Concept Paper

TOWARDS MANAGING ENVIRONMENTAL VULNERABILITY IN SMALL ISLAND DEVELOPING STATES (SIDS)

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TOWARDS MANAGING ENVIRONMENTAL VULNERABILITY IN SMALL ISLAND DEVELOPING STATES (SIDS)

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Acronyms & Terms

ADB	Asian Development Bank
AOSIS	Alliance of Small Island States
EVI	Environmental Vulnerability Index and Profiles
GEO	Global Environment Outlook
GHG	Green-house gases
GMO	Genetically-modified organism
IPCC	Intergovernmental Panel on Climate Change
MEA	Multilateral Environmental Agreement
PIC	Pacific Island Country
SIDS	Small Island Developing States
SIS	Small Island States
SOE	State of the Environment
SOPAC	South Pacific Applied Geoscience Commission
SPREP	South Pacific Regional Environment Programme
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UWICED	University of West Indies Centre for Environment and Development
WSSD	World Summit on Sustainable Development

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I. INTRODUCTION

1.1 Purpose of this concept paper

> In this paper we step back from specific actions proposed in the BPOA for sustainable development and look at the problem from the perspective of vulnerability. Our purpose is to classify the main vulnerability challenges of SIDS in a manner that can be applied predictively, and in an integrated manner. Although many of the measures proposed in BPOA are also relevant to this discussion, and are part of the approach to dealing with SIDS vulnerability and development, there has not been an understanding of how to frame and coordinate all of the efforts in a manner that will *ensure the future*.

The natural environments of Small Island Developing States (SIDS) are thought to be vulnerable to a range of natural and anthropogenic hazards that damage them at rates and intensities above those found elsewhere around the globe. Hazards are those events and processes that can adversely affect the biological integrity or the health of ecosystems. It is expected that because SIDS are small, their human and natural environments have limited capacity to absorb shocks, tend to have few refugia and may be less differentiated, it is expected that the effects of hazards present in other areas of the world will be more pronounced and cause greater damage. It is this greater tendency for damage that sets SIDS apart from most other countries. The greater vulnerability of SIDS, in turn, translates into greater impediments to Sustainable Development (SD), and more recently, the realisation that the current SD paradigm may be inapplicable to them. It is becoming increasingly clear that a new SIDS Paradigm for Sustainable Development is needed. This paper is intended to explore the issues relating to vulnerability of the natural environment, which is the basis of all human well-being and development.

1.2 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

[1] The three aspects (risk, 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.

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 in SIDS. 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.

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 $1m^2$ of land than it would if it were distributed over $1km^2$. 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.

II. ENVIRONMENTAL CHALLENGES FACING SIDS

SIDS are subject to most, but not all, of the range of environmental hazards found across the globe. The most important challenges for SIDS in terms of their natural environments have been extensively reviewed in GEO-2000, and three companion documents, the Western Indian Ocean, Caribbean and Pacific Islands Environment Outlook reports (UNEP 1999 a,b,c,d).

These documents identify serious risks to the environmental integrity of SIDS in all three geographical regions that focus separately in accordance with the GEO Process, on the responders of land, forests, biodiversity, freshwater, marine & coastal areas and atmosphere (Table 1). The most common basic features of SIDS that are thought to lead to their greater environmental vulnerability include both natural and anthropogenic factors (Box 1). These are: geographic isolation, ecological uniqueness and fragility of the environment, rapid human population growth, the presence of limited land resources, high dependence on marine resources, exposure to extremely damaging natural disasters, low economic

Box 1: Inherent features of SIDS leading to their special vulnerability

- ?? Geographic isolation
- ?? Small physical size
- ?? Ecological uniqueness and fragility
- ?? Rapid human population growth and high densities
- ?? Limited natural resources
- ?? High dependence on marine resources
- ?? Sensitive and exposed to extremely damaging natural disasters
- ?? Small economies with low diversification (thinness)
- ?? Economic openness
- ?? Susceptible to Climate Change and Sea level rise
- ?? Poorly-developed infrastructure, limited capacity, funds and human resource skills.

diversification and exposure to external and global changes in climate, trade and markets (SPREP 1992, Thistlethwaite & Votaw 1992, UNEP 1999c,d).

