SUSTAINABLE DEVELOPMENT IN SMALL ISLAND DEVELOPING STATES
The case of the Maldives

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Abstract. This paper explores the status of sustainable development in small island developing states (SIDS), through the presentation of a case study on the Maldives, which is a typical small island developing state in the Central Indian Ocean. At the outset, a brief history of sustainable development as related to SIDS on the international agenda is outlined, starting from Rio to Barbados to Johannesburg. SIDS are expected to face many challenges and constraints in pursuing sustainable development due to their ecological fragility and economic vulnerability. It is the position of this paper that issues related to environmental vulnerability are of the greatest concern. A healthy environment is the basis of all life-support systems, including that of human well-being and socio-economic development. Priority environmental problems are: climate change and sea-level rise, threats to biodiversity, threats to freshwater resources, degradation of coastal environments, pollution, energy and tourism. Among these, climate change and its associated impacts are expected to pose the greatest threat to the environment and therefore to sustainable development. For small islands dependent on fragile marine ecosystems, in particular on coral reefs, for their livelihoods and living space, adverse effects of climate change such as increased frequency of extreme weather events and sea-level rise will exacerbate the challenges they already face. It is concluded that the ‘paper’ path from Rio to Barbados to Johannesburg has made significant progress. However, much remains to be done at the practical level, particularly by the developed countries in terms of new and additional efforts at financial and technical assistance, to make sustainable development a reality for SIDS.

Key words: biodiversity, climate change, coastal ecosystems, coral reefs, energy, freshwater, Maldives, pollution, sea-level rise, Small Island Developing States, tourism, vulnerability.


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1. Introduction

The challenges and needs faced by small island developing states (SIDS) (see Box 1) in pursuing sustainable development are widely recognised. It has been on the international agenda since the early 1990s, beginning with the United Nations Conference on Environment and Development or the Earth Summit at Rio de Janeiro in 1992. SIDS are thought to be both ecologically and economically fragile (Agenda 21; UNEP, 1999a,b,c). Ecologically, most of them are coastal entities with small and dispersed (in the case of archipelagic states) land areas. They generally possess a rich diversity of highly endemic flora and fauna but relatively few natural resources. Their geographical isolation, small size of the economy and dependence on a narrow range of products often leads them to be highly dependent on international trade and therefore are vulnerable to external shocks. Agenda 21 clearly recognises that there are special challenges to planning for and implementing sustainable development in these islands.

In 1994 the UN Global Conference on the Sustainable Development of SIDS was held in Barbados. This was the first global conference on sustainable development

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Note: There is no single definitive list of SIDS, but for the purposes of this paper, those included by the UN-Department of Economic and Social Affairs is used.

*Estimated figures; Source: CIA Factbook. The rest of the population figures are from national censuses.
and the implementation of Agenda 21. The main outcome of the conference was a framework for planning and implementing sustainable development in SIDS, the Barbados Programme of Action (BPOA), taking into consideration the special characteristics and constraints faced by these islands. This framework provides a synopsis of recommended actions and policies to be implemented over the short-, medium- and long-terms in 14 priority areas. These are: climate change and sea-level rise; natural and environmental disasters; management of wastes; coastal and marine resources; freshwater resources; land resources; energy resources; tourism resources; biodiversity resources; national institutions and administrative capacity; regional institutions and technical co-operation; transport and communication; science and technology; human resource development and implementation, monitoring and review.

A reaffirmation of the principles and commitments to sustainable development as incorporated in Agenda 21, the Barbados Declaration and the BPOA was declared during the 22nd special session of the UN General Assembly for the review and appraisal of the implementation of the program of action for the sustainable development of SIDS. World Leaders attending the Millennium Summit also expressed their commitment to continue to address the special needs of SIDS accordingly.

Most recently, at the World Summit on Sustainable Development (WSSD), the special circumstances of SIDS in relation to their environment and development as underlined in Agenda 21, the decisions adopted at the 22nd special session of the General Assembly and the BPOA were revitalised and given new impetus. The WSSD Plan of Implementation calls for action in the following areas:

- accelerating national and regional implementation of the BPOA for sustainable development for SIDS with adequate financial resources, including through Global Environmental Facility (GEF) focal areas;
- transferring environmentally sound technology and assistance for capacity building;
- implementing sustainable fisheries management and strengthening regional fisheries management initiatives;
- assisting SIDS in the sustainable management of their coastal areas and exclusive economic zones (EEZ);
- developing and implementing SIDS-specific components within programmes on marine and coastal biological diversity;
- assisting in the implementation of sustainable freshwater programmes;
- addressing waste and pollution and their health-related impacts by undertaking by 2004 initiatives aimed at implementing the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities;
- taking account of SIDS in World Trade Organisation (WTO) work programme on trade in small economies;
- developing community-based initiatives on sustainable tourism by 2004;
• extending assistance towards hazard and risk management, disaster prevention, mitigation and preparedness and relief from the consequences of disasters, extreme weather events and other emergencies;
• supporting operationalisation of economic, social and environmental vulnerability indices and related indicators;
• mobilising adequate resources and partnerships to address adaptation to the adverse effects of climate change, sea-level rise and climate variability;
• capacity building and institutional arrangements to implement intellectual property regimes;
• supporting the availability of adequate, affordable and environmentally sound energy services and new efforts on energy supply and energy services by 2004;
• capacity building for and strengthening health-care services with emphasis on HIV/AIDS, tuberculosis, diabetes, malaria and dengue fever;
• capacity building for maintaining and managing water and sanitation services in rural and urban areas;
• implementing initiatives aimed at poverty eradication;
• undertaking a comprehensive review and appraisal of the implementation of the BPOA in 2004 and request the General Assembly to convene an international meeting for the sustainable development of SIDS.

This paper explores the constraints and challenges faced by SIDS in their path to sustainable development, through the presentation of a case study on the Maldives, a SIDS located in the Central Indian Ocean (Figure 1). These characteristics are explored in relation to environmental and socio-economic vulnerability. Environmental vulnerability is of utmost importance as it is concerned with the risk of damage to the island’s natural ecosystems or environment which under-pin much of the socio-economic processes on SIDS. The paper also demonstrates that by their very ubiquitous nature, climate change and its associated impacts through sea-level rise and increased frequency of extreme weather events will greatly enhance these challenges and vulnerability. As emphasised by H.E. Ambassador Tuiloma Neroni Slade (2002) in his statement on behalf of Alliance of Small Island States (AOSIS), at the second session of UN Commission on Sustainable Development (CSD 10) in preparation for WSSD: ‘climate change is an additional and exacerbating problem that goes directly to the roots of their sustainability. This problem for small island communities is understated and seriously underestimated by the international community.’ Finally, progress on the implementation of sustainable development of SIDS according to the BPOA and the implications of WSSD Plan of Implementation is assessed.

