



# climate change

small island developing States



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*"The Maldives is one of the small states. We are not in a position to change the course of events in the world. But what you do or do not do here will greatly influence the fate of my people. It can also change the course of world history."*

Statement by H.E. Maumoon Abdul Gayoom  
(Maldives)

4 December 1997, Kyoto, Japan (COP 3)



## Foreword

Since the negotiations that led to the United Nations Framework Convention on Climate Change began, one group of Parties has been particularly active and vocal: the small island developing States, or SIDS.

Why is climate change so important to SIDS? The answer is simple: these small nations are among the most vulnerable to climate change impacts, which will become critical if no appropriate action is taken. Many islands are threatened by rising sea levels. Another growing concern is the increasing number and severity of extreme weather events—with all they entail in terms of loss of life and damage to property and infrastructure that can easily cripple small economies. SIDS are among the Parties least responsible for climate change and are dependent on others to ensure that significant action is taken in support of the Convention. Consequently, they strive not only to support the process directly but also to ensure that proper international action is taken to limit emissions of greenhouse gases and to adapt to climate change.

This publication highlights the SIDS' participation in the Convention as well as some of the ongoing needs and concerns that they have expressed in the course of the UNFCCC process.

Happy reading!

Joke Waller Hunter, Executive Secretary, UNFCCC

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# Small island developing States and climate change

*"It is a particular honour, Madame, as amongst our membership are many countries that have been "first movers" in the international response against climate change.*

*These include:*

- Maldives, host to one of the first Ministerial Declarations on the Impacts of Climate Change;*
- Malta, sponsor of the UN General Assembly Resolution that launched the Convention negotiations;*
- Vanuatu, who submitted the first outline of elements for a Convention;*
- Mauritius, the first state to ratify the Convention, followed quickly by Seychelles and the Marshall Islands;*
- Trinidad and Tobago, sponsor of the AOSIS protocol that spurred the Berlin Mandate process;*
- Fiji and Antigua and Barbuda, the first to ratify the Kyoto Protocol; and the many island States whose delegations work tirelessly in this process to defend the front line in the battle against global warming."*

*Statement by  
H.E. T. Neroni Slade (Samoa on behalf of AOSIS)  
12 November 1998, Buenos Aires, Argentina  
(COP 4)*

Small island developing States (SIDS) have long been recognized by the international community as a special case whose needs and concerns have to be addressed (see box 1). Although these countries are among the least responsible for climate change, they are likely to suffer most from its adverse effects and could in some cases even become uninhabitable. This is what makes them a special case requiring the help and attention of the international community.

Forty-one SIDS are currently Parties to the United Nations Framework Convention on Climate Change (UNFCCC), and 29 are also signatories to the Kyoto Protocol. Many SIDS are members of the Alliance of Small Island States (AOSIS), and 11 are listed as least developed countries (LDCs). See figure 1 for an illustration of how small island nations are represented in the various negotiating groups of the UNFCCC.

SIDS have not only focused their attention on negotiations of the UNFCCC and its Kyoto Protocol over the course of the past 10 years; they have also taken a lead in implementing the Convention.

#### **Box 1. Small island developing States in the international arena**

The unique situation of small island developing States (SIDS) was acknowledged at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992. Governments agreed that concerted action was needed to address development for the sake of future generations.

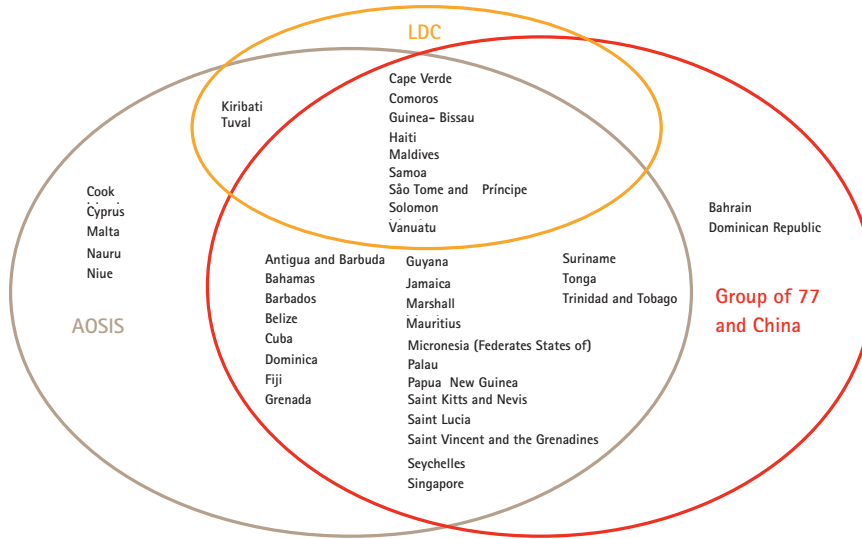
In 1994, in Barbados, the Global Conference on the Sustainable Development of Small Island Developing States included specific actions and measures at the national, regional and international levels in support of sustainable development. The particular vulnerability of SIDS to climate change, climate variability and sea-level rise featured prominently in the Barbados Programme of Action, which identified priority areas and indicated the specific actions needed to address the special challenges faced by the governments of these countries.

The urgency for action to address the special needs of SIDS by implementing the Barbados Programme of Action and the outcome of the twenty-second special session of the General Assembly were both recognized by the United Nations Millennium Summit in 2000, when governments pledged to address the special needs of SIDS "rapidly and in full" by 2015. The Summit also urged the international community to ensure that, in the development of a vulnerability index, the special needs of SIDS were taken into account.

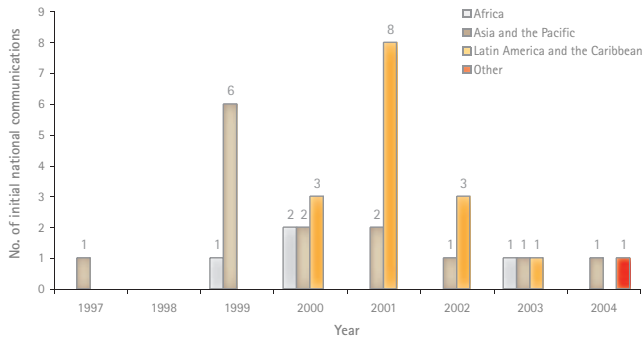
In 2002, the World Summit on Sustainable Development highlighted the fact that SIDS are a special case both for environment and for development by stating that although the governments of these countries continue to take the lead in the path towards sustainable development in their countries, they are increasingly constrained by the interplay of numerous adverse factors.