The environmental challenges facing SIDS are the result of interactions between these basic features that characterise them, and a subset of the environmental hazards common in many countries around the globe. It is this interaction that leads to their greater resulting environmental vulnerability.

In general, the main environmental challenges in SIDS tend to centre on high impact natural disasters, ecological sensitivity, and the less intensive, but more widespread of human activities, with additional hazards driven from outside (Table 1). Further, the action of any of these hazards can secondarily increase vulnerability as a result of the damage sustained (Kaly et al. 1999). The primary challenges fall into five main groups:

Challenge 1: Natural hazards and intrinsic resilience;
Challenge 2: Internal low intensity, widespread anthropogenic hazards;
Challenge 3: Externally driven high intensity anthropogenic hazards;
Challenge 4: Global Climate Change; and
Challenge 5: Acquired vulnerabilities or extrinsic resilience.

Table 1: Summary of main environmental challenges (hazards, risks, problems) affecting the main GEO categories of responders in the 3 SIDS regions

These challenges are listed categorically for convenience, but in reality, most of them are interactive and could not be considered in isolation.

Responders	Main challenges
Land	?? Pollution ?? Land and soil degradation ?? Shortage of land ?? Mining ?? Radioactive and chemical contamination ?? Land titles
Forests	?? Deforestation ?? Forest conversion ?? Mining ?? Logging ?? Loss of traditional controls ?? Fire / drought
Biodiversity	?? Highest marine diversity ?? Extensive coral reefs ?? Sensitive / fragile ecosystems ?? Endemic species ?? Critically threatened biodiversity ?? Extinctions ?? Species introductions
Freshwater	?? Water shortages ?? Limited groundwater ?? Saltwater intrusion ?? Limited surface water ?? Losses from distribution networks ?? Drought ?? Pollution / eutrophication / poor sanitation
Marine / Coastal	?? Many areas low-lying ?? High focus on coastal zone ?? Nutrients (sewage, erosion, fertilisers, eutrophication) ?? Solid waste disposal ?? Sedimentation (deforestation, mining, logging) ?? Physical alteration to reefs, beaches, wetlands, mangroves, watercourses

	?? Loss of critical habitats ?? Coastal erosion and stability ?? Cyclones, storm surges, tsunamis ?? Overexploitation of resources, particularly using destructive fishing
Atmosphere	?? Air quality a problem in larger urban areas ?? Climate Change and El Nino
Cross-cutting	?? Climate Change (changes in temperatures, winds, storms, floods, landslides and droughts) ?? Sealevel rise ?? Loss of entire or parts of islands ?? Population growth ?? Urbanisation ?? Loss of traditional systems and changing expectations

2.1 Challenge 1: Natural hazards and intrinsic resilience

Natural disasters such as cyclones, can affect an entire small island state, leaving no area undamaged for supplying seed organisms, for staging human recovery operations and for supplying resources while the country recovers. This in turn, can lead to greater damage to the environment because it must still be used during recovery to supply human needs. In larger countries, it likely that only a small area of the country will be damaged by natural disasters at any one time so that refugia and alternative supplies for the human populations are always internally available, though in large developing countries they may still not be transportable to areas in need. In SIDS, these natural hazards most commonly include cyclones (e.g. Antigua & Barbuda, Jamaica, Tuvalu, Vanuatu), coastal floods, river floods, drought, tsunamis, earthquakes, volcanoes (e.g. Monserrat) and fires associated with El Nino droughts (e.g. Samoa) (UNEP 1999c).