2. Vulnerability and small islands

Small islands are by no means homogenous in their geographical distribution, physical characteristics, and social, cultural, economical and political contexts. However, they all share similar characteristics which constrain them in their path to
Over the last decade, these characteristics have been increasingly associated with the concept of ‘vulnerability’ of SIDS (UNEP, 1999a,b,c; Kaly et al., 2002).

The BPOA (Paragraphs 113 and 114) called for the development of vulnerability indices and other indicators that reflect the status of SIDS integrating ecological fragility and economic vulnerability. It is now widely accepted that indices such as the per capita income or GDP (which is often used as an indicator of the status of development of a country) are not adequate indicators of status of development in small island states. They neither reflect the complex interactions between the environmental resources and economic and social issues, nor the structural and institutional weaknesses facing SIDS.

2.1. Measuring vulnerability

Vulnerability can be defined as the extent to which the environment, economy or social system is prone to damage or degradation by external factors. Economic vulnerability is taken to refer to the risks faced by these economies from exogenous shocks to the systems of production, distribution and consumption. Environmental vulnerability is concerned with the risk of damage to the island’s natural ecosystems or environment (e.g. coral reefs, mangroves, freshwater, coastal areas, forests), including physical and biological processes, energy flows, diversity, genes, ecological resilience and ecological redundancy (UWICED, 2002; Kaly et al., 2002). Social vulnerability reflects the degree in which societies or socio-economic groups are affected negatively by stresses and hazards. In all the cases, the causal factors can be natural or anthropogenic or both, and can vary with time and place. All three types of vulnerability are a function of (i) the risk of hazards occurring, (ii) the intrinsic resilience (referred as the innate characteristics of a country that would tend to make it more or less able to cope with natural and anthropogenic hazards) and (iii) the extrinsic resilience (described as the ecological integrity or level of degradation of the ecosystems) (Kaly et al., 2002). Box 2 presents the natural and anthropogenic characters that are thought to contribute to their enhanced vulnerability.

Among the three components of vulnerability, issues relating to environmental vulnerability are of the greatest significance. A healthy environment is the basis of all life-support systems, including that of human well-being and development. A team of experts from the South Pacific Applied Geoscience Commission (SOPAC) has been working on the development of a global environmental vulnerability index (EVI) to characterise the vulnerability of natural systems. The EVI will allow comparisons among countries and through time. Priority environmental problems in SIDS have been identified to be climate change and sea-level rise, threats to biodiversity, threats to freshwater resources, degradation of coastal environments, pollution, energy and tourism (BPOA, UNEP, 1999a,b,c; United Nations, 1999b).

Vulnerability to climate change and sea-level rise is an area that deserves extra attention. This is noted by the fact it is on the top of the list of priority areas in the
Box 2. Characteristics of SIDS leading to their vulnerability.

- Geographical isolation
- Small physical size
- Ecological uniqueness and fragility
- Rapid human population growth and high densities
- Limited natural resources
- High dependence on marine resources
- Sensitivity and exposure to extremely damaging natural disasters
- Susceptibility to climate change and sea-level rise
- Small domestic market and high dependence of exports
- Limited terrestrial natural resource endowments and high import content
- Small economies with limited diversification possibilities
- Inability to influence international prices
- Peripherality (related to remoteness and isolation): high per unit transport costs, marginalisation, uncertainties of supply, need to keep large quantities of stocks
- Trade vulnerability: High dependence on trade taxes, vulnerability of domestic industries, dependence on trade preferences, inability to utilise the TRIPS agreement (Agreement on trade-related aspects of intellectual property rights), dispute settlement mechanism or accession
- Limited ability to exploit economies of scale
- Limitations on domestic competition
- Difficulties in absorbing FDI (foreign direct investment)
- Limited investment opportunities, including in communication services
- Problems of public administration
- Dependence on external finance
- Remittances

(List compiled from various sources: Kaly et al. (2002), UWICED (2002), Barbados Program of Action (1994), Witter et al. (2002))

BPOA, the special session of UN General Assembly to review the status of implementation of BPOA and as recently pointed out by Ambassador Slade at the CSD 10. The IPCC defines vulnerability to climate change as the degree to which a system is susceptible to or unable to cope with the adverse effects of climate change, including climate variability and climate extremes. It is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity and adaptive capacity (IPCC, 1998). It has been established that SIDS, as a consequence of their inherent characteristics, are particularly vulnerable to the effects of climate change (Hoegh-Guldberg et al., 2000; Burns, 2001; Nurse et al., 2001). For example, Gommes et al. (1998) calculated an index of vulnerability to sea-level rise, which was composed from the product of an insularity index (ratio between
the length of the coastline and the total land area that it encloses) and population density. Out of all the AOSIS members Maldives was shown to be the most vulnerable and protection cost is estimated to constitute 34% of GDP (Gommes et al., 1998). Hoegh-Guldberg et al. (2000) developed a simplified vulnerability index for Pacific small islands based on the following factors: physical exposure, political stability, population density/pressure, foreign aid per head and subsistence activities. The outcome showed that all the small states were highly vulnerable (Tuvalu, Kiribati, Cook Islands, Palau), while the lowest scores were obtained by the larger states of Vanuatu, Solomon Islands, Fiji and American Samoa.

In response to the BPOA, various groups of island experts have attempted to develop vulnerability indices that reflect the relative economic and ecological susceptibility to exogenous shocks. One example is the Commonwealth Vulnerability Index (CVI). The CVI is based on two principles: (i) the impact of external shocks over which the country affected has little or no control and (ii) the resilience of a country to withstand and recover from such shocks. In their analysis using a sample of 111 developing countries (37 small and 74 large), it was shown that small states were more vulnerable than larger countries, irrespective of income. Furthermore, of the 25 most vulnerable countries, 24 were small states out of which 17 were small islands. According to the study, the most vulnerable country in the world is Vanuatu. A review of many of these indices by an ad hoc expert group of the United Nations Department of Economic and Social Affairs in 1997 concluded that, ‘as a group, small island developing states are more vulnerable than other groups of developing countries’ (United Nations, 1998). However, at present, it seems there is no single satisfactory quantitative measure of vulnerability or vulnerability index (United Nations, 1998).

3. Maldives – a typical small island developing state

In the following section, the environmental, economic and social contexts of Maldives, a small island state, is analysed in order to explore the validity of the ‘special’ status given to SIDS, particularly in relation to environmental vulnerability and the priority environmental problems identified in the previous section. Maldives shares many similarities in terms of environment and socio-economic features with other SIDS, particularly the more vulnerable, smaller and low-lying islands of the SIDS group such as Seychelles in the Indian Ocean, Tuvalu, Kiribati and Nauru in the Pacific, as well as islands such as St. Lucia, Barbados and the Bahamas of the Caribbean.

