Building Resilience in SIDS

The Environmental Vulnerability Index

evi
Environmental
Vulnerability Index

UNEP

SOPAC

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. Tuvalu . Vanuatu .

Contents

The Environmental Vulnerability Index was created by the SIDS of the Pacific to promote sustainable development across the world and cooperation on issues relating to our natural life-support ecosystems.

The EVI in Summary

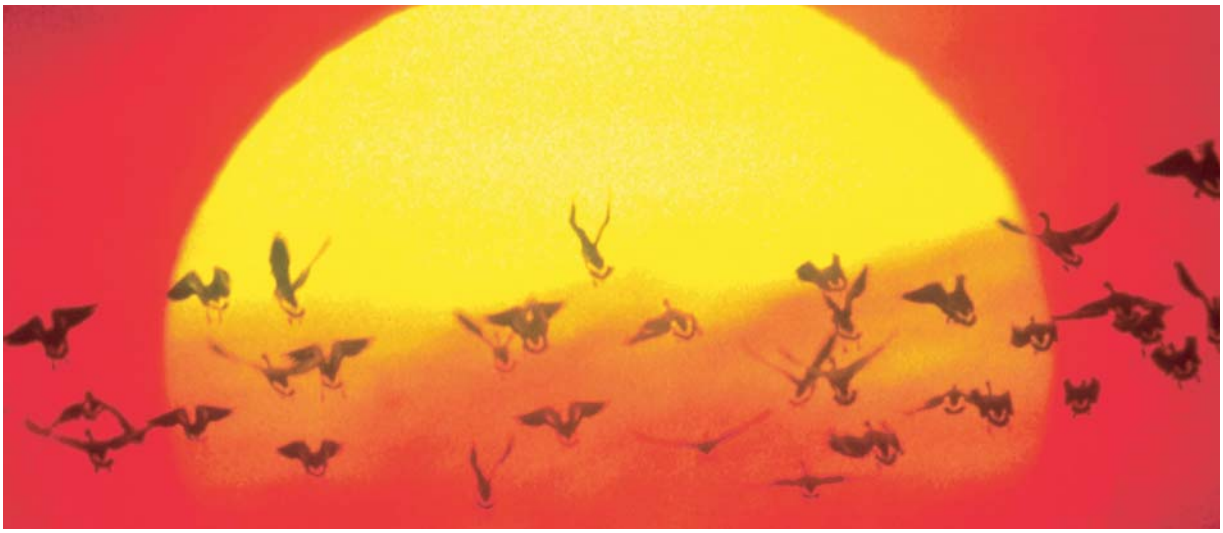
A vulnerability index for the natural environment, the basis of all human welfare, has been developed by the South Pacific Applied Geoscience Commission (SOPAC), the United Nations Environment Programme (UNEP) and their partners. The index was developed through consultation and collaboration with countries, institutions and experts across the globe. This index is designed to be used with economic and social vulnerability indices to provide insights into the processes that can negatively influence the sustainable development of countries.

The reason for using indices for this purpose is to provide a rapid and standardised method for characterising vulnerability in an overall sense, and identifying issues that may need to be addressed within each of the three pillars of sustainability, namely environmental, economic and social aspects of a country's development. Development is often achieved through trade-offs between these pillars. Therefore, in order to promote sustainability, it has become increasingly important to be able to measure how vulnerable each aspect is to damage and to identify ways of building resilience. With this information to hand, the outcome for countries could be optimised for their unique situations and development goals.

> The Barbados Programme of Action (BPoA), Section C5 Vulnerability Index (paragraphs 113 and 114) called for the development of vulnerability indices and other indicators that reflect the status of small island developing states and integrate ecological fragility and economic vulnerability. An emphasis was placed on how such an index and other measures might be used as quantitative indicators of fragility.

The natural environment is unequivocally the life support system for all human endeavours. Far from being a luxury available only to those countries that can 'afford' it, successful environmental management will increasingly become the basis for the success or failure of the economies and social systems. Environmental management now occurs within countries in response to individual development projects and at a global scale through international agreements. The approaches being used are largely concerned with pressure being applied to the environment by humans, or the state of the environment. They concentrate on improving practices through the development of guidelines for action, the use of protection, or by limiting exploitation, degradation and pollution. These approaches are critical to our efforts at environmental management, but are insufficient on their own to ensure a sustainable future. They do not always focus on optimisation or the cumulative outcome of our many actions and management approaches over different scales of time or space. Even countries with a good current state of their environment can be highly vulnerable to future damage.

