88	34	63%	1.62	48%	2.00	75%	2.07	79%	-	0	1.00	0.8	2.29	0.78	2.00	75%	1.88	65%
225	SJ	Svalbard	1.87	15	28%	1.00	22%	3.40	63%	1.25	21%	-	0	1.00	0.6	1.33	0.33	3.40	63%	1.00	15%
226	FK	Falkland Islands (Malvinas)	1.86	21	39%	1.14	26%	3.20	63%	1.67	47%	-	0	1.00	0.6	2.17	0.67	3.20	63%	1.00	27%
227	GY	Guyana	1.86	35	65%	1.57	52%	2.00	75%	2.07	79%	-	0	1.00	0.6	1.75	0.89	2.00	75%	2.00	69%
228	NA	Namibia	1.83	36	67%	1.50	52%	2.17	75%	2.00	84%	-	0	1.00	0.8	1.75	0.89	2.17	75%	1.94	69%
229	SZ	Swaziland	1.83	23	43%	1.50	30%	2.00	63%	2.00	53%	-	0	1.00	0.8	2.40	0.56	2.00	63%	1.78	35%
230	GL	Greenland	1.67	18	33%	1.00	30%	2.80	63%	1.60	26%	-	0	1.00	0.6	1.75	0.44	2.80	63%	1.00	23%
231	MN	Mongolia	1.62	34	63%	1.46	48%	1.50	75%	1.80	79%	-	0	1.00	0.8	1.43	0.78	1.50	75%	1.88	65%
232	BW	Botswana *	1.57	35	65%	1.57	52%	1.50	75%	1.60	79%	-	0	1.00	0.8	1.29	0.78	1.50	75%	1.83	69%
233	GF	French Guiana	1.52	21	39%	1.00	30%	1.80	63%	1.88	42%	-	0	1.00	0.6	2.00	0.67	1.80	63%	1.14	27%
234	AQ	Antarctica	1.42	12	22%	1.00	19%	2.00	63%	1.00	11%	-	0	1.00	0.6	1.00	0.11	2.00	63%	1.00	12%
235	EH	Western Sahara	1.20	15	28%	1.00	22%	1.50	50%	1.20	26%	-	0	1.00	0.6	1.33	0.33	1.50	50%	1.00	19%