The intrinsic characteristics of a country have a bearing on how resilient it is to the hazards that threaten its environment. For example, countries with larger land areas and greater vertical relief, are likely to be less sensitive to encroaching seawaters from cyclones, tsunamis and sea-level rise. Such inherent characteristics become an integral part of the country's vulnerability at the time its borders are defined, are normally unchangeable, and are an important consideration in the overall vulnerability equation.

2.2 Challenge 2: Internal low intensity, widespread anthropogenic hazards

Rapidly increasing human populations, the loss of traditional systems of resource management, changes in land and sea tenure and changing expectations on way of life have resulted in widespread but relatively low intensity widespread ecosystem damage in SIDS. Most SIDS are not involved in heavy industries which produce concentrated or very toxic wastes which can be spread over a wide area (e.g. chemical and nuclear pollution, emissions of greenhouse gases, oil refining), though they may be involved through the actions of outside multinationals (mining, logging) as dumping or testing grounds for toxic materials, or incidentally through global changes in climate (see Section 2.3). Few SIDS are heavily involved in highly mechanised and intensive systems of farming.

Most of the internally generated human impacts in SIDS tend to relate to problems with deforestation / conversion of forests, relatively low toxicity pollution (urban and light industrial wastes, agricultural chemicals, sewage), overexploitation of resources and increasing urbanisation. The damage caused by these activities tends to be widespread over the small area available, resulting in losses of resilience, ecosystem integrity and character and biodiversity, often without resulting in obviously highly degraded areas. The damage is subtle, some of which may go unrecognised, and results from activities spread across the population base, leaving few areas undamaged. For example, overfishing is seen as a major threat in most Pacific SIDS (World bank 1999). The annual rate of loss of forest cover is

4.3% in Comoros, 5.7% in Haiti, 4.5% in Micronesia, 4.9% in St Lucia and 2.1% in Samoa (GOWS 1994, FAO 2000).

2.3 Challenge 3: Externally-driven high intensity anthropogenic hazards

The natural environments of many SIDS are subject to damage through transboundary hazards, and the activities of other governments and multinationals. Their relative isolation has seen SIDS become sites for nuclear testing, the staging of wars and the dumping of toxic wastes. For example, in the Pacific, there are problems with current stockpiles of persistent organic pollutants, entire islands that have been contaminated by nuclear residues, and islands in which the natural ecosystems were disrupted by wartime activities (e.g. borrow pits on Funafuti, Tuvalu). Transboundary problems can also come in the form of pollution, (waters from the Amazon are affecting marine ecosystems in Trinidad), uncontrolled or inappropriate migrations of refugees to already crowded islands, and problems with migratory fisheries stocks (e.g. lobsters in PNG, the Banks Fishery in Mauritius, and Tuna throughout most of the PICs). In many SIDS, external interests have moved into the country and harvested both renewable and non-renewable resources, sometimes only paying a fraction of a fair resource rent and leaving behind a legacy of environmental damage and social disorder. For example, in PNG, most of the country's forests have been logged by companies from Australia, Japan and Malaysia, and most using poor logging practices resulting in damage to forests, erosion and sediment run-off into waterways, wetlands and into the sea. Mining and gas and oil extraction in the country are thought to have impacted on aquatic environments (Hunnam et al. 2001). The active mines produce large quantities of waste materials, which are dumped into rivers or find their way to the sea through run-off. It is likely that the Bougainville Crisis is at least partly attributable to disputes over the bearing of environmental costs in that region of Papua New Guinea. Most Pacific SIDS are subject to 'poaching' of their tuna stocks by distant water fishing nations and have little capacity for effective surveillance and enforcement.

2.4 Challenge 4: Global Climate Change

Climate change and its associated effects is really a special case of Challenge 3 Hazards, those driven by external influences, but is separated for this discussion of vulnerability because its effects operate on different scales of time compared with other Challenges. The main hazards associated with climate change pose serious threats to all of the world's small island states (IPCC 2001). The risks are highest for SIDS, which contributed the least to global emissions of green-house gases (GHG), because their special features (Box 1) mean that there is limited capacity for the islands to mitigate and adapt to the predicted changes:

1. Sea-level rise;
2. Beach and coastal changes;
3. Effects on sensitive ecosystems such as coral reefs, mangroves and seagrasses;
4. Effects on biodiversity of islands;
5. Increase in climate-related natural disasters (storms, floods, droughts); and
6. Changes in climate and climate variability (temperature, rainfall and wind) (UNEP 1999c, IPCC 2001).

