

Methodology for DATS 6103 - Individual Project 2 - Nelson Foster

Climate Change:

Examining Ecological Health, Conflict, and the Overall Environmental Vulnerability Index (EVI) worldwide, to identify the most vulnerable nations to climate change.

Sources/References:

Environmental Vulnerability Index (EVI), 2004 Release (1973–2003), Compendium of Environmental Sustainability Indicators, Socioeconomic Data & Applications Center, Earth Observing System Data and Information System ([EOSDIS](http://sedac.ciesin.columbia.edu/data/set/cesic-environmental-vulnerability-index-2004/data-download)), National Aeronautical & Space Administration (NASA), hosted by Columbia University. Retrieved from <http://sedac.ciesin.columbia.edu/data/set/cesic-environmental-vulnerability-index-2004/data-download>

Socioeconomic Data and Applications Center (SEDAC), 2007. Compendium of Environmental Sustainability Indicator Collections Version 1.1 – Data Dictionary Center for International Earth Science Information Network (CIESIN). Columbia University. Retrieved from <http://sedac.ciesin.columbia.edu/data/set/cesic-environmental-vulnerability-index-2004/data-download>

Ecological Footprint of Countries (EFC), 2004, Ecological Footprint Explorer, Global Footprint Network. Retrieved From <http://data.footprintnetwork.org/compareCountries.html?yr=2004&type=EFCpc&cn=all>

Environmental Vulnerability Index, 2004

Key Variables and Data Definitions: EVI_04
(Analyzing actuals and scaled/EVI subindexes)

EVI:

Environmental Vulnerability index “The EVI is based on 50 indicators for estimating the vulnerability of the environment of a country to future shocks. Unitless index score (ranging from 174 low vulnerability to 450 for high vulnerability)”

The scores range as follows:

Extremely vulnerable	365+
Highly vulnerable	315-364
Vulnerable	265-314
At risk	215-264
Resilient	<264

CONFLT, CONFLTEVI

Human conflict: measured in human conflict years

CSTPOP, CSTPOPEVI

“Human Populations [Coastal] Population living with 100 km of a coast divided by the area of coastal lands (sq km). Density of people living in coastal settlements (i.e. with a city centre within 100km of any maritime or lake* coast). (* To be included, lakes must have an area of at least 100 sq km).”

POPDN, POPDNEVI

“Population Density: Total human population/sq km. Total human population density (number per km² land area). This is a proxy measure for pressure on the environment resulting from the number of humans being supported per unit of land. The greater numbers of people increases pressure on the environment for resources, for the attenuation of wastes and physical disturbance of the environment.”

“HAZARDS :

“The theory behind the EVI identifies three aspects, which can be identified wherever vulnerability is considered. These are: (i) the risk of hazards occurring, (ii) the inherent resistance to damage and (iii) the acquired vulnerability resulting from past damage. The risk associated with hazards is dependent on the frequency and intensity of events that, by definition, may adversely affect the environment.” pp. 69-70.”

DAMAGE, DAMAGEEVI

Vulnerability Resulting from Past Damage: Standardized unit scale (from 1-7; with 1 as good and 7 as bad)

“The theory behind the EVI identifies three aspects, which can be identified wherever vulnerability is considered. These are: (i) the risk of hazards occurring, (ii) the inherent resistance to damage and (iii) the acquired vulnerability resulting from past damage. The risk associated with hazards is dependent on the frequency and intensity of events that, by definition, may adversely affect the environment. The inherent resilience or resistance 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 inherently invulnerable to sea-level rise, regardless of the worldwide level of risk and any other damage that might be sustained to its environments. Acquired vulnerability arises from damage sustained in the past and is related to 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.”

DRY

“Dry periods: (Millimeters of rainfall deficit (negative value). Total rainfall deficit in mm over the past 5 years, averaged over all stations and months for which there were data. Final values expressed as annual figures.”

WET

Wet periods: “Millimeters of excess rainfall. Total excess rainfall in mm over the past 5 years, averaged over all stations and months for which there were data. In their final form results are expressed as annual excess.”

HOT

Hot Periods: “Total degrees (Fahrenheit) of excess heat per year. Annual averages over the past 5 years of summed deviations of daily maximum temperatures that are more than 9F higher than the 30 year monthly mean maximum temperatures, calculated for each climate station in a country and then averaged over all climate stations.”

COLD, COLDEVI

Cold Periods: “Total degrees (Fahrenheit) of heat deficit per year. These are as annual averages over the past 5 years of summed deviations of daily minimum temperatures that are more than 9F lower than the 30 year by month, mean daily minimum temperatures, calculated for each climate station in a country and then averaged over all climate stations. “

SST, SSTEVI

Sea Temperatures: Absolute values of temperature anomalies in relation to the 30 year monthly (1961-1990) averages in degrees C.