**Figure 1:** SIDS groups within the negotiating groups of the United Nations Framework Convention on Climate Change



**Figure 2:** SIDS submission of initial national communications by year and by region



To meet their obligations under the UNFCCC, all Parties must report in national communications information on circumstances related to the achievements of the objective of the Convention and must detail their greenhouse gas (GHG) emissions as well as efforts to address climate change and report on their vulnerability and adaptation options.

SIDS were among the first to complete initial national communications and submit them to the Conference of the Parties (see figure 2). This report is based on the information provided in those national communications as well as from reports of the Intergovernmental Panel on Climate Change and the Global Environment Facility and other regional and bilateral financial and technical support facilities.

# A profile of small island developing States

*"Already, warming of Pacific ocean water of three degrees has been measured in the Pacific. Plankton – the tiny single cell plants and animals that are the basis of the ocean food web in northern latitudes and the source of at least half the oxygen we breathe – are dying. Zoo plankton in the northeast Pacific have declined by 80% since 1950. In the southern oceans, coral reefs are dying, perhaps because of ocean warming, threatening biological productivity in tropical seas."  
"It is [therefore] not just island people who are at risk from climate change: 60% of humanity live in coastal areas and therefore share vulnerability to climate change and sea level rise. Low lying coastal areas in all countries are threatened, including agriculturally productive river deltas world wide."*

Statement by H.E. T. Neroni Slade  
(Samoa on behalf of AOSIS)  
28 March – 7 April 1995, Berlin, Germany  
(COP 1)

Although small island developing States are among the least responsible of all nations for climate change, they are likely to suffer strongly from its adverse effects and could in some cases even become uninhabitable. This is what makes them such a special case requiring the help and attention of the international community.

These island nations are found throughout the world, although most of them are located in the wider Caribbean and South Pacific regions. The land: sea ratios for the SIDS are largely skewed. Their Exclusive Economic Zones (EEZs) are often larger than their land area. Nauru's EEZ, for example, is nearly 15,000 times the size of its land area, whereas Samoa's is eight. Many SIDS – the Maldives, for example – have solely or mostly low-lying land areas; others, such as Haiti, have a varied terrain, including mountainous areas. Their population densities differ widely as well (see box 2).

Ninety per cent of the SIDS are in the tropics. Many are seasonally affected by extreme weather events – tropical storms, cyclones and hurricanes. Climate variability, droughts and flooding are also features of their weather pattern. El Niño Southern Oscillation events also produce dramatic changes in rainfall, rising sea levels and other weather-related phenomena.

#### **Box 2. The widely varying population densities of small island developing States**

An estimated 50 million people live in small island developing States, based on population data for various years covering the period 1990–2002. The average SIDS is fairly densely populated, yet the differences between countries in this respect are large. The largest country – Papua New Guinea – has a population density of about 1 inhabitant per square kilometre of land area whereas one of the smallest, Singapore, has nearing 5,000 persons per square kilometre.







SIDS benefit in different ways from an intimate relationship with the oceans. Singapore, for instance, makes use of its strategic geographic position within the global trading system. Other countries – the Marshall Islands and Tuvalu, to mention just two – depend on their fish resources. And for many SIDS, sea-related tourism has become a mainstay of the economy.

Almost all SIDS depend heavily on fossil fuels. The use of fossil fuels includes not only power production and the desalination of water, but also transport, including tourists as well as to move goods; the main source of foreign exchange; and the exploitation of marine resources. Some SIDS, for example Bahrain and Trinidad and Tobago, also produce and export fossil fuels.

Renewable sources of energy, such as fuelwood, sugarcane bagasse, hydropower and solar water heating, are also being exploited. Indeed, SIDS have a long history of renewable energy use in the agricultural sector, where in some countries wind turbines were traditionally used to pump water and drive machinery for such activities as pressing sugarcane. The use of renewable energy is often still directly linked to agriculture. Biomass, in the form of fuelwood and bagasse, mainly from the production of sugarcane, is the main source of renewable energy these days. Noteworthy is also the use of hydropower in Dominica and Haiti and the use of solar water heating in Antigua and Barbuda and Barbados. In the latter country some 35,000 solar water heaters are in use as a direct consequence of the government's incentives that encouraged their installation.

Many SIDS have considerable potential for further development of renewable energy by virtue of their location, an abundance of sunshine that gives rise to wind, and adequate rain and plant life that can be tapped for energy. In addition, the presence of geothermal springs, vents and other geo- and hydrothermal resources on land as well as in the ocean increases the potential sources of energy production in most SIDS. Future developments could therefore include the increased use of wind, solar and geothermal power as well as ocean thermal and tidal energy conversion. Efforts to increase the use of renewable energy, especially wind turbines, are commonly cited as one of the technology options for breaking SIDS reliance on fossil fuels.

# Financial and technical support for small island developing States

*"... my Government realizes that it is not going to be an easy task for us to implement the Convention without the cooperation of the developed countries. We request that financial assistance from bilateral and multilateral sources be made available and accessible for countries like the Republic of Vanuatu for programs that will enhance sustainable development and also contribute to the implementation of the Convention."*

Statement by Hon. Dr. Edward Tambisari  
(Republic of Vanuatu)  
27 March - 7 April 1995, Berlin, Germany  
(COP 1)



One of the principal channels of support for small island developing States (SIDS) in the area of climate change is the Global Environment Facility (GEF) Trust Fund. With resources made available through this channel, but also using resources of their own and those obtained from multilateral and bilateral sources, SIDS have been able to undertake a number of important activities designed not only to meet their reporting obligations under the Convention, but also to take early action in the area of climate change.

SIDS have sought and obtained resources for building their national capacities and institutions in areas relevant to climate change. Many countries have used these resources to establish climate change committees that can guide national efforts in this area, develop national climate change action plans and mitigation strategies, and initiate education, training, and public awareness campaigns designed to engage the general populace on the problem of climate change. Supported by this institutional setup, SIDS have been active in developing and participating in a number of regional cooperation activities designed to help build capacity for conducting vulnerability and adaptation assessments, to mainstream climate change consideration into developing planning, to cope and adapt to the adverse effects of climate change and to develop renewable energy sources.