The most significant and immediate challenges for SIDS are likely to be related to changes in rainfall regimes, soil moisture budgets, the speed and direction of prevailing winds, short-term variations in regional and local sea-levels, and patterns of wave action (IPCC 2001). These changes are expected to have highly interactive flow-on effects in every aspect of the natural environments of SIDS.

2.5 Challenge 5: Acquired vulnerability or extrinsic resilience

All of the above hazards can lead to further environmental vulnerability when the action of a hazard causes damage and reduces the resilience of the environment to future hazards. This has been termed extrinsic resilience because it is concerned with *acquired vulnerability*. For example, a coral reef damaged by cyclone for three successive years, is likely to be more vulnerable to damage if another cyclone were to hit in the fourth year, than it would if it had time to fully recover. Similarly, the same reef is expected to suffer additional damage (be more vulnerable) if it also has a history of damage from pollution. Cumulative impacts from natural and anthropogenic events can lead to increased vulnerability.

III. APPROACHES TO MANAGING VULNERABILITIES AND BUILDING RESILIENCE

For SIDS to address these challenges and thereby manage their environmental vulnerability, they will first need to fully identify the components and establish suitable measures. Some environmental vulnerabilities are inherent to a country and are unchangeable, while some are forced on SIDS by external influences and others are internal and may be influenced by the country's government and people. Clearly, the approaches and instruments for dealing with these different vulnerabilities will vary, and will include a combination of: (i) measurement and/or assessment; (ii) management within the country; (iii) internal resilience-building; (iv) the use of multilateral environmental agreements (MEAs); and (v) international assistance (Table 2). In Table 3, we show how many of the actions proposed in BPOA for the sustainable development of SIDS are of relevance for addressing vulnerability. However, for the purposes of specifically addressing the issue of vulnerability of SIDS, BPOA actions do not provide sufficient focus on intrinsic vulnerabilities, building resilience and the problem of acquired vulnerability. These aspects require a different approach.

Table 2: Summary of main approaches appropriate to the management of vulnerability and/or the building of resilience for the five environmental vulnerability challenges facing SIDS.

Y / N = "Yes" and/or "No" respectively.

	Repeated Measurement / Assessment	Internal Management	Internal Resilience Building	Multilateral Environmental Agreements (MEA)	International Assistance
Challenge 1: Natural Hazards and intrinsic resilience	Y	N	Y	N	Y/N
Challenge 2: Internal anthropogenic hazards	Y	Y	Y	Y/N	Y
Challenge 3: External anthropogenic hazards	Y	Y/N	Y	Y	Y
Challenge 4: Global Climate change	Y	N	Y	Y	Y
Challenge 5: Acquired vulnerability / extrinsic resilience	Y	Y/N	Y	Y	Y

Table 3: Linkages between the actions proposed in BPOA for sustainable development and the approaches proposed here for managing vulnerability in SIDS.

This paper	Main Links with BPOA Paragraphs
Overall approach suggested	Paras 1, 3-12, 17, 66-67.
Repeated Measurement / assessment	Paras 16, 19, 20-21, 24, 26, 29, 34, 40, 45, 59, 66, 104, 113-114, 117.
Internal Management	Paras 16, 19, 20-21, 24, 26, 29, 34, 38, 40, 45, 49, 55, 59, 64, 66, 68, 73, 78, 79-80.
Internal Resilience building	Paras 16, 19, 20, 26, 34, 45, 64, 78, 80, 96-97, 100-103.
Multilateral Agreements (MEA)	Paras 19, 20, 24, 26, 38, 45, 67, 94, 112, 118-135.
International Assistance	Paras 19, 20, 24, 26, 29, 34, 38, 40, 45, 49, 52, 55, 59, 64, 66, 76, 84-89, 92-93, 95, 111-112, 115, 117.