RELIEF, RELIEFEVI

“Vertical Relief: Altitude range (highest point subtracted from the lowest point in country)
1. This indicator is a proxy for ecosystem diversity. 2. The indicator may also function as a proxy for habitat disturbance through avalanches, slides and large rivers. Biodiversity of habitat & species, potential for habitat disturbance through movements of water and slides. A country with a large altitude range is likely to have a greater variety of ecosystems, which in very high altitude areas, or very low ones (e.g. the Black Sea) leads to the formation of “endemic habitat types”. These can be an integral part of the character of a country, and if lost, the same arguments as for endemic species applies”

LAND, LANDEVI

Land Area: Total land area (accumulated across islands, if present in square kilometers)

“This indicator captures the richness of habitat types and diversity, availability of refugia if damage is sustained or for protection, and species and habitat redundancy. It is generally considered that larger countries will have more options and the ‘critical mass’ required for ecological systems to persist and re-seed each other in the face of ecosystem stressors. There will also be more options for the human populations to allow areas that have been damaged to recover.”

LOW

“Lowlands: Percentage of total land area which is $\leq 50\text{m}$ above sea level anywhere in the country. This indicator focuses on the presence of lowlands in a country with implied impacts associated with pollution, ecosystem disturbance, flooding and coastal vulnerability. Areas of lowlands are those that will tend to be the first to flood, will tend to accumulate pollution that is mobilised by surface run-off, provide an important entry point (and extraction point) for groundwaters and if on the coasts of the sea or lakes may be subject to storm surges, tsunamis or sea level rise. They tend to be areas of high biodiversity and/or form critical habitats. They may also be critical areas for productivity, soil formation, erosion, natural resources and pollution attenuation. A country’s resilience to future hazards will be related to risks on lowland areas. This would be especially important if there are many sensitive ecosystems susceptible to the loss of keystone species and interactions with on-going human impacts.”

IMBAL

Ecosystem Imbalance: + or - change in trophic level calculated by weighting each trophic level present in the national catch by the tonnes reported.

“Ecosystem stress, loss of diversity, damage to the trophic structure of ecosystems, loss of balance. This indicator captures the risk to aquatic ecosystems from risks associated with shifting the natural relationships, diversity and energy-flows within and among ecosystems. Although fisheries are used here, the indicator is more generally concerned with the downstream effects on habitats and other organisms. The greater the downward (negative) trend in trophic level change, the more likely that the marine biomass and trophic structures have been damaged. Such changes could lead to outbreaks or overgrowth of unexpected or pest organisms, monopolies of certain species, and losses of ecosystem elements that may be dependent on the behaviour or populations of others. The effects of these factors would be especially important if there are many endangered species, sensitive ecosystems, and interactions with on-going human impacts.”

VEG

“Natural Vegetation Cover Remaining: Percentage of original (and regrowth) vegetation cover remaining. This indicator focuses on the loss of natural vegetation cover in a country with implied impacts on biodiversity and ecosystem integrity. The loss of natural vegetation has resulted in a loss of biodiversity, and may also have resulted in impacts on ecosystem structure and function through complex ecological interactions. Areas of natural vegetation are viewed as refugia for threatened species, those unknown to science, or those which may act as a future resource (e.g. for biochemical applications). Natural forests and vegetated areas are also likely to be important areas for groundwater intake, soil production, CO₂ – oxygen relationships and attenuating air and water pollution. A country’s resilience to future hazards will be related to the rate and total loss of naturally vegetated areas. This would be especially important if there are many sensitive ecosystems susceptible to the loss of keystone species and interactions with on-going human impacts.”

KEY AGGREGATE SUB INDEXES:

CCEVI:

“Climate Change Sub-Index: The Climate Change Sub-Index of the EVI represents an unweighted average of the scores for the following variables: WINDEVI, DRYEVI, WETEVI, HOTEVI, SSTEVI, LANDEVI, DISPEVI, RELIEFEVI, LOWEVI, VEGEVI, WATEREVI, POPDNEVI, and CSTPOPEVI.

-Definitions of Climate Change Sub Index Elements:

WINDEVI: High Winds (Scaled), Values are total knots of excess wind per year.

DRYEVI: Dry periods (Scaled), Millimetres of rainfall deficit (negative value). Total rainfall deficit in mm over the past 5 years, averaged over all stations and months for which there were data. Final values expressed as annual figures.

WETEVI: Wet periods (scaled), Millimetres of excess rainfall. Total excess rainfall in mm over the past 5 years, averaged over all stations and months for which there were data. In their final form results are expressed as annual excess.

HOTEVI: Hot Periods (scaled), Total degrees (Fahrenheit) of excess heat per year. Annual averages over the past 5 years of summed deviations of daily maximum temperatures that are more than 9F higher than the 30 year monthly mean maximum temperatures, calculated for each climate station in a country and then averaged over all climate stations.

