

Assessment of Solid Waste Management Practices and Its Vulnerability to Climate Risks in Maldives Tourism Sector

Submitted to:

Ministry of Tourism, Arts and Culture

Male', Republic of Maldives

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Acronyms

BPEO	Best Practical Environmental Option
CAPEX	Capital expenditure
CCTF	Climate Change Trust Fund
CDM	Clean Development Mechanism
EPA	Environmental Protection Agency
EU	European Union
GDP	Gross Domestic Product
GOM	Government of Maldives
IWMC	Island waste management centre
JICA	Japan International Cooperation Agency
LAM	Liveaboard Association of the Maldives
Maldives	Republic of Maldives
MATI	Maldives Association of Tourism Industry
MCC	Male' City Council
MEMP	Maldives Environmental Management Project
MoTAC	Ministry of Tourism, Art and Culture
MSI	Mauritius Strategy for further Implementation
MVR	Maldivian Rufiyaa
OPEX	Operations expenditure
SPREP	Secretariat of the Pacific Regional Environment Programme
SIDS	Small-island developing states
ToR	Terms of Reference
UNDP	United Nations Development Programme

Units

ha	hectare
kg	kilohgram
Km	kilometer
km ²	square kilometer
m	meter
m ³	cubic meter
mt	metric ton (tonne)
mtpd	metric ton per day

1. Summary

1.1 Background

The Republic of Maldives (Maldives) is an archipelago comprised of 1,190 coral islands in 26 atolls spread over an area of about 750 km on a north-south axis and 120 km on an east-west axis. The land area of Maldives accounts for about 1% of the country's territory. The Maldives' islands are low lying land areas with an average height above sea level of 1.8 meters (m).

The country's population of approximately 394,450 people (July 2012 estimate) lives on 198 of the 1,190 islands in the Maldives. An additional 80 islands have tourist resorts. About 70% of the inhabited islands have a resident population of less than 1,000 people. The estimated (July 2012) population growth rate for the Maldives was negative (-0.127%). Male', the urban center for the country, had as of 2009 an estimated population of 120,000, or 30% of the country's residents. The total urban population of Maldives is 40%.

The GDP for the Maldives in 2011 was reported as MVR (Maldives Rufiyaa) 20,051.0 million (in 2003 constant prices), or MVR 50,830 per capita. The annual growth rate in GDP from 2010 to 2011 was 7.5%, primarily due to increased tourism after the sector's contraction following the global economic crisis in 2008-2009.

In 2011 the Maldives set a record in tourist arrivals to the country with over 930 thousand visitors in a year, according to the Ministry of Tourism, Art and Culture (MoTAC). As important, the country had an annual average growth rate of tourist visits of nearly 18% in 2011. In the Maldives the four types of accommodations available to tourists are: resorts, hotels, guest houses, and safari vessels.

The initial resorts were developed on two atolls located near Male' and the international airport. Even though the islands available for tourism have expanded to the entire country, 67.5% of resort bed capacity is on the two atolls that were initially developed, which puts the majority of resort generated waste in relatively close proximity to the treatment center on Thilafushi Island.

From a tourism and solid waste perspective, the number of 'bed nights' increased by 9.1% to almost 6.53 million in 2011. This equates to an overall nationwide tourist bed occupancy rate of 73.1% in 2011.

The MoTAC's projection for the tourism sector through 2015 forecasts continued growth in tourist visits. Correspondingly the implication is for increased expansion of solid waste attributed to tourism.

1.2 Waste Characteristics

Waste Quantity. An estimated 860 metric tons per day (mtpd), or 312,075 metric tons (mt) per year, of solid waste is discarded in the Maldives. About 21% is attributed to tourism with the balance divided among urban areas (65%) and island communities (35%).

An estimated 134 mtpd of solid waste is generated by the 101 resorts in the Maldives; whereas, the safari vessels (157 boats) discarded an average of 8.0 mtpd.

Waste Composition. Island community solid waste was reported to have a high organic fraction (70%). Recyclables (metals and plastics) account for only 3% of discards; while the balance of the solid waste is classified as residuals. At tourist resorts the organics fraction was estimated to account for 89% of discards. The primary components being food waste (40%) and garden / yard (landscaping) trash (38%). On safari boats there are no landscaping wastes causing food waste to be 67% of wastes from vessels.

1.3 Current Solid Waste Management Practices

Tourist Waste Components. Food discards are separated from other wastes and dumped in the ocean.