The Environmental Vulnerability Index (EVI) is among the first of tools now being developed to focus environmental management at the same scales that environmentally significant decisions are made, and focus them on planned outcomes. The scale of entire countries is appropriate because it is the one at which major decisions affecting the environment in terms of policies, economics and social and cultural behaviours are made. If environmental conditions are monitored at the same time as those concerning human systems, there is better opportunity for feedback between them. Without exception, the environment is the life-support system for all human systems and therefore an integral part of the developmental success of countries.



Sustainability and purpose of the EVI

In Our Common Future (the Brundtland Report), sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Where in the past, environmental management was separated from the concerns of economies, it must now become an integral part of the economic, social and cultural systems of each country. The relationship between the human world and the planet that sustains it has undergone major, unintended changes over the last century. Resources and ecosystem services were, and still are being rapidly being exhausted and/or damaged, and how vulnerable they are to damage is of concern to us all. Damage and change have been seen in the world's atmosphere, soils, waters, plants and animals, and in the relationships among them. The rate of this change is outstripping the our current scientific capabilities to assess and advise . Attempts have been made over the past few years at developing criteria for ecologically sustainable development and general conceptual frameworks for sustaining the Earth's life support systems . These attempts have tended to be process rather than outcome focused. They can also be cumbersome to evaluate and implement, and may not easily allow for measuring the success of the steps being taken. Further, they are not focused on ensuring the future in a way that facilitates the integration of all three pillars of sustainability: environment, economy and society.

Logic of the EVI

Vulnerability can be defined as the potential for attributes of any system, human or natural, to respond adversely to events. Hazardous events are those that can lead to loss of diversity, extent, quality and function of ecosystems. These changes are often described as damage to the biological integrity or health of ecosystems, and therefore their ability to keep supporting humans. These may include natural hazards as well as human pressures. Vulnerability to damage arises from a combination of the inherent characteristics of a country, the forces of nature and human use, including the special case of climate change.

Vulnerability can provide a valuable indication of how sustainably humans are living within their environmental means through a dual focus. The EVI simultaneously examines levels of risk and conditions now, predicting how the environment is likely to cope with future events. For example, environments that have been damaged in the past, particularly more recently, are likely to be more at risk of damage from events in the future. The EVI focuses on feedback and interactions, being more pro-active than measures of the state of the environment, though it includes them. A result indicating high vulnerability speaks of a high risk of damage from future conditions, some of which may be related to damage in the past, and may therefore be a more appropriate measure for adaptive management, particularly at the scale of countries.

EVI Mechanics

The EVI is based on 50 indicators for estimating the vulnerability of the environment of a country to future shocks. These indicators are combined by simple averaging and reported simultaneously as a single index, a range of policy-relevant thematic sub-indices and as a profile showing the results for each indicator. Simple averages across indicators were used because they can be easily understood and more complex models do not appear to offer any advantages to the expression or utility of the index. This overview with drill-down structure means that in addition to an overall signal of vulnerability, the EVI can be used to identify specific problems. The EVI has been designed to reflect the extent to which the natural environment of a country is prone to damage and degradation. It does not address the vulnerability of the social, cultural or economic environment, nor the environment that has become dominated by those same human systems (such as cities and farms) because these are included in the economic and social vulnerability indices which are needed separately to identify trade-offs. Therefore, the natural environment includes those biophysical systems that can be sustained without direct and/or continuing human support. The environment at risk includes ecosystems, habitats, populations and communities of organisms, physical and biological processes (such as beach building and reproduction), productivity and energy flows, diversity at all levels, and interactions among them all. Each of these ecosystem goods, services and relationships may be affected by natural and human hazards, the risk of which may vary with time, place and human choices and behaviour.

The indicators used are 'smart' or end-point indicators, selected because they signal a wide variety of conditions and processes that must be operating well if that measure is favourable in terms of environmental vulnerability. Smart indicators are a way of minimising data requirements while providing a good characterisation of environmental vulnerability. For example, the presence in a country of a high percentage of original forest cover automatically indicates that all the processes that lead to maintenance of good cover must be operating well for that end-point to be present, without the need to measure the many hundreds of indicators that could individually lead to losses. The conditions present may include good policies for preservation, low widespread degradation, sufficient renewable water recharge, and little problem with acid rain.