The Republic of Maldives consist of a double chain of coral atolls, 820 km in length and 130 km at its widest point within a total area of 90,000 km², situated in the Central Indian Ocean (MPND/UNDP, 1999) (Figure 1). Geologically, the atoll chain is formed on the crest of a volcanic mountain range which extends 2000 km from the Lakshadweep islands near India to the Chagos islands south of the equator. There are an estimated 1192 coralline islands and found within the
lagoon are microatolls, faros, patch reefs and knolls. The abundance and variety of these reef forms, particularly ring shaped faros and microatolls are unique to the atolls of the Maldives (Naseer, 2000; MoT, 2000). It is estimated that the atolls of the Maldives are over 10 000 years old and have been known to be inhabited for up to 2500 years (MHAHE, 2001).

The islands are distributed among 26 natural atolls, which are grouped into 20 units for administrative purposes (MHAHE, 2001). The maximum height above sea level recorded is around 3 m. They vary in shape and size from small sandbanks with sparse vegetation to elongated strip islands. Although the total land area is estimated to be only 300 km², the maritime area of the country’s EEZ under the jurisdiction of the state amounts to more than 859 000 km² (MHAHE, 2001). Many of them are highly dynamic, being moved around the reef surface, or totally destroyed or formed during storms. Most of the islands are quite small (average 0.7 km²) with only nine being larger than 2 km². The largest island is about 5.2 km². Over 80% are low-lying with an average elevation above mean sea level of 1–1.6 m (MHAHE, 2001).

The climate is tropical, oceanic with little diurnal or seasonal temperature variation. Annual mean temperature range from 28°C to 32°C and on average receives 8 h of sunshine per day, throughout the year. The climate is governed by the southwest monsoon from April to August, characterised by strong winds and the northeast monsoon with gentler winds. Average annual rainfall is around 1855 mm per year (MHAHE, 2001).
The inherent nature of the islands predispose them to frequent damage from storm and wave surges. This vulnerability has direct implications for a number of activities related to the economy and indeed livelihoods.

### 3.1. Demography

In 2000, the total population of the Maldives was 270,101 (MPND, 2002). The average population growth rate was 2.8% in the period 1990–1995 and 1.9% in 1995–2000. If the current growth rate remains unchecked, the population can be expected to double in a space of 50 years. The population is spread over 199 islands and approximately 79% are below the age of 35 years. The most populous of the inhabited islands and the centre of commerce is the capital Malé. The population of Malé in 2000 was 74,069, which constitutes 27.4% of the total population (MPND, 2002). Further, at any one time there may be around 16,000 expatriates (MoT, 2000). With a total area of around 1.8 km², Malé is one of the most densely populated cities in the world (about 50,000 persons/km²).

The population density on some other islands is also very high. Nearly half the inhabited islands have population densities over 2000 persons/km². Of these inhabited islands, 90 have fewer than 500 people, 72 have between 500 and 1000, 38 have between 1000 and 5000 and only 3 have more than 5000 (MPND/UNDP, 1999; MNPD, 1999). Hence the population is extremely fragmented and dispersed.

For hundreds of years, the Maldives people lived more or less in harmony with their environment. This was made possible due to the low level of populations in the islands which fluctuated around 60,000–70,000 people from the early 1900s (Pernetta, 1989). Improved health care, for example the eradication of malaria and treatment of childhood diseases such as dysentery led to an explosive population growth from the late 1960s to a population of 200,000 in the 1980s, in just 20 years.

The rapid growth of population and high densities in some islands has put great pressure on the natural and economic resources. For example, the high densities of population in Malé have led to depletion of the freshwater aquifer and quality of living space. An average house in some of the overcrowded islands can have more than 12 adults, in addition to a number of children. Often, the houses are poor in quality of construction and in accessibility to essential services like water and sanitation. The level of overcrowding and lack of privacy are believed to be an increasing source of emotional problems and stress, which have been linked to such problems as juvenile delinquency, drug abuse, crime and child abuse, all of which appear to be on the increase. Other problems include increased number of school leavers competing for limited number of jobs and potentially high number of dependants with increased life expectancy. It is important to address these demographic patterns in order not to exceed the carrying capacity of the islands.
3.2. SOCIO-ECONOMIC STATUS

The Maldives relies totally on coastal and marine resources for subsistence and its economic development. Tourism and fishing are the major economic activities, contributing 18.5% and 6.9% to the GDP respectively. Historically, fishing was the main traditional occupation and economic activity of Maldivian people and was also the major source of foreign exchange earnings. Fishery is focused on tuna and reef fish such as ‘baitfish’, grouper, emperor shark and a variety of aquarium fish. However, in the last 15 years or so, tourism has become more important and the contribution of fisheries to the GDP has shown a declining trend. In 1978, fisheries contribution to the GDP was estimated at about 22% but by 1999 this figure has decreased to 6.5% (MHAHE, 2001). Trade in marine products is the next most important sector. Analysis of the fishing sector also shows that the number of persons employed in the sector is in decline, manpower base is ageing, fish catch is flat, some marine resources are being overexploited and tuna prices show marked fluctuations (MPND, 1999). Agriculture is carried out mainly at subsistence level, as land is scarce and the soils of the Maldives are poor, composed of parental coral rock and sand. They form a layer, from only few centimetres to about 20 cm thick, are alkaline and deficient in nitrogen. Agriculture is focused on mainly coconut, chillis, watermelon and a variety of root crops. The contribution of agricultural sector to GDP is around 7.7% (MHAHE, 2001).

The rate of tourism growth has been impressive, from a mere 1097 tourists (2 resorts) in 1972 to over 467 154 tourists (86 resorts) in 2000 (MoT, 1999). Tourism now generates approximately 40% of government tax and non-tax revenues. These earnings play a major role in the socio-economic development of Maldivian society, providing a source of funds for investment in essential social infrastructure such as educational, health institutions, transport and power generation. The contribution of tourism to total foreign exchange earnings and to the Balance of Payments is highly significant, even after taking into account the ‘leakages’. Leakages arise mainly due to imports of supplies, materials and equipment, remittances by overseas nationals, commissions, interest and profit share payments to overseas investors and lenders including tour operators, and can be as much as one third of total earnings (MoT, 2000). In 1998, net foreign exchange earnings from tourism contributed about two thirds of gross foreign exchange earnings and also covered 65% of imports other than tourism imports (MoT, 2000). Maldives economy is highly dependent on imports for commodities.

Tourism also generates a considerable share of employment and contributes directly to growth in household incomes generated from remittances associated with resorts and tourists. At atoll or island level, income generation opportunities are significant and many report an increase in their income and associated living standards. This is mainly through increased fishing, particularly reef fishing, carpentry and masonry in resort construction and maintenance, by supplying safari boats, local handicrafts, selling souvenirs, mat weaving and thatch for roofing material in resorts. In 1998, about 50% of the workforce were employed in the tourism sector.
However, it is important to note that over 40% of jobs in the sector are occupied by expatriates.