Combustible waste components including garden / yard (landscaping) trash and paper products are incinerated. Combustion under suitable process systems can reduce waste volume up to 90%. Since the incinerators at resorts do not operate under ideal conditions a lesser volume reduction would be expected. Glass waste is required to be volume reduced in a crusher.

There is limited potential for recycling as recyclables comprise a small quantity of discards, the dispersed generation of materials presents a logistics obstacle to cost effective consolidation, and the Maldives are distant from end user markets in India.

Residual waste includes construction and demolition (C&D) debris (organics such as wood and paper and inorganics such as concrete), glass, miscellaneous discards such as textiles, leather, rubber, and hazardous waste such as batteries. Some of these residuals such as glass are recycled or used as clean fill on resort developments.

Tourist Facilities. Food discards typically are separated from other wastes and dumped in the sea. Combustible waste components including garden / yard trash and paper products are incinerated. Combustion under suitable process systems can reduce waste volume up to 90%. Since the incinerators at resorts do not operate under ideal conditions a lesser volume reduction would be expected. Bottles (glass) waste is required to be crushed which reduces the volume to be managed. Crushed glass typically is sent for disposal unless used as a construction material.

An estimation of solid waste management arrangements by resorts throughout the Maldives is provided in Figure 1.1.

Island Communities. Waste collected from households by a private operator or carried by householders may be taken to an Island Waste Management Center (IWMC). A number of such centers have been constructed but unfortunately a program for gathering waste from the centers for shipment to a suitable location in the Maldives does not exist.

As these centers have reached capacity due to a lack of an organized program for waste collection from the IWMCs, island residents stop delivery of waste to the centers. Instead discards are left on a beach or discarded in low lying areas in woody sites. The waste put on the beach is visually unsightly both for

island residents and people on other nearby islands especially tourist resorts. Aside from the aesthetics on the island where the waste is generated, waste thrown on beaches below the high tide line can be entrapped by rising water and float into the sea where it may sink to the sea bottom or onto reefs or wash ashore on tourist resort beaches.

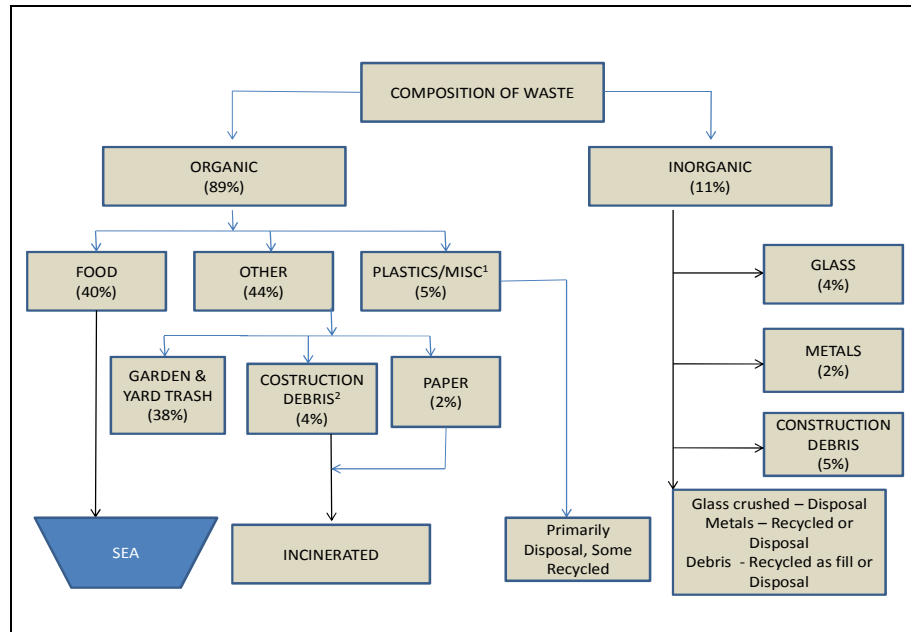


Figure 1.1: Waste Management Practices at Typical Tourist Resort

1. Miscellaneous includes other organic residuals such as textiles, leather, and rubber. Additionally, hazardous waste (1%) was included in this component.
2. Organic construction debris includes wood and paper products.

Thilafushi Treatment / Disposal Site. Since the early 1970s, waste has been used to fill the lagoon on Thilafushi Island. The constructed island is being used for industrial activities. A portion of the island is used as waste management treatment and disposal facility for Male' and other areas of the Maldives that choose to deliver waste to the site. The site operation program includes open burning to reduce the volume of waste for disposal.