One example of regional cooperation on climate change is the Caribbean Planning for Adaptation to Climate Change (CPACC) programme. With resources obtained from the GEF trust fund, Caribbean SIDS cooperated in identifying

strategies to cope with adverse effects of climate change, particularly sea level rise. In addition, work was undertaken to develop an integrated management and planning framework for cost-effective responses and adaptation to climate change in coastal and marine areas, to provide training and institutional strengthening that could enhance regional and national capacities, and to identify and assess policy options. Based on the success of these initial activities, the Caribbean SIDS went on to create a sub-regional institution that will be dedicated to supporting action in the region on climate change.

Regional cooperation programmes, with the support of the GEF, are also under way in the area of renewable energy, in the Caribbean and the Pacific. These programmes are designed to remove barriers to renewable energy use and to facilitate the promotion of the widespread implementation of renewable energy technologies. With these programmes in place, the Pacific and Caribbean regions hope to increase the use of renewable energy in the years to come. In the Caribbean, for example, renewable energy provides less than 2 percent of the region's commercial electricity. The planned activities being undertaken, are projected to increase that figure to some 5 percent by 2015, resulting in an annual reduction of carbon dioxide emissions by some 680,000 tons.

In 2001, two new funds – the Least Developed Countries (LDC) Fund and the Special Climate Change Fund (SCCF) – were established, and an Adaptation Fund was set up under the Kyoto Protocol. Collectively, these constitute important new channels for mobilizing resources to



support the implementation of climate change activities in SIDS in addition to those available through the GEF Trust Fund, through bilateral and multilateral funding, and through private-sector investments.

Of the three funds, only the LDC Fund was operational by the end of 2002 – supporting, among other efforts, the preparation and implementation of national adaptation programmes of action (NAPAs). When completed, these will serve to identify key and urgent adaptation needs in LDCs, such as capacity-building, policy reform, integration of climate change considerations into sectoral policies, and project-level activities in key economic sectors. Total contributions of USD 32.5 million had been received; USD 11 million was spent to support the preparation of NAPAs. Ten SIDS that are also LDCs have received assistance in preparing these programmes of action. The GEF continues to mobilize additional resources to replenish the LDC Fund so that it can support the implementation of NAPA projects designed to address urgent and immediate climate-change-related action in eligible countries.

In 2003, the Conference of the Parties decided that the resources of the Special Climate Change Fund would initially be used to support priority activities in adaptation and technology transfer and in associated capacity-building. At the end of 2004, the SCCF became operational, and pledges of USD 34.7 million had been received. Ready to support eligible activities in early 2005, the SCCF becomes an important source of funding for action by SIDS in the areas of adaptation and technology transfer.

With the Kyoto Protocol's entry into force on February 16, 2005, two new and important sources of funding will become available to SIDS: the Adaptation Fund and the Clean Development Mechanism (CDM). The Adaptation Fund will be operationalized by the GEF with proceeds from CDM projects and with contributions from donor countries. Its resources will assist SIDS meet the costs of adaptation to the adverse effects of climate change.

The Clean Development Mechanism offers an opportunity to mobilize additional resources for the implementation of projects in SIDS that help mitigate climate change and at the same time advance sustainable development. It is expected that implementation of small-scale CDM projects, especially in the area of renewable energy, energy efficiency, fossil-fuel switching, agriculture, landfills, and low GHG emission vehicles, will channel additional resources to promote the transfer of environmentally safe and sound technology and know-how apart from those available under the GEF Trust Fund and the SCCF.

These are just a few examples of concrete actions being undertaken by SIDS both to contribute to the Climate Change Convention and to take steps to mitigate the inevitable impacts of climate change. Small island developing States contribute very little to global warming. On average, the SIDS emit just 1.5 per cent as much GHGs as industrial countries do.

# Contributions to global warming

*"We are not endowed with any natural resources. Our day-to-day energy need is totally dependent on imported fossil fuels. While not obligated to set emission control targets under the Convention, Singapore has already invested millions of dollars to contain our CO2 emissions."*

*"We have made conscious effort to limit greenhouse gas emissions due to power generation. Switching from fuel oil to natural gas is an effective measure to reduce CO2 emission."*

*"In the transport sector, we have actively discouraged private car ownership and promoted the use of public transport. As part of government's continual effort to help mitigate global warming, we have recently announced the introduction "green" vehicle tax incentive in 2001 to encourage the import of electric and hybrid vehicles."*

*"On the energy demand side we have formed an interagency Committee on Energy Efficiency (IACEE) to take a critical look at Singapore's energy consumption"*

Statement by Singapore  
21 November 2000, The Hague, Netherlands  
(COP 6)



### *SIDS have a very low level of GHG emissions*

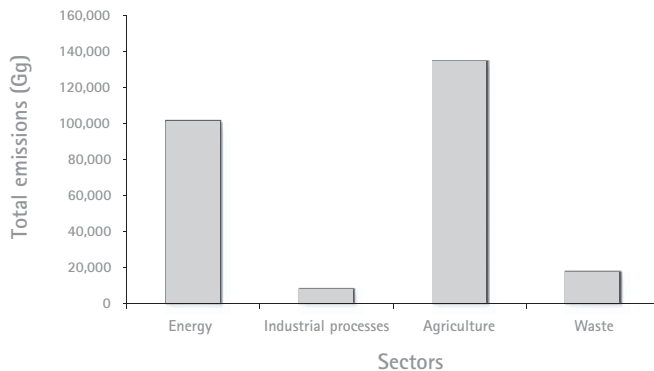
The total aggregated reported emissions from SIDS are extremely low, 258.5 million tonnes of carbon dioxide equivalent in 1994 (see table 1). In contrast, industrialized countries that are Parties to the UNFCCC emitted 16.7 billion tonnes of carbon dioxide equivalent that year.

### *SIDS have a rather unusual distribution of GHG emissions*

In the sectoral distribution of aggregated GHG emissions in SIDS, the agriculture and energy sectors together accounted for about 90 per cent of total emissions in 1994 (see figure 3). Emissions from the waste and industrial processes sectors were not insignificant, however.