SSTEVI, Sea Temperatures (scaled), Absolute values of temperature anomalies in relation to the 30 year monthly (1961-1990) averages in degrees C

LANDEVI, Land Area (scaled), Total land area (accumulated across islands, if present in square kilometers)

DISPEVI, Country Dispersion (scaled): Total length of land and sea borders (km) / land area of country (accumulated across islands, if present) (1000 sq km).

RELIEFEVI: Vertical Relief (scaled), Altitude range (highest point subtracted from the lowest point in country)

LOWEVI: Lowlands (scaled), Percentage of total land area which is ≤50m above sea level anywhere in the country.

VEGEVI: Loss of natural vegetation cover (Scaled), Percent change in natural forest cover over last 5 years.

WATEREVI: Renewable Water (scaled), Water use as a percent of total renewable water (note this does not imply that any water used actually comes from renewable sources)."

“POPDNEVI: Population Density (Scaled), Total human population/sq km.

CSTPOPEVI: Human Populations (Scaled), Population living with 100 km of a coast divided by the area of coastal lands (sq km).

CBDEVI

Biodiversity Sub-Index Standardized unit scale (from 1-7; with 1 as good and 7 as bad) The Biodiversity Sub-Index of the EVI represents an unweighted average of the scores for the following variables: SSTEVI, LANDEVI, DISPEVI, ISOLEVI, RELIEFEVI, LOWEVI, BORDEVI, IMBALEVI, OPENEVI, MIGEVI, ENDEMEVI, INTROEVI, ENDANGEVI, EXTINCTEVI, VEGEVI, VEGLOEVI, FRAGEVI, RESRVEVI, and MPAEVI.

-Definitions of Biodiversity Sub Index Elements

SSTEVI: Sea Temperatures (scaled), Absolute values of temperature anomalies in relation to the 30 year monthly (1961-1990) averages in degrees C

LANDEVI: Land Area (scaled), Total land area (accumulated across islands, if present in square kilometers)

DISPEVI: Country Dispersion (scaled): Total length of land and sea borders (km) / land area of country (accumulated across islands, if present) (1000 sq km).

ISOLEVI: Geographic Isolation (scaled), Distance to nearest continent (in km)

RELIEFEVI: Vertical Relief (scaled), Altitude range (highest point subtracted from the lowest point in country)

LOWEVI: Lowlands (scaled), Percentage of total land area which is ≤50m above sea level anywhere in the country.

BORDEVI, Shard Borders (scaled, Number of borders shared with other countries, regardless of whether they are on land or in the sea.

IMBALEVI: Ecosystem Imbalance (scaled), + or - change in trophic level calculated by weighting each trophic level present in the national catch by the tonnes reported.

OPENEVI Environmental Openness (scaled), Freight density as X = thousands of dollars of freight moved into the country per sq km of land

MIGEVI: Migratory Species (scaled), Density of migratory species expressed as number of species per 1000 sq km land area under various categories of GROMS migrants.

ENDEMEVI: Endemic Species (Scaled) Species per million km², Number of known species that migrate outside the territorial area at any time during their life spans (include land and aquatic species) / area of land.

INTROEVI: Introductions(scaled), Number of species introduced per 1000 sq km of land area.

ENDANGEVI: Endangered Species (Scaled), Density of endangered species expressed as number of species per 1000 sq km land area categorised by IUCN as either critically endangered, endangered or vulnerable

EXTINCTEVI: Extinctions(Scaled), number of known extinct species per 1000 sq km land area.

VEGEVI: Natural Vegetation Cover Remaining (Scaled), Percentage of original (and regrowth) vegetation cover remaining.

VEGLOEVI: Loss of natural vegetation cover (Scaled), Percent change in natural forest cover over last 5 years.

FRAGEVI: Fragmented Habitats (Scaled), 1. Total length of all roads in a country (km) / land area (sq km) 2. Cumulative area of all fragments of natural cover greater than 1,000 ha in the country as a percent of total land area.

RESRVEVI: Terrestrial Reserves (Scaled), Percent of the total land area set aside as reserves.

MPAEVI: Marine Reserves (Scaled), Percent of the shelf area set aside as marine reserves.”

Ecological Footprint of Countries (2004)

Ecological Footprint:

“A measure of how much area of biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices. The Ecological Footprint is usually measured in global hectares. Because trade is global, an individual or country’s Footprint includes land or sea from all over the world. Without further specification, Ecological Footprint generally refers to the Ecological Footprint of consumption. Ecological Footprint is often referred to in short form as Footprint. “Ecological Footprint” and “Footprint” are proper nouns and thus should always be capitalized.” Source - <http://www.footprintnetwork.org/resources/glossary>

Key Variables and Data Definitions: EFC_04

Carbon: Carbon Dioxide Emissions

Fishing Grounds: Fisheries for human consumption

Cropland: Land used for agricultural purposes

Built -Up Land: Urban areas

Forest Products: Forest land used for industry

Grazing Land: Amount of grazing land

Total: Total Ecological Footprint