A proposed plan under negotiation would contract with a company that will manage the waste received through its use for energy in the form of electricity.

Proposed Solid Waste Management Facilities. Two potential waste management programs are under development. One would serve the Ari Atolls. The second program would cover several atolls in the North Central Region.

1.4 Vulnerability of Solid Waste Facilities to Climate Risks

The Maldives is especially vulnerable to climate-related hazards, including extreme rainfall events, droughts, rising sea levels, damaging winds, and elevated water and air temperatures. Nonetheless from a solid waste perspective, the primary climate risk to waste management facilities appears to be related to effects of severe storms, including sea surges that lead to flooding, and damaging winds. Other causes of flooding such as sea level rise are longer-term in nature and have broader implications to the Maldives that transcend waste management.

Tourist Accommodations. During severe storm events, it is likely that resorts and other tourist accommodations will not have many guests, as the guests will either delay their visit to the Maldives due to a forecast storm of such magnitude that could cause flooding from storm surge and/or heavy rainfall or guests already at tourist facilities will likely be evacuated. This seemingly would apply to the four types of tourist facilities.

To the extent that there are guests at a tourist facility, they will continue to generate discards that will need to be managed. Temporary storage may exist given the expected lesser number of visitors. Medium term storage may be needed at resorts, as an example, as there will likely be limited opportunity to discard organic waste to the sea without such organic waste being washed back into the resort itself.

Resorts and other types of accommodations should develop a contingency plan for temporary waste storage at either a land area at a higher elevation near their resort complex or construction of an emergency storage area on a platform at sufficient height and distance from the sea to minimize the effect of storm flooding.

For an average resort, the daily quantity of solid waste discarded, including food waste, is 1.3 mt. A week storage capacity should be sufficient to hold 9.1 mt. While this estimate is based on a 82.4% occupancy rate, an unlikely scenario for the reasons stated above, it is a conservative parameter. The space needed for this quantity of waste would be slightly more than 33 cubic meters, based on an assumed density of 300 kg / m³.

Island Communities. Unlike tourist facilities, which will likely have fewer guests with a forecast severe storm that may lead to flooding, island communities will be more likely to have the same population, as under normal circumstances. Additionally the residents will likely generate about the same amount of waste as under normal circumstances, except to the extent that flood water damages personal effects that are then discarded.

The temporary storage options for island communities are similar to those available to resorts.

1.5 Best Practices for Solid Waste Management

Maldives. The Best Practical Environmental Option (BPEO) to address climate risks in solid waste management for the tourism sector is the hierarchy of options provided in Figure 1.2. This hierarchy

applies to all types of waste management situations including solid waste in the tourism sector and island communities.

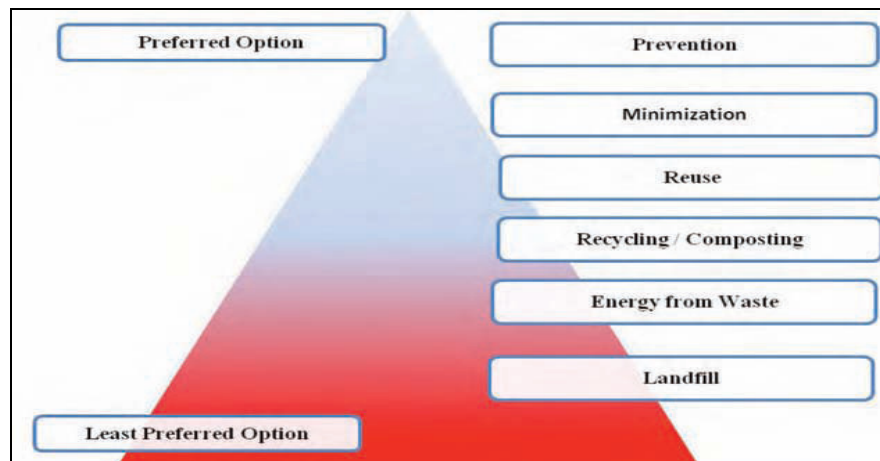


Figure 1.2: Hierarchy of Solid Waste Management Options

Most of the resorts seem to be nominally in-compliance with the MoTAC's regulations on solid waste management by the tourism industry.

There is an on-going concern about proper waste management on the safari boats, in general. As stated in Section 1.2, the safari vessel fleet discards a combined total of 8.0 mtpd. An estimated 6.0 mtpd is food waste.