The profile of the GHG emissions of SIDS is also quite different from that of industrial nations. In terms of aggregated emissions (in carbon dioxide equivalent) in 1994 (or the closest year available) nitrous oxide appears to be the largest GHG emitted (47 per cent of the total aggregated emissions), compared with carbon dioxide at 41 per cent, followed by methane (12 per cent). This is in sharp contrast to industrialized countries, where carbon dioxide is the dominant GHG.

**Figure 3:** Aggregate greenhouse gas emissions (excluding LUCF) for SIDS, by sectors



### *SIDS have limited capacities to report on GHG emissions*

The comprehensiveness of reporting on GHG inventories varies widely among all Parties to the Convention; in the case of SIDS, the full range of sectors – energy, industrial processes, agriculture, land-use change and forestry, and waste – is seldom included; generally only a few sectors are covered, mainly energy. The type of gas reported is also generally rather limited; sometimes only one or two gases are reported on, with carbon dioxide being the most common.

**Table 1. Aggregate greenhouse gas emissions (excluding LUCF), small island developing States, 1994 or closest year**

Region	Country	Aggregate emissions, by gas		
		CO <sub>2</sub>	CH <sub>4</sub> (thousand tonnes)	N <sub>2</sub> O
Africa	Cape Verde*	218	69	6
	Comoros	71	55	393
	Mauritius*	1 738	97	224
	Seychelles*	179	54	24
	<b>Total Africa</b>	<b>2 206</b>	<b>275</b>	<b>647</b>
Asia and The Pacific	Cook Islands	33	11	37
	Kiribati	19	9	-
	Maldives	129	24	-
	Marshall Islands***	-	-	-
	Micronesia (Federated States of)	236	7	3
	Nauru	28	7	0
	Niue	4 441	14	28
	Palau	86	32	7
	Papua New Guinea	1 141	90	3 782
	Samoa	102	69	389
	Singapore	26 800	-	59
	Solomon Islands	294	-	-
	Tuvalu	5	1	0
	Vanuatu	55	235	9
	<b>Total Asia and the Pacific</b>	<b>33 369</b>	<b>499</b>	<b>4314</b>
Latin America and the Caribbean	Antigua and Barbuda**	288	98	2
	Bahamas	1 866	21	310
	Barbados	1 913	1 788	50
	Belize	598	5 566	171
	Cuba	23 497	9 356	5 248
	Dominica	77	63	13
	Dominican Republic	15 003	4 660	778
	Grenada	135	1 471	1
	Guyana	1 446	885	375
	Haiti	157	2 455	2 297
	Jamaica	8 561	1 222	106 443
	Saint Kitts and Nevis	71	59	34
	Saint Lucia	269	596	22
	Saint Vincent and the Grenadines	95	62	222
	Trinidad and Tobago**	14 987	1 116	239
<b>Total LAC</b>	<b>68 963</b>	<b>29 418</b>	<b>116 205</b>	
Other	Malta	2 310	342	17
	<b>Total other</b>	<b>2 310</b>	<b>342</b>	<b>17</b>
<b>Total SIDS</b>	<b>258 565</b>	<b>106 848</b>	<b>30 534</b>	<b>121 183</b>
<b>Total Annex I Parties (Industrialized countries)</b>	<b>16 719 707</b>	<b>13 581 320</b>	<b>2 057 727</b>	<b>1 080 660</b>

\* 1995 data.

\*\* 1990 data.

\*\*\* Marshall Islands did not provide national estimates of its anthropogenic emissions by sources and removal by sinks of GHGs not controlled by the Montreal Protocol.

# A special vulnerability to climate change

*"The sea is our very close neighbour. In fact, on the island where I live, Funafuti, it is possible to throw a stone from one side of the island to the other. Our islands are very low lying. When a cyclone hits us there is no place to escape. We cannot climb any mountains or move away to take refuge. It is hard to describe the effects of a cyclonic storm surge when it washes right across our islands. I would not want to wish this experience on anyone. The devastation is beyond description ... This concern is so serious for our people, that the Cabinet, in which I am a member, has been exploring the possibility of buying land in a near-by country, in case we become refugees to the impacts of climate change."*

Statement by Hon. Teleke P. Lauti  
(Tuvalu)

November 2000, The Hague, Netherlands  
(COP 6)





In spite of variations in geographical, physical, climatic, social, political, cultural and ethnic features and economic development, small island developing States share certain characteristics that underscore their overall vulnerability to climate change, climate variability and sea-level rise:

- Generally limited natural resources, with many already heavily stressed from unsustainable human activities
- A concentration of population, socio-economic activities, and infrastructure along the coastal zone
- High susceptibility to frequent and more intense tropical cyclones (hurricanes) and to associated storm surge, droughts, tsunamis and volcanic eruptions
- Dependence on water resources for freshwater supply that are highly sensitive to sea-level changes
- Relative isolation and great distance to major markets, affecting competitiveness in trade
- Extreme openness of small economies and high sensitivity to external shocks
- Generally high population densities and in some cases high population growth rates
- Inadequate infrastructure in most sectors
- Limited physical size, effectively eliminating some adaptation options to climate change and sea-level rise
- Insufficient financial, technical and institutional capacities, seriously limiting the capacity of SIDS to mitigate and adapt to any adverse impacts of climate change.

A few examples of the vulnerabilities in specific islands illustrate well this high level of susceptibility to the adverse impacts of climate change:

- In Barbados and many other islands, almost all foods, fuels, construction materials and other goods are imported
- In the Maldives and Papua New Guinea, some 50–80 per cent of the land area is less than 1 metre above mean sea level
- In the Seychelles, about 80 per cent of the infrastructure and population are found along the coast
- Critically limited resources are required to address pressing short-term environmental problems in Grenada
- In Palau, prolonged droughts are experienced during El Niño Southern Oscillation events
- Throughout the South Pacific region, frequent and more intense tropical cyclones, as well as climate-related and other extreme events, were experienced during the 1990s.

Due to the geographic location of the SIDS and the profound influences of oceanic circulation systems, natural precipitation varies from one year to the next much more than in other countries. This can lead to various forms of extreme rainfall events, such as droughts and floods, that have a wide range of adverse impacts – including some catastrophic damages – on natural and human systems.