The lack of Maldivian employees in the tourism industry manifests a general shortage of skills in all sectors of modern economy and government in the Maldives. In 1995, only 32% of the population had completed primary schooling, while less than 6% had completed secondary, pre-university and university education (MPND, 1999). In the same period, it was estimated that one in five of all jobs in Maldives were occupied by expatriates (MPND, 1999). Rapid growth in tourism and other sectors mean an ever-increasing expatriate workforce and therefore greater leakage of foreign exchange earnings.

Real GDP per capita is currently around US$ 700 per person per annum with a growth rate of 6.2% in the period 1996–97. However, great disparities and inequalities in income and access to essential infrastructure exist between islands (MNPD/UNDP, 1999). This is most pronounced when Malé is compared with other islands. Income disparities between Malé and the atolls are reported to be in the order of 2:1 and access to social and physical infrastructure and services at 4:1 (MNPD/UNDP, 1999). The inequality in access to social and physical infrastructure is partly related to the high cost of providing these services to the small and dispersed populations. For example, the average construction cost of a primary school or a health clinic on an atoll in Maldives can be five to six times higher than that would cost in a non-SIDS developing country like Sri Lanka, due to the high cost of maritime transport, need to import building materials and failure to achieve economies of scale (MPND, 1999). The average income for households on Malé is around Maldivian Rufiya (MRf) 35 (~US$ 3) per person per day and MRf 20 (less than US$ 2) per person per day in the atolls. Approximately 1 in 4 of all Maldivians live on incomes of less than US$ 1 per day, or below the World Bank’s definition of poverty (MNPD/UNDP, 1999). Presently, a population and development consolidation strategy is being pursued in order to develop islands with the greatest potential for growth and expansion, with a view to attain equitable and sustainable development for the entire population (MHAHE, 2002).

3.3. FRESHWATER

Freshwater is confined to an underground ‘freshwater lens’ which comprises a freshwater zone separated by a transition zone of a few metres’ thickness between the freshwater and underlying seawater. This lens is found 1.5–2.0 m below the land surface and changes continuously with the tide. The water is alkaline and availability depends upon the rate of abstraction and recharge by rain. During the dry season, up to 25% of household in all atolls report a shortage of water (MHAHE, 2002). In the island of Malé (the capital) this lens has been severely degraded from overexploitation. The thickness of the freshwater zone has decreased from 20 m in 1973 to 6–8 m in 1983, and less than 3 m in 1993 (Pernetta, 1993). Additionally, due to the porous nature of the soil and poor waste disposal methods, the water is susceptible to pollution and contamination. Currently, the main source of freshwater in Malé
is from desalination – which is extremely costly, requires dependence on imported fuels and contributes to increased green house gas (GHG) emissions. Hence, it does not represent a very sustainable source. In view of the declining quality of water in most inhabited islands, high priority is now given to increasing rainwater harvesting by construction of rainwater storage tanks at both the community and individual levels (MHAHE, 2002).

3.4. Energy

The Maldives has no reserves of coal, oil or gas. Wood fuel is the main indigenous and most important source of energy. It is primarily used in the resident sector for cooking and a small percentage in fish processing, palm sugar making and lime making industries. In 1994, wood fuel made up almost 55% of total energy consumption (FAO-REWDP, 2000). The total energy consumption per capita was estimated at 4570 kWh for 1998 (IEA, 2000).

To a lesser extent, other biomass sources such as dried coconut husks, shells and leaves, various types of dried grasses and waste paper are also used. The use of wood for energy is a major cause of deforestation and at the same time presents serious health implications from indoor-air pollution, particularly to women and children.

Imported petroleum products is the chief source of commercial energy, of which the major part is used to produce electricity. Each island has to have its own power generation system and infrastructure, with the capital island Malé having the highest power generation and consumption. Electricity is provided by the government owned State Electric Company. Over 85% of the total electricity consumption is by the domestic sector, the rest being attributed to commercial and government consumption (Idris, 2000). The percentage of population with access to electricity has grown over the past decades. Now, more than 60 of the inhabited islands have electricity 24 h a day, accounting for 55% of the population. However, 21% of the population have less than six hours or no access to electricity (MPND/UNDP, 1999).

Solar energy is the only renewable form of energy utilised in the Maldives. For example, to power navigational lights, communication transceivers on fishing boats and for power supply at the remote installations in the national telecommunications network. The telecommunications network is the single biggest producer and user of renewable energy, in the form of solar power and solar–diesel hybrid systems. The largest site has a capacity of 3.5 kW and the aggregated capacity of the total of 177 sites is approximately 130 kW. The installations are not connected to the grid and are privately owned (Idris, 2000). There is a need to proliferate such renewable, sustainable forms of energy throughout the country. Access to energy is important, as it plays a major role in raising the living standards and quality of life of communities.
3.5. Pollution

The disposal of solid waste is a particularly critical problem. Limited land area makes the option of landfill unsustainable in the long term and other options of collection and disposal, such as incineration have so far proved to be economically unfeasible. Solid waste is produced in a much larger volume by tourist resorts than local inhabited islands. Estimated waste production is within the range 40–204 tons per year per resort, depending on the size of the resort, with up to 16.5 kg waste per visitor per week (Brown et al., 1997). Compared to other atolls, solid waste generated per capita in Malé is much higher, with an average of 2.48 kg per capita per day in Malé, as opposed to 0.66 kg of waste per person per day in the atolls (MHAHE, 2002). Waste from Malé, Hulhulé International Airport and many resort islands are transported to ‘garbage island’ to be disposed in a landfill. In many inhabited islands solid waste is just dumped near the beach or buried in unlined pits. Due to the high permeability of the coral limestone bedrock, the aquifer is susceptible to pollution from such activity with the risk of spreading diseases. Often wetland areas such as swamps and mangroves are also used as waste disposal areas, thus destroying these fragile habitats. Moreover, considerable amount of the waste is discarded at sea and in close vicinity of reefs, particularly in the case of outer atolls and heavily used tourist islands.

The only public sewerage system in the country was established in Malé in 1988 and more recently in the island of Villingili, where untreated sewage is discharged directly into the sea on both the lagoon and ocean sides of the island. Effluents from septic tanks and raw sewage are discharged directly into the sea from tourist islands and on more isolated islands open beaches are frequently used. Nutrient rich waste water affect the growth of hard corals which favour nutrient-poor conditions. The impact is manifested in enhanced growth of seagrasses and algae, which although localised at first, may become more extensive depending on the site conditions and level of discharges.