3.1 Measurement and/or assessment of vulnerability

The first step in attempting to manage the vulnerabilities of SIDS will be to identify all aspects of vulnerability in the countries and measure or assess them repeatedly through time. The future of SIDS, to be sustainable, must be based on a symbiotic relationship between people and the natural environment. 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, and needs to be accounted for at this scale. Attempts to do this have been made over the past few years by developing criteria for ecologically sustainable development (Heinonen et al. 2001) and general conceptual frameworks for sustaining the Earth's life support systems (Daily 1999). Even these attempts, though valuable, tend to be process rather than outcome focused, can be cumbersome to evaluate or implement, and may not easily allow for auditing the success of the measures being taken. They are not focused on 'ensuring the future' (Tonn 2000).

Over the last decade, UNEP, ADB and the regional environmental organisations working with SIDS, have gone a long way toward identifying the main hazards and sensitivities affecting the natural environment through state-of-the-environment (SOE) reporting. This work has more recently culminated in GEO-2000 and focused Environment Outlook assessments for the three main SIDS regions (UNEP 1999a,b,c,d, ADB 2000). These documents provided an excellent starting point for the identification and assessment of the main issues that would pertain to vulnerability at the scale of countries.

Work on environmental vulnerability has from its beginnings tended to focus more on quantitative techniques, not surprising because it must incorporate levels of risk to hazards, and intrinsic and acquired sensitivity interactively. Attempts have been made to provide measures of vulnerability in rating or index form for climate change and sea-level rise (Pernetta 1990, IPCC 1991, 1992, Downing 1992) and human impacts on the environment (Ehrlich & Ehrlich 1991, UNEP 1998). A range of other early indices and indicators that purported to measure environmental vulnerability were misnamed and were actually about vulnerability of human systems subject to natural hazards (e.g. Pantin 1997).

More recently the Pacific Island Countries, through the South Pacific Applied Geoscience Commission (SOPAC) and its collaborators, have developed a comprehensive vulnerability index and profiles for the natural environment. The Environmental Vulnerability Index (EVI) is among the first of tools now being developed to focus environmental management proactively by using vulnerability rather than state of the environment, by working at the same scales that environmentally-significant decisions are made, and by concentrating on outcomes. It is a method that uses 54 *smart indicators* to assess the vulnerability of the environment at the scale of entire countries (Table 4). 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 made. If environmental conditions are monitored at the same time as those concerning human systems, there is better opportunity for feedback between them. The EVI has indicators that cover all major aspects of vulnerability, including the five challenges identified for SIDS (Table 4). This index is undergoing testing and is expected to be released later in 2002.

Table 4: List of indicators of environmental vulnerability of a country being tested by SOPAC and its collaborating countries and experts.

Indicators are characterised in terms of sub-index and broad category to allow for better identification of sources of vulnerability as follows: REI = Risk exposure sub-index; IRI = Intrinsic resilience sub-index; EDI = Environmental Degradation sub-index (extrinsic resilience); Met = Meteorological; G = Geological; CC = Intrinsic Country Characteristics; B = Biological; and A = Anthropogenic influences. Full text for each indicator may be found in Kaly et al. (2002).