One resort mentioned by officials in government and the tourism industry, as seeking an innovative solid waste management program, is the Kuramathi Resort. One treatment process that was being tested when the resorts was visited (January 2013) is a pre-composting unit that uses an in-vessel aerobic composting technology to accelerate the decomposition process. The end product is a homogeneous mulch that requires additional decomposition in a pile before it is suitable for use.

International. The Mauritius Strategy, a development program directed at Small Island Developing States (SIDS) on a global basis, includes proper solid waste management as one of its objectives. However a review of the reported waste management programs of SIDS countries showed similar problems as those that exist in the Maldives.

A Pacific islands organization – Secretariat of the Pacific Region Environment Programme (SPREP) – also has solid waste as one of its components. Among its activities is a two part training program on a range of waste topics.

International - Water Transportation. The use of water borne vessels are limited for this most energy efficient transport option primarily because the lack of suitable loading and off-loading options. Two cities with a water based transportation system are Hong Kong and Shanghai, China.

An option that might be viable would use open barges stationed at island communities and resort islands. Waste could be delivered to the barges that could then be consolidated into a group and towed to a treatment / disposal facility such as at Thilafushi.

International – Technology. The technology options suitable for the Maldives are limited because of the relatively small quantity of solid waste that is generated over a dispersed area. This situation is well recognized with regard to waste transport to a point(s) for consolidation prior to treatment and/or disposal.

Various entities may suggest that cost effective and technically viable solutions are available. Maldivian officials should require examples of reference facilities that demonstrate the successful operation of commercial-scale plants using waste streams similar to those found in the Maldives. A technology that successfully functions in developed countries that discard waste with a very different composition may be unsuitable for the Maldives.

1.6 Institutional Factors on Solid Waste Management for the Tourism Sector

The Ministry of Tourism, Art and Culture administers the regulations specifically directed at waste management which were promulgated in response to Law 2/99, and are known as the Regulation on the Protection and Conservation of Environment in the Tourism Industry. The objective of the regulation is to protect the environment related to the tourist industry and to encourage and facilitate sustainable development of tourism. Solid waste management is one component of the regulation.

Among the requirements of the waste management section of the regulation is the use of incinerators to reduce the volume of the organic fraction of discards. An exception is food waste that can be disposed of in the sea. The other exception is plastics that are prohibited from combustion due to concern about toxic emissions. Another volume reduction edict is the use of a crusher to process glass bottles.

A predecessor ministry to The Ministry of Environment and Energy issued the National Solid Waste Management Policy that defines a comprehensive number of solid waste topics and strategies for implementation. Unfortunately the strategies have yet to be fully implemented or if implemented have not been faithfully put into operation.

Draft solid waste regulations were published in 2010 and are being revised. The current draft revision is supposedly significantly different from the 2010 version. The newly revised draft is supposed to be available for public review by February 2013.

The key international bilateral and multilateral convention / protocol to which the Maldives are committed pertaining to climate change and relate to existing waste management practices in the tourism sector is:

- Kyoto Protocol, as modified by the Doha Amendment (December 2012). The Maldives was the fourth country to ratify the agreement on December 30, 1998.

1.7 Monitoring of Solid Waste in the Tourism Sector

For the tourism sector on a national level there is monitoring on compliance of the MoTAC regulations. Tourist resorts are visited annually by MoTAC staff. Unfortunately, the expense of visits to resorts are paid for by the resorts, which means that the resorts have ample advance notice of a visit and are thus able to correct any non-compliance issues in advance of the arrival by MoTAC monitors.

The only other monitoring system identified was the waste tracking program at the Thilafushi treatment / disposal site. A program to log delivery of waste to the site was instituted by the MCC. The objective of the log is to be able to account for the use of the unloading dock, which is used as the basis for assessing a charge to the entities that deliver waste to the site.

Potential Monitoring System. An initial objective for the Maldives might be the development of a database on waste flows. Currently, available data indicates that a number of resorts send waste to Thilafushi and a few to the disposal site on Addu Atoll. Nonetheless, it is unclear where the balance of resorts and other tourist facilities as well as community islands send their wastes.

Such an initial monitoring program would require tourist facilities, especially resorts and safari boats, and all community islands to record how waste is managed. The relevant data to be tracked might include:

- Name of resort, safari vessel, community island.
- Destination where discards are sent for treatment including recycling or open burning / disposal.
- Date shipped.
- Name of vessel on which waste was shipped.
- Date received at destination (including dumped on community island; open burning).