Another significant source of pollution comprise fish processing factories and other islands where fishing is an important economic activity. Fish are cleaned at the beach and the waste is dumped directly into the lagoon. Such activity not only poses risk to the reefs, but to human health as well via spreading of diseases. Studies in fishing villages of Laamu Atoll, where such pollution and anthropogenic enrichment of lagoon systems by fish wastes occur, an increase in sea grass has been observed (Miller and Sluka, 1999). The sea grass has been observed to encroach upon corals of lagoonal patch reefs and although the impact of sea grass competition on these reefs have not been investigated, it is suggested that it could pose a threat to these reefs.

With the increased frequency of sea transport, pollution by diesel and oil is another potential threat. Increased shipping traffic with the associated risk of oil spills and dumping, and oil pollution from the increasing mechanisation of fishing boats especially in and around fishing ports and harbour areas are of particular
concern. Moreover, the used oil is often just disposed of in the sewerage system or dumped with other solid waste in containers.

Presently, since Maldives does not practice large-scale agriculture or farming, pollution from pesticides or fertilisers is a minor threat. The disposal of hazardous waste is another major issue, though fortunately, it is believed that the generation of hazardous waste, particularly from other atolls is minimal (MHAHE, 2002).

3.6. BIODIVERSITY

The extent of biological diversity including flora and fauna present in the islands of the Maldives has not been adequately documented, but as is common for atolls/islands highly endemic flora and fauna are found. Vegetation consists mainly of coconut palms, banyans, bamboo, pandanus, banana, mango, and breadfruit trees. Based on published data, 583 species of plants have been recorded and of these 55% are cultivated species. Occasionally, mangroves may be found fringing the ocean sides of the islands, but they occur more commonly associated with inland brackish water bodies. Terrestrial animal species are rather limited, however, about 165 species of seabirds, shorebirds and landbirds are recorded (Zuhair, 1997).

In contrast to the terrestrial biodiversity, the marine biodiversity is amongst the richest in the region. The coral reef area of Maldives is one of the largest and support the greatest diversity of corals and associated organisms, along with the Chagos Archipelago, in South Asia (Rajasuriya et al., 2000). This is also because Maldivian atolls form part of the so-called ‘Chagos stricture’ representing an important link or stepping stone between the reefs of the Eastern Indian Ocean and those of the Eastern African region; and as such the fauna combines elements of both eastern and western assemblages (Spalding et al., 2001). The total coral reef area is estimated at 8920 km² and contributes 5% of the world’s reef area (Spalding et al., 2001). In the Maldives, over 250 species of scleractinian corals (representing over 60 genera) and over 1200 species of reef fishes are recorded (Pernetta, 1993). 400 reef fish species have been identified and catalogued out of which 7 species are endemic (Naseer, 2000). A great diversity of other marine species including 36 species of sponges, 400 species of molluscs and 350 species of crustaceans are also found. Five species of turtles are found in the Maldivian waters, all of which are endangered, including the loggerhead, green, Hawksbill, Olive Ridley and leatherback turtles (MHAHE, 2002). Seven species of dolphins and nine species of whales are also recorded. Though not well documented, mangroves and seagrass systems are also present associated with coral reefs of Maldives. Seagrass beds are often found in shallow lagoons behind the coral reefs. It provides a habitat to various crustaceans, molluscs and fish. More importantly, it is also believed that these habitats provide a breeding ground for many coral reef and other marine fishes.

Coral reefs possess great ecological, social and economic value wherever they occur in the world. Members of practically all phyla and classes are believed to be present in coral reef ecosystems. They provide vast number of people all over the world with food, recreational possibilities, coastal protection, as well as aesthetic
and cultural benefits and are described to have tremendous value as life-support systems to society (Moberg and Folke, 1999). One estimate suggests that reef habitats provide living resources (e.g. seafood) and services (e.g. tourism, coastal protection) worth US$ 375 billion annually (Bryant et al., 1998). It is estimated that outside of the Western Pacific, the Maldives is the nation that is most dependent on coral reefs for the maintenance of land area, food, export earnings and foreign currency from tourism revenues (Spalding et al., 2001).

The high densities of people, lack of environmental awareness and poor management and developmental activities have placed great stress on the fragile coral reef ecosystems. Though, on the whole, Maldives coral reefs are in good condition, localised degradation has been experienced around those islands with high level of population and development. Causes of reef degradation include coral mining, dredging, land reclamation activities, pollution, badly engineered coastal constructions, channel clearance and tourist activities. About 11% of reefs are estimated to be at risk (Spalding et al., 2001) and about two to five percent are estimated as irreparably damaged prior to the 1998 bleaching event (Rajasuriya et al., 2000).

3.7. Climate change and sea-level rise

One of the greatest environmental threats to Maldives and other similar island states is climate change and sea-level rise. In the regions where small island states are located including the Indian Ocean, review of past and present trends indicate that temperatures have risen by as much as 0.1°C per decade and sea levels by 2 mm year$^{-1}$. It is reported that the 1990s was the warmest decade and 1998 the warmest year in instrumental record since 1861 (IPCC, 2001). For example, in the Maldives analysis of surface air temperature data available for Malé (central atolls) for the 30 year period (1969–1999) indicate that annual maximum temperatures have increased by 0.17°C per decade and the annual minimum temperatures by 0.07°C per decade (MHAHE, 2001).

Global ocean temperatures have increased significantly since the late 1950s and more than half of the increase in heat content has occurred in the upper 300 m of the ocean at a rate of about 0.04°C per decade. In the Maldives, for the period 1950–2000, a significant increasing trend of 0.16°C per decade is observed (Edwards et al., 2001). Evidence also shows that the ocean thermohaline circulation is weakening with consequences to global ocean heat distribution (IPCC, 2001).

Warm episodes of the El Niño-Southern Oscillation (ENSO) phenomenon (which consistently affects regional variations of precipitation and temperature over much of the tropics, sub-tropics and some mid-latitude areas) have been more frequent, persistent and intense since the mid-1970s, compared with the previous 100 years (IPCC, 2001).

Globally, average temperatures are predicted to rise by 1.4–5.8°C for the period 1990–2100 (IPCC, 2001). Mean rainfall intensity is also projected to increase by about 20–30%. The frequency of extreme temperatures during the dry season is
likely to increase with the implication of increased thermal stress conditions during the 2050s and more so during the 2080s. Such predictions imply more frequent episodes of droughts as well as floods for the region (Nurse et al., 2001).

Some studies also predict an increase of approximately 10–20% in the intensity of tropical cyclones under enhanced CO₂ conditions (Nurse et al., 2001). Another cause of concern is the projected increase, though small, in amplitude of ENSO events. The ENSO phenomenon is the strongest natural fluctuation in climate on interannual timescales (IPCC, 2001). Though it has its core activity in the tropical Pacific, changes associated with it can have far reaching consequences in other regions, as manifested by the mass coral bleaching events around the globe due to sustained high sea surface temperatures (SSTs) linked to the ENSO events. The Central Indian Ocean was the hardest hit during the most recent and strongest ENSO episode in 1998. Box 3 provides some examples of extreme weather events and their implications in Maldives.