No.	Indicator	Sub-index	Category	No.	Indicator	Sub-index	Category
1	Sea temperature	REI	Met	28	Loss of natural cover	REI	A
2	High winds	REI	Met	29	Tourists	REI	A
3	Dry periods	REI	Met	30	Wastewater	REI	A
4	Wet periods	REI	Met	31	Production wastes	REI	A
5	Heat spells	REI	Met	32	Waste treatment	REI	A
6	Cold spells	REI	Met	33	Oil spills	REI	A
7	Volcanos	REI	G	34	Toxic industries	REI	A
8	Earthquakes	REI	G	35	Vehicles	REI	A
9	Tsunamis	REI	G	36	SO_2	REI	A
10	Land area	IRI	CC	37	Fertilisers	REI	A
11	Fragmentation	IRI	CC	38	Pesticides	REI	A
12	Isolation	IRI	CC	39	Fisheries stocks	REI	A
13	Vertical relief	IRI	CC	40	Degradation of land	EDI	A
14	Lowlands	IRI	CC	41	Freshwater	EDI	A
15	Coastal vulnerability	IRI	CC	42	Subsurface mining	REI	A
16	Endemics	IRI	CC	43	Surface mining	EDI	A
17	Pathogens	REI	B	44	Terrestrial Reserves	EDI	A
18	Potential for introductions	REI	B	45	Marine Reserves	EDI	A
19	Introductions	EDI	B	46	War & civil unrest	EDI	A
20	Endangered species	EDI	B	47	Legislation	EDI	A
21	Extinctions	EDI	B	48	Sanitation	EDI	A
22	Natural Vegetation	EDI	B	49	GMOs	EDI	A
23	Intensive farming	EDI	B	50	Shared Borders	IRI	CC
24	Fisheries	EDI	B	51	Fragmentation of vegetation	EDI	A
25	Coastal settlements	EDI	A	52	Migratory Species	REI	B
26	Population density	REI	A	53	Icesheets & glaciers	EDI	G
27	Population growth	REI	A	54	Slides	REI	G

3.2 Internal management

Certain aspects of vulnerability are amenable to management within SIDS through the normal channels of policy, legislation, political will and public cooperation, while there are some that are not (Table 2). The occurrence of natural hazards (e.g. cyclones) and intrinsic sensitivities (e.g. low elevation) (Challenge 1 vulnerabilities) are generally not under the control of the governments and/or people in a country and cannot be managed by them. These are aspects of a country's vulnerability that have to be 'lived with', though it will become clear below that effort can and should be put into building resilience against their negative effects (Box 2 and Section 3.3). A similar situation can occur with externally induced vulnerabilities, such as climate change / sea-level rise (Challenge 4) and many Challenge 3 and 5 vulnerabilities. For example, apart from negotiating with responsible governments, SIDS are generally unable to directly influence the global emissions of GHGs or prevent pollution from migrating across borders into their jurisdictions.

Box 2: Comprehensive Hazard and Risk Management (CHARM)

SOPAC is currently assisting Pacific Islands Countries to develop an improved disaster reduction capability through the adoption of an integrated and whole of country approach to risk management. The CHARM programming approach will:

?? Specifically link together the development priorities and programs of individual countries
?? Clearly identify gaps within existing or proposed country project activities
?? Enable SOPAC to work closer with its regional partners and to develop the Community Risk Program annual work plan and activities schedule around clearly identified country needs and priorities.

In contrast, Challenge 2 vulnerabilities, the anthropogenic hazards to the natural environment generated in-country, can be managed and balanced against the social and economic objectives of SIDS. These vulnerabilities can be managed using commonly accepted tools coupled with a reliable feedback mechanism which could be provided through repeatedly measuring vulnerability in a country, and how the level changes as policy is implemented. Some externally driven and secondary vulnerabilities (Challenges 3 and 5) might be managed in a similar fashion. This would apply to external interests utilising a country's resources (mining, logging, oil, gas) and SIDS should examine their opportunities for reducing their vulnerabilities in those areas.

3.3 Internal resilience-building

The opportunity for SIDS to decrease their environmental vulnerability so that they are less susceptible to damage from all types of hazards (Challenges 1-5) lies in actions that strengthen the natural environment, provide refugia for recovery or reduce some of the negative interactive effects operating between factors. Strengthening the natural environment can involve reducing stressors (e.g. better treatment or disposal of sewage), rehabilitation of damaged areas[3], or allowing sufficient periods for recovery. For natural resources, this might include ensuring that harvesting does not exceed the maximum sustainable level, not only for the purpose of maintaining the resource itself, but also the ecosystem of which it is part. By allowing recovery in natural ecosystems that might have been damaged in the past, resilience is being built into the system against future events.