Climate projections suggest that significant climate change and sea-level rise are expected in all regions during the twenty-first century. Increases in atmospheric concentrations of GHGs due to human activities over the



past 100 years will continue to alter the climate and related systems on Earth in the coming century, if not for longer. Subsequently, SIDS face the certain prospect of increased challenges to their efforts to achieve sustainable development.

Indeed, an ensemble of climate model simulations for seasonal temperature and rainfall changes in the four regions by the 2050s and 2080s project the following changes:

- Temperature increase is projected for all regions and for both seasons
- Warming over the Mediterranean and the Caribbean Sea areas is higher during northern hemisphere winters for both time periods, whereas warming in the other two regions exhibits different seasonal patterns for the 2050s and 2080s
- For the 2080s, SIDS in the Mediterranean area are projected to experience the highest warming, with surface air temperature rising by 3.9°C for December – February and 4.5°C for June – August
- Projections show a dominantly increased pattern in seasonal rainfall for the four regions, with islands in the Mediterranean area getting the most increase in rainfall during northern hemisphere winters (by the 2080s, 16 per cent higher than the 1961–1990 average level)
- The largest decline in seasonal rainfall is projected for SIDS in the Caribbean area, with a reduction during northern hemisphere summers of nearly 20 per cent.

These projected changes are likely to exacerbate the current climate-related stresses in various SIDS. Higher temperatures are expected to adversely affect the health of some island inhabitants who already suffer through heat waves and associated increased outbreaks of vector-borne diseases. The health of important marine species such as coral reefs will also suffer. Changes in seasonal rainfall patterns may take the form of more frequent and more intense droughts and floods for many of the already troubled SIDS.

Vulnerability and adaptation assessments undertaken by SIDS also support the prediction that sea level will rise worldwide as a consequence of climate change. This is consistent with the conclusions of the Third Assessment Report of the Intergovernmental Panel on Climate Change, which indicated that by the end of the twenty-first century global sea level will rise 9–88 centimetres depending on regional variations in ocean circulation and other geophysical conditions. Sea-level rise will vary across the planet, with some regions (such as the Pacific) experiencing a greater increase than the global average.

Although natural systems and people living in SIDS have developed a wide range of adaptive strategies and measures to cope with a certain degree of change in climate and sea level, in many of these nations the environment and various biological systems are already close to their tolerance limits or are experiencing climate-related stress. Their vulnerability to climate change – already high – thus worsens with each passing year.

# Potential impacts of climate change

*"The Maldives is an archipelago consisting of tiny islands scattered in a vast expanse of the Indian Ocean. Over 80% of the land area have less than one meter above mean sea level, climate change and its associated sea level rise would undoubtedly be a catastrophe and threaten the livelihood of the islanders in the Maldives alike many thousands of others in low-lying island states. Sixteen years ago in April 1987, Maldives experienced unusual high waves causing extensive damage to the islands. Two thirds of the whole Maldives, including the capital island, Malé, was inundated for two days causing extensive damage to the infrastructure. Male International Airport, the only gateway to the Maldives, was closed for two days, causing delays in receiving the relief assistance from the international community, cancellation of tourist arrivals and lot more."*

Statement by Mr. Abdullahi Majeed  
(Maldives)  
11 December 2003, Milan, Italy  
(COP 9 Round-Table )

Climate change is likely to have far-ranging effects on the environment and the economic prospects of small island developing States, as well as on the health of the people living in these areas.

### Water resources

The availability of freshwater is a major limiting factor for economic and social development in the SIDS (see box 3). Many of these countries rely entirely on a single source of water supply, making them highly vulnerable to climatic and other environmental changes.

In island States where rainwater is the primary source of supply, water availability is sensitive to rainfall patterns and changes in storm tracks. A reduction in rainfall coupled with sea-level rise, changes in El Niño intensity and frequency, and changes in rainfall seasonality would decrease the volume of drinking water, reduce the size of the thin freshwater lens. Additional water management and related challenges due to climate variability, climate change and sea-level rise include increased flood risks, impeded drainage and the presence of elevated water tables.

### The coastal environment

The loss of land along coastlines due to sea-level rise, especially on atolls and low limestone islands, is likely to disrupt all the economic and social sectors in these countries. Coastal erosion will have profound adverse impacts on the tourism industry and on infrastructure.

### Box 3. Impacts of climate change, climate variability, and sea-level rise on water availability and quality in small island developing States

Climate change and sea-level rise are likely to threaten freshwater resources through saltwater intrusion within freshwater aquifers. The frequency and severity of droughts, as experienced in recent decades, may intensify in the future. Countries such as the Bahamas and Barbados, which are almost entirely dependent on groundwater supplies, will be seriously affected. Mauritius depends on groundwater for 60 per cent of its water supply for domestic, industrial and agricultural purposes. Boreholes situated near the coast will be at risk due to saltwater intrusion.

Water resources will be threatened by a combination of droughts and lower rates of recharge of the groundwater lens on most atolls, such as the Federated States of Micronesia, Kiribati and Tuvalu.

Sea-level rise, along with the indiscriminate extraction of freshwater from the well fields, will put this already threatened resource at even higher risk in SIDS that depend on the extraction of water from shallow freshwater lenses, as the Bahamas does.

*"The older generation tells us that certain parts of the reefs were above water when they were young. Every year the storms are getting worse, both more intense and destructive. Sea water contaminates many of our precious fresh water lenses."*

Statement by Hon. Tom D. Kijiner  
(Marshall Islands)  
6 April 1995, Berlin, Germany  
(COP 1)