Sea level is projected to rise at a rate of 5 mm year⁻¹ (with a range 2–9 mm year⁻¹) and may rise in the range 0.09–0.88 m by 2100 (Nurse et al., 2001). For low-lying SIDS this represents perhaps the greatest threat. Already in the island of Tuvalu

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**Box 3. Extreme weather events.**

**April 1987:** Severe swell waves caused widespread damage to Malé, the international airport at Hulhule and other surrounding inhabited islands and resorts. On Malé the swells either washed away or inundated a large part of the 600 000 m² of land reclaimed from the shallow lagoons along the southern and western coasts. The area had been reclaimed between 1979 and 1986 at a cost of Rf 50 million (US$ 4.2 m) (MPND, 1999). A large part of the retaining wall on the southern seafront was also destroyed and the cost of breakwater repairs and rebuilding was estimated at US$ 5 million (Edwards, 1989; MPND, 1999). In addition, a waste disposal compound was badly affected, spreading refuse to surrounding areas leading to outbreaks of diarrhoeal diseases (MPND, 1999). To prevent a recurrence of such events and to set up an improved system of coastal defence around Malé, an estimated US$ 51 million was utilised, acquired through foreign aid (MPND, 1999).

**June–July 1988:** Flooding and wave damage to mainly the western side of the archipelago due to severe southwest monsoon. Thulhadoo was flooded for up to 30 m inland and 32 houses had to be evacuated (Edwards, 1989). About 3–5 m of beach area was also eroded on the south side of the island.

**May 1991:** Severe storms swept over the archipelago, with worst effects on the southern islands. The storms damaged or uprooted about 60 000 banana trees and thousands of mango and breadfruit trees in Addu Atoll alone. Around 2000 buildings were also reported to be damaged (MPND, 1999)
and some islands of Papua New Guinea in the Pacific are experiencing storm overwash and shrinkage of their land area by 20 cm per year (Boyd, 2001). For a typical island of the Maldives, the potential effects of sea-level rise under different climate change scenarios projected for Maldives is presented in Figure 2. Based on the IS92a and IS92e GHG emission scenarios of the IPCC, climate models predict that by the end of this century the temperature may have increased by 2.0–3.8°C and sea level may rise by 49–95 cm.

Figure 2 illustrates that with a maximum height above mean sea level of less than 1 m, potential sea-level rise of even few centimetres will have tremendous impact on these low-lying islands, culminating in total inundation. Moreover, this is expected to occur in the very near future (2025).

Another critical concern to the Maldives would be impact on the groundwater availability. Rising sea levels would decrease the thickness of the freshwater lens and therefore the availability of freshwater. Moreover, storm over-wash of the islands by increased frequency and intensity of storms will lead to increased incidences of contamination of freshwater by saltwater.

The scientific community agrees that though there is a large degree of uncertainty about the mechanisms involved and about the likelihood or timescales of such transitions, the possibility for rapid and irreversible changes in the climate system exists (IPCC, 2001). Furthermore, they establish that there already is a global commitment to climate change and sea-level rise as a result of greenhouse forcing arising from historic emissions. Even with a fully implemented Kyoto Protocol, by 2050 warming would be only about 1/20th of a degree less than what is projected and therefore, climate change impacts are inevitable (Nurse et al., 2001).
3.8. IMPLICATIONS OF CLIMATE CHANGE TO SUSTAINABLE DEVELOPMENT

The United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto protocol stated its main objective to achieve stabilisation of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (UNEP/IUC, 1999a,b). Simultaneously, it also proposed that such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner (UNEP/IUC, 1999a,b). Unfortunately, progress in meeting these goals has been minimal.

For countries like Maldives and other SIDS that depend to a large extent on fragile coastal and coral reef ecosystems for livelihoods and income, the current situation is distressing. They are very sensitive to changes in their environment, and therefore would be one of the first ecosystems to be affected by global climate change. The potential severe degradation of coral reefs and other associated coastal ecosystems will greatly hinder the ability of SIDS to promote sustainable development. Ironically, SIDS have contributed least to GHG emissions (Table I) but will be subjected to some of the most significant adverse effects of climate change.

When physiologically stressed, corals may lose much of their symbiotic algae (zooxanthellae), which supply nutrients and colour. In this state corals are referred to as ‘bleached’. Corals can recover from short-term bleaching by regenerating the symbiotic relationship with the zooxanthellae. However, during this period there would be slowed growth and reproduction, increased susceptibility to diseases, lowered ability to compete and withstand other stress factors. For instance, increased sedimentation or reduction in salinity due to heavy rains will impede recovery and lead to death. Prolonged bleaching can cause irreversible damage and subsequent mortality (Pomerance, 1999). Factors that cause bleaching can be both natural and human-induced. For example, prolonged high or low temperatures, high or low levels of visible light and UV radiation, low tides (long periods of exposure to air), low or high salinity, pollution and diseases. Increases of SSTs above the normal warmest period maximum is believed to be the major cause of mass bleaching events over the past two decades (Strong et al., 1998; Hoegh-Guldberg 1999; Wilkinson et al., 1999; Edwards et al., 2001). During the coral bleaching event of 1998, an

<table>
<thead>
<tr>
<th>Area</th>
<th>Population (millions)</th>
<th>CO\textsubscript{2} emissions per capita (t)</th>
<th>Total CO\textsubscript{2} emissions (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maldives</td>
<td>0.24</td>
<td>0.54</td>
<td>0.13</td>
</tr>
<tr>
<td>Pacific Islands</td>
<td>7.1</td>
<td>0.96</td>
<td>6.82</td>
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<tr>
<td>OECD</td>
<td>1092.3</td>
<td>11.09</td>
<td>12117.05</td>
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<tr>
<td>World</td>
<td>5624.4</td>
<td>4.02</td>
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estimated 90% of the reefs of the Maldives were bleached either partially or totally (Edwards et al., 2001). Fortunately, recovery is recorded in many areas. However, if the increasing trend in SSTs of Maldives at 0.16°C per decade continues, and the April–May high temperature anomalies as experienced in 1998 (which led to the mass bleaching) would become a regular event in only 30 years’ time (Edwards et al., 2001).

The health of reefs are directly correlated to the economic mainstays of the nation: fishery and most importantly, reef-based tourism which is the driving force of the Maldives economy. Reef fishery presently comprises only a small percentage of total fishing activity, which is based on tuna fishery. However its importance is increasing, and moreover, the baitfish which are dependent on coral reefs is of great importance to the pole and line tuna fishery. In this way, reef fishery and tuna fishery are inextricably linked. Though some changes in the diversity and abundance in reef fish have been noted following the mass coral bleaching event, no major changes in the fishery have been reported. It is believed that effects on fishery would take a longer time manifest.