Refugia in the form of protected areas are an excellent resilience-building mechanism for SIDS. Despite the obvious shortage of land area in many SIDS, the need to set areas aside is even more pressing than other countries. Reserves provide areas for attenuating diffuse pollution, preserving biodiversity and a source of new organisms if those in surrounding areas become damaged or depleted (e.g. marine reserves are said to improve fishing in non-reserve areas by exporting adult and juvenile fishes).

3.4 Multilateral and non-binding environmental agreements

Many SIDS are signatories to a large number of global (>15) and regional (>11) Multilateral Environmental Agreements (MEAs). Many of these remain poorly implemented in SIDS due to a lack of funding and capacity. MEAs cannot affect Challenge 1 vulnerabilities, but have value for the management of all other types of vulnerabilities and for increasing the environmental resilience of SIDS. Some of the more recent MEAs on biodiversity and Climate Change have been effective in developing appropriate environmental policies that operate to manage vulnerabilities generated inside and outside of a country (UNEP 1999c). Many of the agreements have been effective in mobilising funding for increasing understanding within SIDS and, internationally, of the issues facing them. Although there are still many barriers to implementation of MEAs in SIDS, it is clear that they are an important part of mechanisms for reducing vulnerability.

3.5 International assistance

By definition, all SIDS are developing countries and receive some form of assistance from international and regional development organisations, donor governments, international development banks and non-government environmental organisations. There is a large potential within the relationship between SIDS and these organisations to examine and develop programmes for addressing those aspects of vulnerability subject to action, and for general resilience-building in-country. All five types of vulnerability have at least some aspects that could be addressed in these relationships. For example, programmes that focus on building resilience of the natural environment and improving public awareness have the potential to reduce vulnerability to natural disasters. Vulnerability measures, such as the EVI, would be valuable in this process because it would allow bilateral partners to identify the main environmental vulnerabilities within individual SIDS and act as an auditing mechanism so that there is a feedback mechanism between actions taken and results obtained.

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[3] Rehabilitation / restoration should be seen as a last resort because (a) it is expensive and (b) it is not known whether ecosystems that have been restored recover the full functions of natural ecosystems.

IV. RECOMMENDATIONS

It is clear that some of the environmental vulnerabilities of SIDS are intrinsic and cannot be influenced by human actions, while others could be managed at least in part by the SIDS governments and people. The burden of environmental vulnerability is, however, relatively greater than in other developing and developed countries because of the intrinsic characteristics of SIDS. There is an urgent need to identify and measure all aspects of the special vulnerability of SIDS to ensure that: (i) development priorities and approaches are appropriate to the special conditions found in SIDS; and (ii) the special vulnerabilities of SIDS are taken into account in international processes (this may include adjustments or interventions). It is therefore recommended that:

1. Streamlined and permanent (periodic) data collection mechanisms be established to collect environmental vulnerability data in all SIDS countries to form the basis of vulnerability management and resilience building processes;
2. The EVI be completed as a mechanism for identifying and measuring environmental vulnerabilities in SIDS and monitoring changes in response to actions and through time;
3. Mechanisms be established (e.g. through AOSIS) for taking SIDS special vulnerability into account in regional and international processes, including adjustments and assistance as necessary;
4. The implications of SIDS special vulnerability be re-examined in terms of Sustainable Development; and
5. Public awareness and capacity be increased in SIDS in relation to the unique conditions of environmental vulnerability. Options for management and resilience-building should be discussed.

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VI. TERMS

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).

ERI Extrinsic Resilience sub-Index; 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.

Indicator Any variable or measure which characterises the level of risk, resilience or responder degradation in a country

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 <u>resist</u> 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 measures 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 <u>prone</u> to damage / degradation by hazards.