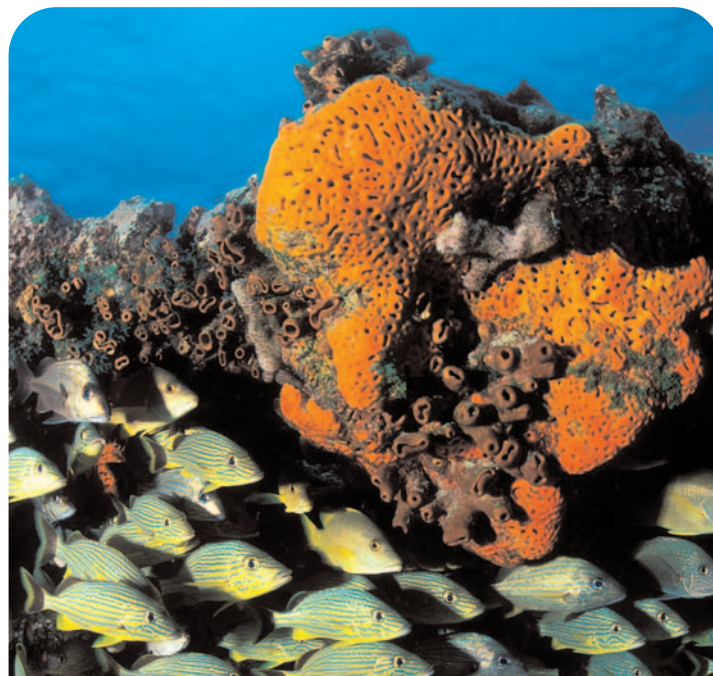


Human activities such as sand mining, coastal and beach erosion is already a problem on many islands – a problem that is likely to be exacerbated by sea-level rise. Papua New Guinea reports that 25 per cent of its existing shoreline has already been inundated. If sea level rises by 1 metre, the Maldives will disappear entirely, and in Grenada, up to 60 per cent of the beaches would disappear in some areas following a 50-centimetre sea-level rise.

Coral reefs have a huge influence on the lives of people in many SIDS. They function as natural breakwaters along the coasts of many tropical islands and they represent one of the most important natural resources for food, beach sand, and building materials. They also provide habitats for marine animals and reef fish, generating significant revenues for many island economies through tourists interested in snorkeling and scuba diving. On many islands, coral reefs are already facing threats from climate change and other stresses; Dominica, for example, reports that 15 per cent of its coral reef is showing some signs of bleaching.

Due to their narrow temperature tolerances, some species of corals currently live at or near their thermal limits. Projected increases in sea surface temperature suggest the thermal tolerance of reef-building corals will be exceeded within the next few decades. Moreover, the incidence of bleaching may rise rapidly (see box 4).

Mangrove forests, another coastal resource, have diverse and important ecological and socio-economic functions, providing protection against cyclones, storms, tides, storm



**Box 4. Extreme weather events induced by sea-water warming as cause of large-scale coral bleaching**

The 1998 El Niño caused sea-water temperatures to increase by 1.0–1.25°C in Palau over several weeks, which was followed by massive coral bleaching. During September 1998, the water temperature reached the level capable of inducing coral bleaching to a depth of 90 metres. Almost 70 per cent of Scleractinian corals were bleached at a 10–12 metre depth throughout Palau. Populations of some coral species declined by as much as 99 per cent, with an economic loss estimated at USD 91 million.

surges and the introduction of pests and exotic insects. They also function as nutrient sinks for animal and plant productivity, as soil stabilization forces, and as a source of wood products. However, many mangrove forests are under stress from excessive exploitation, reducing resilience to the projected rise in sea level (see box 5).

### Agriculture and food security

Subsistence agriculture is vital to SIDS economies, nutritional status and social well-being, particularly the low-lying atoll countries where food security is a major concern. Currently, subsistence agricultural production on some islands is already under stress from, for example, a shortage of freshwater. With climate change, the growth of subsistence root crops and vegetables is likely to be affected by heat stress, by changes in soil moisture and evapotranspiration, and by changes in extreme weather events, such as tropical cyclones, floods and droughts. Moreover, sea-level rise and its consequent saline intrusion will have major impacts on crop production, especially in low islands and atolls in the Pacific, where all the crop agriculture is found on or near the coast (see box 6).

Fisheries resources make a significant contribution to the protein intake of island populations. In tropical islands, marine ecosystems such as coral reefs, sea grass communities and salt ponds are important forage sites for a variety of fish species. The availability of fish can be affected by changes in water temperatures and the distribution of food sources they depend on. The unfavourable effects of higher carbon dioxide

### Box 5. Exacerbation of stresses on mangrove forests

Antigua and Barbuda is currently losing its mangrove ecosystems at an annual average rate of about 1.5–2 per cent, with a sea-level rise of 3–4 millimetres a year. Based on this, it is estimated that there will be few, if any, mangroves left in this nation by 2075, because the coastal slopes of most areas will not allow for landward retreat of these trees. If the sea level rises 10 millimetres a year, mangroves could disappear from Antigua and Barbuda by as early as 2030 or 2035.







concentrations on these ecosystems, coupled with ongoing widespread coral bleaching, pose serious threats to the resilience and livelihood in many small island States.

*"The extreme rainfall of 1997 cost Seychelles several million dollars in loss of agriculture and infrastructure. This year, as a result of an anomalous warming of the sea, corals were extensively bleached. The effects are still seriously felt in fishery. And as I speak to you now, if current drought conditions persist, jobs will be lost through critical water-dependents industries, such as industrial tuna processing and tourism."*

Statement by Seychelles  
November 1998, Buenos Aires, Argentina  
(COP 4)

## Biodiversity

The long-term survival of the generally rich biodiversity on small islands has already been under threat from such human-related stresses as pollution, overexploitation and poor management. As in other regions, climate change will have direct and indirect impacts on the biodiversity of SIDS. Increases in atmospheric carbon dioxide would alter the composition of species and threaten the diversity of marine ecosystems such as coral reefs, the habitats of endangered species and the breeding sites of sea birds. Sea-level rise could put such species at considerable risk.



### Box 6. Declines in food and fishery production expected

Unfavourable climatic conditions could be devastating to the banana industry and to the agricultural sector as a whole in St. Vincent and the Grenadines. Climate change, particularly changes in precipitation and atmospheric carbon dioxide concentration, is likely to result in changes in altitudinal zonation, species type, vegetation type and location. Moreover, sea-level rise and increased ocean temperatures coupled with marine pollution will have a substantial impact on the major nurseries of the fishing industry, such as mangroves and sea grass beds.

An increase in the frequency or intensity of El Niño events would adversely affect agricultural production, with the possibility of greater reliance on imported foods. Fish production has been reduced by up to 60 per cent in Grenada and in the Marshall Islands during an El Niño year.



## Human settlements and infrastructure

In most SIDS, narrow coastal plains provide attractive locations for human settlements and a variety of infrastructure – social services, tourism facilities, airports, port facilities, roads and vital utilities – to support economic and social needs. With the projected rate of sea-level rise and changes in the patterns of extreme events such as storms and coastal flooding, these settlements and critical infrastructure will be at severe risk (see box 7). In some countries, particularly low islands and micro-atolls, resettlement outside the national boundary may have to be considered. Implementing this could become extremely complicated, however, especially for densely populated coastal lowlands. In extreme circumstances, some atolls may be abandoned altogether, which could be socially and culturally disruptive as well as resource-intensive and which may be well beyond what most of these atoll countries can afford.