There are three distinct aspects of vulnerability recognisable for environmental, economic and social aspects of countries, all of which need to be evaluated to provide an overall sense of the issues at play. These are the risks associated with hazards, resistance and acquired vulnerability (damage). The first aspect relates to the likelihood of hazards coming into play, while the latter two aspects are related to the ability of the environment to withstand the effects of hazards. In the EVI, indicators were specifically selected to ensure that information on these three aspects is incorporated in the overall vulnerability of countries. There are 32 indicators of hazards, 8 of resistance and 10 that measure damage. The hazard indicators relate to the frequency and intensity of hazardous events. The resistance indicators refer to the inherent characteristics of a country that would tend to make it more or less able to cope with natural and anthropogenic hazards. This includes measures such as absolute size (there

are fewer options for refuges in small countries) and number of shared borders (there are greater risks of transboundary effects). Damage indicators relate to the vulnerability that has been acquired through loss of ecological integrity or increasing levels 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 it is likely to be to future hazards.

Indicators were also selected to ensure a good spread of information across the different elements that comprise and/or affect ecosystems. Indicators on weather & climate (6 indicators), geology (4), geography (6), ecosystem resources & services (28) and human populations (6) were chosen to ensure a good cross-section of the ecological processes, including human interactions occurring in countries.

The anatomy of vulnerability. To illustrate the anatomy of vulnerability, let us look at an example we deal with every day concerning our vulnerability to catching a cold. In this case, our overall vulnerability would be influenced by: (1) the hazards, or the number of cold virus particles we would come in contact with during each day; (2) our inherent resistance in the form of the immune system with which we were born; and (3) our acquired vulnerability, which relates to the damage we might have sustained and how we look after ourselves (whether we drink, smoke, exercise etc). These same three aspects can be recognised in environmental, economic and social vulnerability.

For most indicators, signals are based on average levels observed over the past 5 years, but may include data for much longer periods for geological events. The indicators signal risk potentials based on the experience of the immediate past because these are the influences most likely to affect short-term trends in environmental vulnerability and how ecosystems may respond to hazards compared with the years preceding them. This does not imply that that there are no effects of older events, only that the EVI has been designed to focus on this time frame. With repeated evaluations, the EVI will demonstrate changes in otherwise longer-term processes. The outcome of this strategy will be an understanding that for a while after an event, vulnerability to future hazards is elevated. The short timeframe also allows improvements to be measured quickly for indicators that can be directly influenced by human action.