Around 45% of all tourists visiting Maldives are divers, with 69% of the divers making more than 5 dives during their stay (Westmacott et al., 2000). One estimate suggests that annual total number of dives made by visiting tourists is around more than half a million, at a cost of US$ 35 per dive (MHAHE, 2001). The financial losses to tourism in Maldives due to the April–May 1998 mass coral bleaching event was estimated at US$ 3 million. A further survey focusing on tourists’ willingness to pay (WTP) for better reef quality identified that for 47% high quality reef was of utmost importance. Global welfare loss to the Maldives due to the bleaching event was estimated at US$ 19 million (Westmacott et al., 2000).

It is estimated that close to 70% of tourists also visit Maldives for its white sandy beaches (MoT, 2000). Hence, loss of beach area through increased erosion related to increased frequency of storms and other extreme weather episodes or general degradation of reefs which supply the sand to islands and sea-level rise would represent an additional considerable loss to tourism.

Another area of major concern is the impact to valuable infrastructure. For example, currently, an average investment for a resort with 200 beds is estimated to be over US$ 9 million and for a modern 700 bed resort US$ 43 million (MoT, 2000). Notwithstanding the fact that islands are so small that the entire island has to be considered a coastal entity, tourist demand encourages building rooms as close to the beach as possible and even over the lagoon itself on stilts. An estimate from one resort indicate that US$ 60 000 per year is needed to maintain coastal protection of the island for example in the form of groynes. (MHAHE, 2001). Impact to other important investments such as the airport on the island of Hulhulé is also of major concern. Hulhulé is between 1.0 and 1.7 m above sea level. The runway itself is only 1.2 m above mean sea level and has only 0.5 m clearance at highest high water (MHAHE, 2001). Damage caused to Hulhulé due to the 1987 tidal wave episode was considerable and cost of repairs were estimated at US$ 4.5 million (Edwards, 1989) (see also Box 3). The total investment in the airport to date is estimated at
around US$ 57 million, excluding the cost of recently opened Hulhulé Island Hotel and other investments by local businesses (MHAHE, 2001).

The coral reefs provide natural protection to the islands from waves, storm surges and flooding. At the same time, the shapes and size of the small islands are determined by the tidal and current patterns. The beach systems on them are highly dynamic and have directional shifts within the shoreline in accordance with the prevailing seasonal conditions (MHAHE, 2001). These features make them extremely vulnerable to erosion. It is estimated that 50% of all inhabited islands and 45% of all tourist resort islands suffer from varying degrees of beach or coastal erosion (MHAHE, 2001). The cause is not clear but changes in the intensity of wind and the resulting changes in currents and waves could be one reason as well as reef degradation and erosion. In a recent study of the reefs of Chagos following the 1998 coral bleaching and mass mortality event, 1.5 m of reef surfaces have been shown to be eroded, together with reduction in the three-dimensional structure (Sheppard et al., 2002). Another reason could be badly engineered coastal structures such as groynes, jetties, and causeways which alter currents and sedimentation patterns. Coral and sand mining, dredging, land reclamation and the consequent destruction of coral reefs can be another major cause.

Already a 1.5 km long breakwater at a cost of US$ 14 million with has been constructed on the southern side of Malé following the 1987 flooding by tidal waves. More recently, protective seawalls have been constructed on the western, eastern and southern perimeter of Malé at a cost of US$ 100 million. The estimated cost for the seawall that is presently under construction on the northern side is US$ 20 million, bringing the total cost of protection of Malé alone to US$ 134 million (MHAHE, 2001). These defence structures were built only to protect Malé from waves of height 2 m above present mean sea level (as experienced in extreme weather episodes) and at the time, the potential impacts of climate change were not taken into consideration at all.

Maldives has limited options to respond to coastal erosion and inundation. Three possible coastal responses were proposed by Biljsma et al. (1996) in the IPCC Second Assessment Report (cited in McLean et al., 2001):

1. **Protect:** which aims to protect the land from the sea so that existing land uses can continue, by constructing hard structures (e.g. sea walls) as well as using soft measures (e.g. beach nourishment).
2. **Accommodate:** which implies that people continue to occupy the land but make some adjustments to, for instance, elevating buildings on piles.
3. **Retreat:** which involves no attempt to protect the land from the sea; in an extreme case the coastal area has to be abandoned.

Given the natural features of the islands – the small size and overall low elevation of entire islands, adaptation measures such as accommodation and retreat may not be viable options. Protection appears to be the most feasible adaptation option. However, even under protection, soft (also less expensive) measures such as beach nourishment are also difficult to implement, as beach material is limited in supply.
Additionally, their extraction from lagoon, as has been practised, has been observed to further exacerbate erosion problems. In the light of these limitations, hard engineered coastal protection structures such as seawalls seem to be the appropriate option. But as noted, this type of protection measure is extremely expensive and presents a major financial drain to poor countries such as Maldives. Looking at the extremely high cost of protection by such methods, it seems obvious that it cannot be the solution for all the 199 inhabited islands. One estimate of the cost of protecting only 50 of these islands was projected to be over US$ 1.5 billion (MHAHE, 2001). With a GDP of US$ 161 million (in 1999), the cost of protection of only 50 of the 200 inhabited islands would be 9 times more than the country’s GDP. Therefore, without external aid, it would be an impossible task to achieve.

Coral reefs have survived major global climatic changes in geological history showing that they are potentially resilient and robust. Research has shown that corals and reef communities possess numerous mechanisms for acclimatisation and adaptation through diverse reproductive strategies, flexible symbiotic relationships, physiological acclimatisation, habitat tolerance and community interactions (NOAA, 1998). However, it should be noted that, periods of coral reef growth have been interspersed with major periods of no reefs; and fossil record and climatic history suggest that ‘coral reefs’ as we know them are geologically rare features (Buddemeier and Smith, 1999). Presently, the increased stress of human activities have already placed many reefs at risk. At the same time, coral reefs are expected to face a multitude of changing environmental factors such as rising SST, rise in sea level and increased intensity of extreme weather events at unprecedented rates. In the past, it may be that the absence of other stressors helped them to cope, for instance, with rising sea levels of about 20 cm per decade (Burns, 2001). Therefore, if environmental changes exceed the adaptive and aclimative capacities established under previous rates and ranges of disturbance, modern coral reefs will probably lose their resilience and robustness (NOAA, 1998).

4. Progress in implementation and future prospects

Although the paper has focused mainly on the problems faced by Maldives in relation to sustainable development, and in particular due to climate change, many of them are shared by most of the SIDS to varying degrees. It is worth noting that the United Nations Environment Programme (UNEP) has recently published state of the environment reports on the islands of the Pacific, Caribbean and Western Indian Ocean regions which provide comprehensive and valuable information on the environmental problems and policy priorities in the context of development, as part of their Global Environment Outlook (GEO) series. These reports provide an ideal source of information to compare with the situation of Maldives.