## Human health

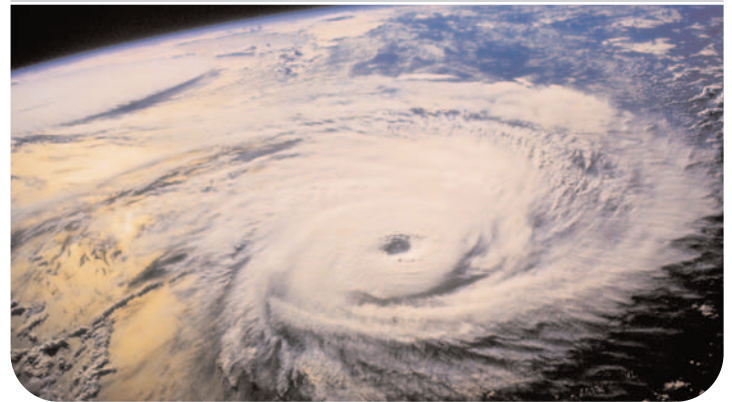
Many SIDS lie in the tropical zone, where the climate is favourable for the transmission of tropical diseases such as malaria, dengue, filariasis and schistosomiasis. In recent years, tropical islands have experienced high incidences of vector- and water-borne diseases that were attributed to changes in temperature and rainfall patterns, which may be linked to events such as El Niño, droughts and floods. With a warming climate and disrupted water supplies and sanitation systems due to droughts and cyclones, there could be even more of an increase in the incidence of

### Box 7. Susceptibility of critically important settlements and infrastructure to extreme weather events

In Dominica, 90 per cent of the population lives along the coastal area. Most of these settlements have very little room for expansion except through hillside residential development – areas that are highly susceptible to the ravages of extreme events such as hurricanes.

All of the human settlement, industry and vital infrastructure of Kiribati, the Maldives, Marshall Islands and Tuvalu lie very close to the shoreline. Some islands are already severely affected, with losses not only of shoreline but also of houses, schools and other infrastructure. The Maldives will disappear entirely if the rate of sea-level rise exceeds the rate of coral growth and sand generation.

Most of the public infrastructure in Niue is situated on the western coast of the island, which is very susceptible to cyclone damage. Devastation by Cyclone Ofa in 1990 highlighted the vulnerability of the island; there was extensive damage to the general hospital, a hotel, a wharf and a number of private homes on the western coast.





these diseases. Malaria, for instance, is associated with a temperature above 22°C.

Outbreaks of water-borne diseases such as shigellosis, cryptosporidiosis, giardiasis, and amoebiasis could increase as a result of disruption of sewage and water supply systems. With changes in temperature and rainfall, some vectors could extend their current range, so there is likely to be wider transmission of some diseases (see box 8). The interior highlands of many islands are currently free of vectors that transmit malaria, dengue and other tropical diseases. They could become favourable breeding sites under climate change. An increase in the frequency and intensity in extreme weather events might also cause more physical injuries, as noted already in some Pacific island States.

*" we pointed out that our region already suffers heavily from a high incidence of tropical cyclones, and that rising sea levels, coupled with the anticipated increases in the frequency, and intensity of these cyclones, as a result of global warming, would effectively devastate most, if not all, of our vital infrastructure, and threaten the lives of a majority of our population. In the short time since Kyoto, we have experienced two of the most devastating hurricanes the region has ever suffered – Georges and Mitch."*

Statement by Hon. Vincent Lasse  
(Trinidad and Tobago on behalf of CARICOM and Haiti)  
12 November 1998, Buenos Aires, Argentina  
(COP 4)

#### **Box 8. Possibility of severe health problems due to extreme weather changes in rainfall patterns or temperatures**

In Kiribati, any change in the pattern of rainy and dry seasons, in temperature and in the moisture content of waste could trigger an increase in diseases, and new diseases might occur. A warmer climate could exceed the tolerable climate conditions for humans.

Preliminary analysis of the incidences of the three most common diseases in Grenada – influenza, viral conjunctivitis and gastroenteritis – indicates a close correlation with July and annual precipitation. Significant positive correlations are observed for August precipitation and the incidence of viral conjunctivitis and influenza. Thus changes in rainfall patterns during such critical periods will have considerable impacts on human health, comfort and welfare.





### Economic and socio-cultural resources

For most SIDS, tourism is an important contributor to national economies, foreign exchange inflows, and employment. For example, tourism accounts for 95 per cent of the gross national product in the Maldives, and 70 per cent of the labour force in the Bahamas is employed in the tourism sector.

Tourism could be disrupted through the loss of beaches, coastal inundation, degradation of coastal ecosystems, saline intrusion, damage to critical infrastructures, and the bleaching of coral reefs. Physical loss and damage to coasts and infrastructure in SIDS coupled with the projected milder winters in North America and northern Europe, would threaten the tourism industry by reducing the appeal of the islands as favourable destinations. In addition, the tourism industry may suffer from climate change mitigation measures, such as levies on aviation emissions which would increase the cost of air travel.

Climate change could have other direct and indirect economic and social impacts in some SIDS. The insurance industry is among the most sensitive to changes in the frequency and intensity of extreme weather events such as tropical storms and floods. Any increase in frequency or magnitude of such phenomena would trigger an increase in insurance premiums or lead to the withdrawal of coverage, as islands in the Caribbean have experienced after a series of severe hurricanes.

Climate change and sea-level rise will also put certain traditional island assets at risk, including subsistence, traditions, community structure, and coastal villages and settlements. Although it is difficult to attach a market value to some of these assets, they are of vital significance to SIDS. Sea-level rise and climate change, coupled with other environmental changes, have already been blamed for the destruction of some important and unique cultural and spiritual sites, coastal protected areas, and traditional heritage sites in several Pacific islands.