The monitoring form should be signed by the following parties:

- Origin. Resort manager / safari vessel captain /community island official, or designated representative.
- Transport. Captain of vessel used to transport waste to a designated site (if the waste is not managed on-site).
- Destination. Site manager or designated representative.

Copies of the signed monitoring form would be sent (electronically or by post) to the primary contact person at the points of origin and destination as well as the transport vessel. Any discrepancies in the information provided should be made known as soon as possible. A copy of the monitoring form also should be sent to a designated person with the EPA.

Another objective could be a quantitative assessment of the waste collected by individual generators such as resorts, safari vessels and community islands. The information derived could be used to determine a range of actions such as the loss of waste during transport from spillage or blowing refuse

A formal program would rely on weigh bridges (scales) at both point of origin and destination. No weigh bridges were identified at either waste origins or destinations at present. Installation and operation of weigh scales would be a costly undertaking both for CAPEX and OPEX (operation, maintenance, and calibration).

A less reliable means of tracking waste quantity is an estimate on waste volume managed at both the point of origin and destination and a reasonable assessment of waste density based on the composition of waste collected for transport at the point of origin and destination.

EPA is the most likely entity to be responsible for applying density factors to the waste streams being managed. The EPA also could apply a data check on the calculated waste quantity using the following formula.

$$Q = BC * OR * (GR - [FW + OM] * D)$$

Where:

Q = Quantity. Amount of waste for disposal and off-site treatment.

BC = Bed Capacity. At a resort or safari vessel or the population of an island community.

OR = Occupancy Rate. For a resort or safari vessel.

GR = Generation Rate. Expressed as kg per capita per day.

FW = Food Waste. Percent of total discards that are food waste discarded into the sea. For resorts as an example the percent of food generated was estimated to be 40% of which 90% is managed through disposal in the sea.

OM = Other Material. Materials that are recycled or composted or in some other means are diverted from the waste destined for disposal.

D = Days. Number of days since waste was previously shipped to a disposal site.

This formula will only provide an approximation of the waste quantities from resorts, safari vessels, and island communities. Nonetheless the product (Q) will provide a basis to track waste flows and potential lost waste in the management system. These calculations may provide a basis for monitoring progress in addressing solid waste management program implementation.

1.8 Conclusions and Recommendations

Conclusions. The conclusions reached on this assignment are:

- Tourism is a critical part of the Maldivian economy, as it accounts for 30.2% of GDP. Proper solid waste management is an important element to maintaining and even expanding tourism's role in the economy. Visitors to the Maldives are seeking a pristine environment, not one with garbage floating in the sea and trapped on the reefs.
- The amount of solid waste generated in the Maldives at the tourist facilities (180 mtpd) and island communities (240 mtpd) are manageable. Nonetheless, the waste is dispersed over a wide area leading to logistically challenging and expensive options for the collection and treatment / disposal. Failure to implement a rational solid waste program will have a long-term deleterious effect on the tourism sector.
- Safari vessels have been blamed for dumping waste, in addition to food, in the sea. Nonetheless, the total estimated average daily solid waste generation for the safari vessel fleet (157 boats) is 8.0 mt in 2013. Food waste (6.0 mtpd) was estimated to account for 67% of average discards for the safari fleet, or an average daily generation rate of food discards per vessel of 38 kg. The average solid waste generation rate of the remaining discards (glass, metals, plastics) is 0.9 kg per tourist per day, or 2.0 mtpd for the safari fleet. This is a small quantity of solid waste.
- The potential for recycling of metal, plastics, and glass from tourist facilities and island communities is limited due to the relatively low percent of these materials in the waste streams from these generators. Additionally, the dispersed nature of tourist facilities and island communities presents a logistics obstacle to consolidate the materials for market. Finally, the Maldives are remote to potential users (India) of recovered materials. Even with these limitations recycling is a high priority Best Practical Environmental Option (BPEO), given the positive benefits inherent in recycling.

Incineration of garden / yard (landscaping) waste and paper products could reduce the volume for disposal by 90%. However, there may be a tradeoff between volume reduction and air emissions. Small-scale incinerators used at resorts may result in emissions of particulates (smoke) and toxics. If such conditions exist it could be attributed to inadequate operations staff training and lack of equipment maintenance as well as the high moisture content of the materials (landscaping waste) combusted.

Composting of landscaping and food waste might offer an alternative to incineration. Low technology composting systems (windrow) are land intensive; whereas higher technology options will reduce the need for land area but an increased CAPEX investment in equipment.