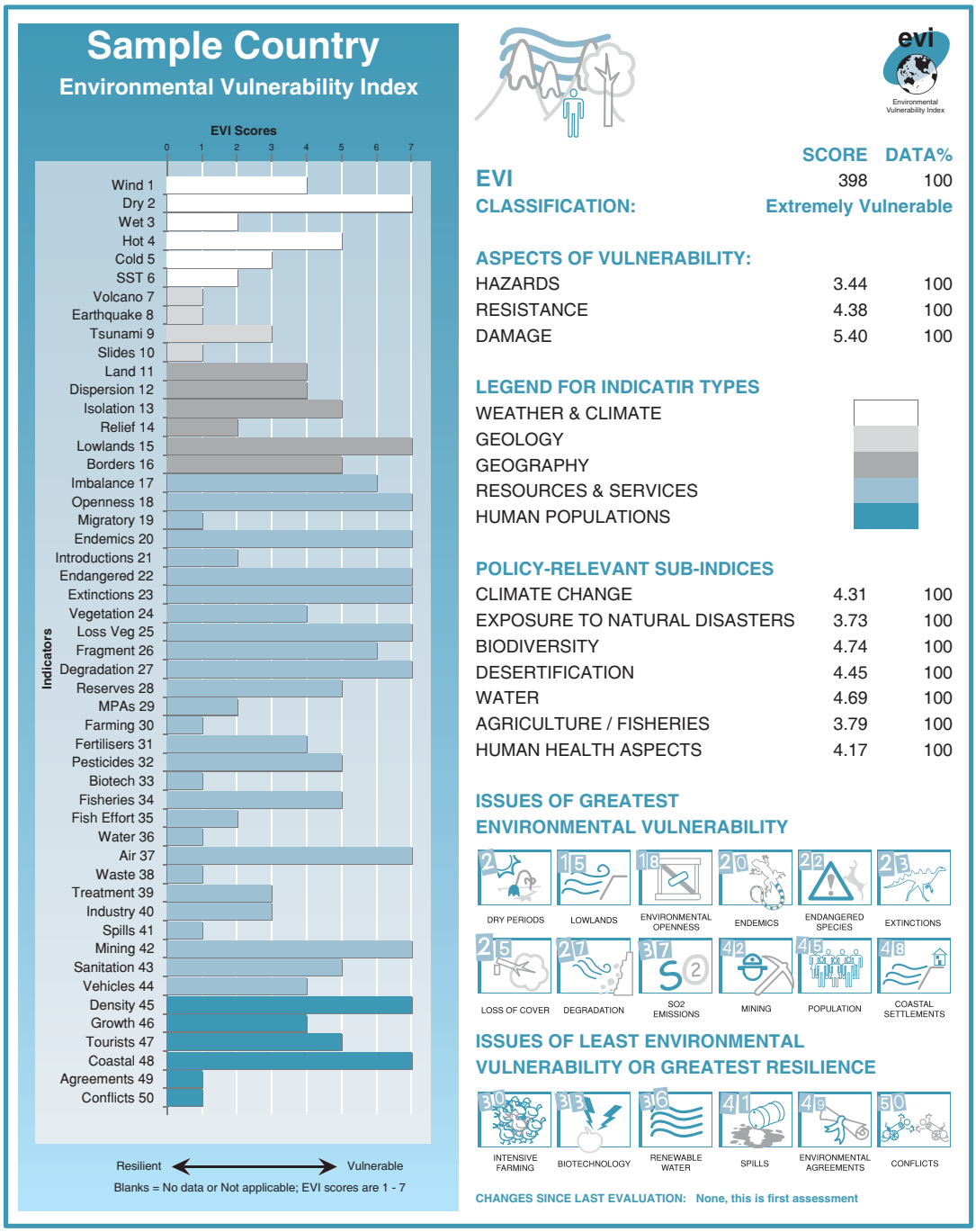
All of the EVI's indicators are transformed to a common scale so that they can be combined by averaging, and to facilitate the setting of thresholds of vulnerability. This new scale has been designed to reflect the environmental vulnerability associated with each indicator, regardless of any other scale on which an indicator could simultaneously exist. The EVI scale was defined as ranging between a value of 1 (indicating high resilience / low vulnerability) and 7 (indicating low resilience / high vulnerability). The EVI scale was determined separately for each indicator, is designed to be policy-relevant, and is based on the best available scientific information.

The EVI was developed on the basis of the logical requirements for assessing the environmental vulnerability of countries. There are still data gaps in the EVI, a problem found in all international reporting, but a tolerance has been built into the index which requires a minimum of 80% of data returns over the 50 indicators for a valid EVI evaluation. This strategy allows for some flexibility where data are not yet available, though it is expected that data for all of the EVI indicators will be available for most countries within a short time. There are currently sufficient data for valid evaluations of more than half of the world's countries, and it is intended that data gaps will be addressed on an on-going basis. In addition, there are 5 indicators that may not be applicable in land-locked countries because they do not have coasts (however, for some inland lakes are considered to have relevant coasts). Missing or not-applicable data do not contribute to the EVI calculation and do not increase or decrease the score, with the EVI being calculated only over indicators for which there are data.

EVI reports for countries are organised as a single-page, information-dense report card. The information available on the report includes overall EVI score in points, with percent of data over which it was calculated and a classification of overall vulnerability. The classification, shown below, quickly identifies whether the environment of a country is highly vulnerable overall.

Extremely vulnerable	365+
Highly vulnerable	315+
Vulnerable	265+
At risk	215+
Resilient	<215

Below this, are presented the results for the three aspects of vulnerability, hazards, resistance and damage, and the percentage of indicators relevant to each for which data were available. These results are presented in relation to the EVI scale (1-7). The results for each of the policy-relevant sub-indices are given in the next section, followed by a brief identification in pictorial format of the main vulnerability issues the country is facing, and its areas of greatest resilience. Sub-indices have been calculated for climate change, exposure to natural disasters, biodiversity, desertification, water, agriculture and fisheries, and human environmental health (see last page for details on indicators and how they were combined for specific uses). On the left side of each report, the results obtained for individual indicators, the profile, are given in a bar chart so that individual issues contributing to high vulnerability scores can be clearly identified. At the bottom of the report, space has been allocated for the future when the country's EVI is re-evaluated and changes since last evaluation can be assessed.