In summary, the importance of the relative vulnerability of the natural environment and economy of SIDS is now well established. Even though similar problems are present in most or all developing countries, because of the small size they are felt
more acutely in SIDS. As clearly illustrated by the case study on Maldives, the interdependency between environment and socio-economy is tremendous. For example, the extreme paucity of land-based resources, limited mineral resources, scarcity of arable land, and a lack of durable, sustainable building materials leads to over reliance on marine resources, destruction of coral reefs and mangroves for building and other purposes. The high population densities in some islands and coastal areas combined with high rates of population growth put increasing pressure on the natural and economic resources. Moreover, the population being scattered over numerous islands constrains equitable distribution of goods and services. The low elevation above sea level of much of the land area increases the susceptibility to coastal erosion, inundation and flooding by high waves associated with storms and other extreme weather episodes. The narrow economic base focused on fishery and tourism leads to economic vulnerability as these are sectors that are largely dependent on international markets, not to mention leading to the overexploitation of fish resources and degradation of the natural environment by tourism development. Additionally the high dependence on imports makes the economy very dependent on foreign exchange earnings, which in turn places heavy reliance on exports. Low income and purchasing power of the people, diseconomies of scale in production of goods and services, infrastructure and transport, lack of financial and human capital, and lack of skilled human resources are other factors contributing to its economic vulnerability. While SIDS face all these problems already, climate change will greatly enhance them and put tremendous burden on the SIDS governments to address the issue.

In terms of economic development, outlook for many of the SIDS is worrying. According to the UNCTAD (2002), out of the nine least developed countries (LDC) – SIDS, two are slow-growth economies (Sao Tome and Principe and Haiti), four are regressing economies (Kiribati, Vanuatu, Comoros and Solomon Islands) and only 3 are high growth economies (Maldives, Samoa and Cape Verde).

Annual review and appraisal of progress in the implementation of the BPOA for the Sustainable Development of SIDS is carried out by the UN-DESA. It was seen that, in general, overseas development assistance to SIDS has substantially declined (United Nations, 1999c). It was also seen that the pattern of bilateral Official Development Assistance (ODA) and Foreign Direct Investment (FDI) flow was largely determined by historical and geographical ties disadvantaging some SIDS. Analysis of trends in the external development support to SIDS between 1992 and 1997 showed that a considerable number of programme areas have not received adequate attention in terms of ODA. Looking at total bilateral and multilateral commitments, the larger shares were in human resource development, transport and communication, freshwater resources, land resources, coastal and marine resources and energy resources. Climate change and sea-level rise, biodiversity resources and management of wastes, all considered as high priority areas requiring urgent action, received the lowest level of assistance (United Nations, 1999c). In the light of this, the UN called for an intensification of efforts to provide external
development assistance through new and additional commitments and disbursement of resources. A mere shift in sectoral allocation of ODA resources will not be sufficient.

Similarly, at a meeting of representatives of donors and SIDS in 1999, under the auspices of UN–DESA and UNDP on the mobilisation of resources to assist SIDS in effectively implementing the BPOA, SIDS representatives pointed out that notwithstanding their efforts at national and regional levels, progress in the implementation of the Programme of Action has been impeded by, among other problems, lack of financial support from the international community, inadequate human resources with appropriate training, inadequate institutional capacity, inadequate capacity for the enforcement of environmental legislation and regulations, and inadequate investment resources (United Nations, 1999a).

The BPOA is far from being fully implemented and at the same time, it is estimated that 70% of the tasks and efforts outlined in the programme has been carried out by SIDS themselves (UWICED, 2002). One notable and valuable achievement of the BPOA is the establishment of SIDSnet, an internet site hosted under UN-DESA that provides a platform for communication and information exchange within SIDS and between SIDS and the rest of the world. Most SIDS also have in place National Environment Action Plans and National Development Plans which incorporate sustainability.

With regard to the WSSD Plan of Implementation, there are just seven time-bound targets in the plan: to halve the number of people without access to proper sanitation by 2015; to restore depleted fish stocks by 2015; and to significantly reduce the extinction rate of he world’s plants and animals by 2010. Time-bound targets directly related to sustainable development and SIDS were only established in relation to addressing waste and pollution, sustainable tourism, energy sector and for the review and appraisal of the BPOA by 2004. Sadly, there was no target date for the universal ratification of the Kyoto Protocol on Climate Change. Indeed, considerably more attention needs to be given to the major principles of sustainable development as they relate to SIDS, particularly, to Principles six and seven of the Rio Declaration and Article 3 of the UNFCCC.

*Principle 6 of Rio Declaration:* The special situation and needs of developing countries, particularly the least developed and those most environmentally vulnerable, shall be given special priority.

*Principle 7 of Rio Declaration:* In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit to sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

*Article 3 of the UNFCCC:* The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.
Although there were calls and pledges at the WSSD to increase ODA, no specific figures or dates were set. Presently, only five countries: Norway, Denmark, the Netherlands, Sweden and Luxembourg have so far met the 0.7% of GDP on development aid. The USA, the world’s richest country spends only 0.1% of its GDP on ODA (OECD, 2002).

It is clear that until the gap between commitments made and translation into action is bridged, the future remains bleak for sustainable development of SIDS.

5. Conclusion

SIDS appear to be the most vulnerable group of countries in the world, in terms of their ecology and economy. They face a multiplicity of challenges and constraints, related to their ecological fragility and environmental vulnerability in their path to achieve sustainable development. SIDS have a most intricate and sensitive relationship between their environment, socio-economy and culture and environmental vulnerability is a critical issue. The greatest environmental threat facing most of the SIDS is climate change and its associated impacts through sea-level rise and increased frequency of extreme weather events. Through the solidarity and hard work of SIDS, they have been able to establish international recognition of their special status and need for cooperation from the international community to assist them in their pursuit of sustainable development. This is manifested by the references to SIDS as a special case in the major international agreements and agenda related to sustainable development since the Earth Summit at Rio, culminating in the inclusion of a specific chapter devoted to SIDS and sustainable development in the WSSD Plan of Implementation. Hence the ‘paper’ path from Rio to Barbados to Johannesburg has made significant progress. However, in practical terms, much remains to be done. SIDS by themselves are working hard to pursue sustainable development, but they urgently need the assistance and cooperation from developed countries in terms of further and additional financial and technical assistance to persist in their path to sustainable development. Capacity building at all levels and sectors of development is of the highest priority – a prerequisite for self-reliance and lasting sustainability of any state. Otherwise, for most of the SIDS sustainable development will remain just a distant dream.

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