# Adaptation and constraints to developing adaptive capacity

*"I believe the experiences of our nation is quite similar to those of other small island developing States; and it means that we've already begun to experience the effects of climate change that for the most part, industrialized countries have brought upon us. The fear of submergence is not mere science fiction though that is all too easy for sceptics to dismiss.*

*I have no doubt that at current levels of emissions of greenhouse gases (or even at levels where there is only a nominal decrease in the level of emissions of greenhouse gases) submergence is a possibility. The primary point is, however, that a long, long time before that point is reached, our reefs could be dead, our fishes fleeing, our groundwater completely salinated, our food crops depleted and our islands made inhabitable. Needless to say, our economies destroyed."*

Statement by Hon. Isaac V. Figir  
(Federated States of Micronesia)  
30 March 1995, Berlin, Germany  
(COP 1)

Enhancing adaptive capacity is critical for the small island developing States if they are to meet the challenges of projected climate change and sea-level rise. Yet climate change is just one of many pressing problems that most SIDS face. Their socio-economic concerns include poverty alleviation, high unemployment, and the improvement of housing, education and health care facilities – all of which often compete for the slender resources available. Under these circumstances, progress in adaptation to climate change will almost certainly require the integration of appropriate risk reduction strategies with other sectoral policy initiatives in areas such as sustainable development planning, disaster prevention and management, integrated coastal management, and health care planning (see box 9).

SIDS recognize that adapting to climate change and variability could be costly and that in some cases it may require changes in societal norms and behaviour. Given the wide range of uncertainties associated with climate change and sea-level projections and with vulnerability and adaptation assessments, however, a no-regrets principle is important in order to use and manage limited resources in a sustainable manner and to cope with the many changing conditions – including climate change – in SIDS.

In spite of the wide range of adaptation options that could be successfully implemented in the SIDS, some fundamental constraints limit the choices of options and their implementation. Broadly, these barriers fall into three categories:

#### Box 9. Examples of adaptation measures identified by some small island developing States

- **Agriculture** – management and infrastructure development (Mauritius)
- **Water resources** – more efficient management of both demand and supply; improved monitoring and forecasting systems for floods and droughts (Seychelles); desalination of sea water (Federated States of Micronesia, Malta)
- **Human settlement and infrastructure** – hazard mapping; improved forecasting and early warning systems; insurance provision (Antigua and Barbuda)
- **Public health** – development of a health surveillance and forecast system; strengthening of data collection and reporting systems; vaccination campaigns and health education (Saint Kitts and Nevis)
- **Tourism** – protection of essential facilities and infrastructure as part of the Integrated Coastal Zone Management strategy (Barbados, Grenada, Jamaica, Saint Lucia and Singapore)
- **Coastal zone** – integrated, sustainable coastal zone resource management (Dominica)

*“As an island State, we are at greater ecological and economical risks associated with adverse effects of climate change. We cannot over emphasize what Mauritius stands to lose if climate change problems are not addressed adequately and in a timely manner. The threat to agriculture, tourism and fisheries, three of the main pillars of our economy, cannot be overestimated.”*

Statement by Hon. R. A. Bhagwan  
(Mauritius)

21 November 2000, The Hague, Netherlands  
(COP 6)



### **Inadequate data or information and technical capacity for timely and effective adaptation planning**

In most SIDS, there is a lack of baseline information for understanding the complex interplay between and within natural and human systems in small islands. There is also a considerable gap in the provision of information on likely changes in climate and human systems at the small-island scale. Consequently, most SIDS have not yet been able to undertake an in-depth, nationwide climate change impact and vulnerability assessment in an integrated manner. Without such national assessments as a sound basis for designing and planning adaptation policies, strategies and programmes, decisions on adaptation will be problematic.

### **Weak institutional capacity**

Given the complex interactions and feedbacks between natural and human systems, any decisions on adaptation strategies must take an integrated approach across different sectors. With SIDS facing a variety of pressing economic and social challenges, however, there is an urgent need for a well-structured institutional framework to address climate change adaptation issues across sectors and scales. Hence, strengthening institutional capacity remains an important prerequisite for the effective planning and implementation of adaptation strategies at national level.



### Limited financial resources

Some of the adaptation options identified by SIDS may be costly and beyond their financial capacity (see box 10). The governments of these countries will therefore need international assistance to facilitate more detailed research into traditional, natural and less intrusive (and generally less costly) forms of adaptation.

#### Box 10. Examples of projected costs of adaptation measures

Protecting Jamaica's coastline from impacts of a sea-level rise of 1 metre is estimated to cost USD 462 million annually – 19 per cent of the country's GDP.

In order to protect Male, the capital of the Maldives, from flooding and the impact of large waves, a system of protective barriers (called tetrapods) was built at a cost of USD 4,000 per metre. Although this was largely financed by the Government of Japan, the project diverted much-needed development aid from other key socio-economic priorities. With projected changes in climate and sea level, maintaining and enhancing such protective structures will be difficult with only domestic financial resources.

*"As an island nation, Sao Tome and Principe continues to see our very existence threatened by global warming. Our shorelines erode, our national territory shrinks as the seas rise. Is my small country to end up nothing but a tiny volcanic peak sticking up above the waves with the last of our people clinging to the land left unclaimed by the rising sea? The Kyoto Protocol must be implemented by all for the benefit of all."*

Fradique Bandeira de Melo de Menezes  
President, Sao Tome and Principe  
24 September 2004, UN General Assembly 59 session



*"Our Pacific island nations, including my own country, know from bitter experience of cyclones that regularly batter our region, of the disheartening effect of disasters in setting back in a matter of hours hard-earned development achievements of many years. SIDS concerns and the vulnerability of our nations are therefore quite real. While we accept the primary responsibility for achieving the goals of the [Barbados] Programme of Action, the reality is that the support of the international community is indispensable to success."*

Tuila'Epa Sailele Malielegaoi  
Prime Minister, Samoa

24 September 2004, UN General Assembly 59 session

*"The catastrophic events of the present hurricane season bring into sharper focus yet another dimension of the vulnerability of Caribbean countries. The January 2005 International Meeting in Mauritius to review the implementation of the Barbados Plan of Action must seek to comprehensively address the new and emerging threats to the sustainable development of small island developing States...[A] whole new set of security issues have now arisen in the Caribbean as a result of these developments and the International Community might wish to take note."*

Patrick Manning

Prime Minister, Trinidad and Tobago

24 September 2004, UN General Assembly 59 session

# climate change

small island developing States



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