The EVI is unlike other environmental indices that describe the relative position of a country in relation to worldwide observed values. The EVI has been designed using thresholds which have been built in to the 1-7 EVI scale to create a link or anchor between what conditions are observed in countries and those that are environmentally sustainable. Using this approach, indicators are scaled independently of the observed values, providing an in-built mechanism by which countries can immediately assess their vulnerability, rather than identifying their position in relation to others. An additional advantage of this approach is that any individual indicator can be evaluated without information from any other, and any country can evaluate its EVI without information from other countries to provide a context.

The first global results

The inserts accompanying this report show the results for all countries with valid EVI scores, and the trend for those with less than 80% of the required data. It groups countries within the 5 vulnerability classifications (from Extremely vulnerable to Resilient) in alphabetical order, and specifically identifies SIDS. This information is accompanied by a world map showing the distribution of EVI values, in addition to information on the status of the data now held in the EVI database.

Uses of the EVI

The EVI is essentially a synthesis framework for understanding the environmental vulnerability of countries. It is designed for use at the national scale, but could be evaluated at a range of geographic scales, including regions and provinces. The index and associated outputs can provide feedback to environmental managers on changes in environmental quality and vulnerability resulting from changes in policy and action. By using a common index, the characterisation can be comparative through time and space because there is a common basis for the measurements. If re-evaluated through time (suggested timeframe of every 5 years), the EVI can be used as a tool for adaptive management and ultimately for monitoring successes toward achieving sustainable development. It can also be used in developing countries for identifying issues that would benefit from external assistance, and can provide a performance indicator for the effectiveness of donor funding. The EVI contains within it much information on better practices and as such, can be used to raise awareness of environmental vulnerability and the actions that increase or decrease it. The box overleaf shows some of the uses of the EVI suggested by participants to workshops held during the development of the index.

National uses of the EVI

. National planning . Mechanism for identifying and prioritising issues requiring action, including those that cannot be directly influenced by human interventions (natural hazards and inherent characteristics) but for which vulnerabilities could be compensated for by increasing resilience in other areas . Develop policies to reverse trends that are increasing the risk of damage to the environment that supports development . Guide for legislation and resource management with a focus on trade-offs and achieving a sustainable balance for development goals . Mechnism for bringing together stakeholders, including government, civil society, NGOs, resource users and managers to coordinate their efforts and identify individual and joint responsibilities . Increasing national awareness . Transforms data that are currently not in widespread or efficient use to a form that greatly enhances the benefits to be derived from them . Promotes data collection and sharing between agencies for the benefit of the whole country . Basis for allocating budgets, including donor funding into priority areas . Regional and International reporting and conventions ? Monitoring progress resulting from actions and policy changes.

International uses of the EVI

. Mechanism for standardising and streamlining national reporting for multilateral agreements . Basis for funding assistance and dealing with transboundary issues . Improve awareness of vulnerability and sustainability issues . Mechanism for improving and updating international data resources.

Conclusions

The EVI is one of a new generation of tools designed specifically to help meet the challenges of assessment and advice to decision-makers and is intended to complement similar measures of economic and social vulnerability. It contains a wealth of information and a simplified format for identifying environmental vulnerabilities. The EVI is not 'perfect science', nor is it a one-stop solution to the complex problems we face today. In a perfect world we would use absolute measures of all the elements that make up our world and their interactions, a task that is clearly impossible. Using indicators, the EVI is intended to be a pragmatic tool that can be used right now to better inform our decisions.

The purpose of the EVI is to provide information on short-term trends to indicate vulnerability of the environment over the next few years. This approach is in keeping with the overall aim to provide information that will allow governments, funding agencies and others to adaptively respond to the vulnerabilities of countries as they stand at any point in time.

We need the information that tools such as the EVI can generate to recognise parts of our environmental systems that still have good resilience so we can maintain them. Clearly, preserving existing resilience would be the easiest, most pragmatic first step. We also need

to be able to recognise areas of high vulnerability so that we can either manage them directly (for example, the loss of forests) or build resilience in other areas for issues that cannot be directly influenced by our actions (such as natural disasters). With tools like the EVI we can look forward to a future in which we could identify optimum development pathways and outcomes, without unwittingly compromising the environment that supports us.

Statement made by the EVI Review Think Tank Meeting 4-6 October 2004
The EVI is sufficiently well-developed to begin national implementation. Within the limitations of the available data, it successfully captures the nature and scope of environmental vulnerability, enabling countries to manage their vulnerability and protect and build their resilience. It is quantitatively robust and highly policy relevant at national and international levels. Countries could now be called upon to trial the index to test it under various national conditions and determine how well it defines their vulnerability and meets their national objectives.

With respect to the Barbados Programme of Action (BPoA), the EVI captures the environmental vulnerability of SIDS and emphasises their ecological fragility. It can also assist in national reporting for international processes, such as the Millennium Development Goals and priorities set at World Summit on Sustainable Development. It can generate outputs useful for reporting to international conventions such as the United Nations Framework Convention on Climate Change, Convention on Biological Diversity, Convention to Combat Desertification, etc, as well as many regional processes. At the national level it provides environmental profiles that can be used for priority setting and for identifying areas for urgent action. It is designed to capture short-term trends, changes and improvements (on a 5 year scale) and thus provide early warning of major risks and support for adaptive management. Indicators within the EVI may also be used for state of environment reporting.

The EVI will meet BPoA requirements for the environmental area, but needs to be complemented by economic and social vulnerability indices for a complete measure of vulnerability. The environmental and economic indices need to be piloted together at the national level, and the social index developed, leading to harmonisation of all three indices.

Indicator description and classification

INDICATORS	TYPES	ASPECTS	SUB-INDICES						
1. HIGH WINDS	Weather & Climate	Hazards	CC	D				CCD	
2. DRY PERIODS	Weather & Climate	Hazards	CC	D		AF	W	CCD	
3. WET PERIODS	Weather & Climate	Hazards	CC	D		AF	W	CCD	
4. HOT PERIODS	Weather & Climate	Hazards	CC	D				CCD	
5. COLD PERIODS	Weather & Climate	Hazards		D				CCD	
6. SST	Weather & Climate	Hazards	CC			AF			CBD
7. VOLCANOES	Geology	Hazards		D					
8. EARTHQUAKES	Geology	Hazards		D					
9. TSUNAMIS	Geology	Hazards		D					
10. SLIDES	Geology	Hazards		D					
11. LAND AREA	Geography	Resistance	CC						CBD
12. DISPERSION	Geography	Resistance	CC						CBD
13. ISOLATION	Geography	Resistance							CBD
14. RELIEF	Geography	Resistance	CC					CCD	CBD
15. LOWLANDS	Geography	Resistance	CC					CCD	CBD
16. BORDERS	Geography	Resistance							CBD
17. IMBALANCE	Resources & Services	Damage							CBD
18. OPENNESS	Resources & Services	Hazards							CBD
19. MIGRATIONS	Resources & Services	Resistance							CBD
20. ENDEMICS	Resources & Services	Resistance							CBD
21. INTRODUCTIONS	Resources & Services	Damage	CC						CBD
22. ENDANGERED	Resources & Services	Damage							CBD
23. EXTINCTIONS	Resources & Services	Damage							CBD
24. VEGETATION	Resources & Services	Damage					W	CCD	CBD
25. LOSS OF COVER	Resources & Services	Hazards					W	CCD	CBD
26. FRAGMENTATION	Resources & Services	Damage							CBD
27. DEGRADATION	Resources & Services	Damage					W	CCD	
28. RESERVES	Resources & Services	Hazards					W		CBD
29. MPA's	Resources & Services	Hazards							CBD
30. FARMING	Resources & Services	Hazards							
31. FERTILISERS	Resources & Services	Hazards			HH		W		
32. PESTICIDES	Resources & Services	Hazards			HH		W		
33. BIOTECH	Resources & Services	Hazards							
34. Fisheries	Resources & Services	Hazards							
35. FISHING EFFORT	Resources & Services	Hazards							
36. WATER	Resources & Services	Hazards	CC		HH		W	CCD	
37. Air	Resources & Services	Hazards			HH				
38. WASTE	Resources & Services	Hazards							
39. TREATMENT	Resources & Services	Hazards			HH		W		
40. INDUSTRY	Resources & Services	Hazards							
41. SPILLS	Resources & Services	Hazards							
42. MINING	Resources & Services	Hazards							
43. SANITATION	Resources & Services	Hazards			HH				
44. VEHICLES	Resources & Services	Hazards							
45. POPULATION	Human populations	Damage	CC	D			W		
46. GROWTH	Human populations	Hazards					W		
47. TOURISTS	Human populations	Hazards							
48. COASTAL	Human populations	Damage	CC	D					
49. AGREEMENTS	Human populations	Hazards							
50. CONFLICTS	Human populations	Damage							

CC=Climate Change; D=Exposure to natural disasters; HH=Human health; AF=Agriculture & Fisheries; W=water; CCD=Desertification; CBD=Biodiversity.

References & Notes

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