One resort instituted a pre-composting mechanical mixer on a trial basis; the product produced after a couple hours of mixing was homogeneous mulch that would require additional days of aerobic composting in piles to become suitable for use. The resort indicated that it had a need for only part of the product and hoped to sell the balance for agricultural / horticultural uses to buyers on other nearby islands.

- The Thilafushi waste management center reportedly has 20 ha of capacity remaining for disposal, which could last for another 25 years. This assumes that suitable treatment processes are put in-place to reduce the volume of waste for disposal. Further disposal capacity could be made available by an increase in the elevation for waste disposal. A mounded landfill would limit future uses for the disposal site. Nonetheless, disposal capacity is needed and there seems to be a consensus that there are limited areas to develop additional disposal capacity in the Male' area.
- Development of treatment / disposal centers in additional areas, such as the Ari Atolls and the North Central Region, in the Maldives are important components to a comprehensive solid waste management system.
- A transport structure to transfer waste from tourist facilities and island communities is a challenge to development of a comprehensive, cost effective treatment and disposal network for the Maldives. Fortunately, 67.5% of resorts, which comprise the majority of tourist bed capacity, are located on the two atolls (Alifu and Kaafu) near Male'. The wastes from these resorts are discarded in close proximity to the waste management center on Thilafushi Island.

A transport option suggested that might be suitable is a transfer / transport system that would use barges to store waste at tourist facilities and island communities. The barge could be moved periodically to a hub point, where the barges could be bundled together for shipment to a waste management center in Thilafushi or another location.

One recommendation of this report is that this transfer approach and other options be studied further to assess the technical, cost, and operational elements of such systems.

- Severe storms, including sea surges that lead to flooding, and damaging winds, are the primary climate risks to the Maldivian solid waste management system in the near term. Rising sea levels also pose a risk in a longer term basis.
- The other 39 SIDS countries have not reported success in managing their solid waste under conditions similar to those found in the Maldives. Nonetheless, although no contact with other SIDS members was mentioned during meetings with Maldivian officials, it might be worthwhile for the Maldives to establish / participate in a communications network to share information on institutional laws, regulations, enforcement programs, and policies; operational practices; funding mechanisms; and related considerations for the mutual benefit of SIDS members.
- An advanced waste disposal charge was one Innovative program implemented by a SIDS country in the Pacific region. The charge is designed to cover the cost of solid waste management in the purchase price for the product. Inclusion of the cost of waste management in the product price gives consumers an economic incentive to adjust their purchasing habits and possibly reduce the amount of waste discarded.

The Maldives might use a similar programs to raise funds for its solid waste programs particularly those at the island community level.

- The draft National Solid Waste Management Policy (released in 2010) defines policies and strategies for a sound solid waste management system. For various reasons the Policy has not been implemented to the determinant of the national waste management program and the tourism sector in particular.

Of particular importance from an aesthetic perspective is promulgation of a regulation to require that waste loads transported by mechanical means on land (truck) or sea be either put into enclosed containers or covered by a tarp / net to prevent spillage / blowing of solid waste along waste transport routes.

- A formal system for tracking waste flows would be useful for development of plans / programs to manage solid waste in a more organized manner. However, given the relatively small total quantity of waste discarded in the Maldives and, more importantly from individual resorts, safari vessels, and island communities, a more formal and sophisticated monitoring system might be cost prohibitive. At least that is the impression provided given the seeming lack of financial resources dedicated to solid waste management, overall, and monitoring, in particular.

Recommendations. A realistic plan and implementation schedule that can be met is needed for waste management in the tourism sector and the island communities. The implementation plan should be phased-in in incremental steps such as pilot programs to sort out logistics and costs. A reliable revenue source that will cover costs is a critical component for a long-term sustainable program that enables the Maldives to maintain its natural aesthetics. It is this natural beauty that draws tourist to the country and makes an important contribution to the economic health of the Maldives.

A nationwide plan should also include detailed studies such as a cost effective transfer operation that might include a 'hub and spoke' approach. As addressed in Section 7.1, to manage a barge based transport system for the collection and delivery of waste to a treatment / disposal facility. Additionally such plans should be part of an overall plan for waste management in urban areas (Male' and Addu City).

Suitable regulations on waste management activities also should be part of a plan. Among the activities to be regulated, one important one from a tourism perspective, would be a rule on the use of enclosed containers or tarps / nets to prevent waste spillage or blowing into the sea. Overall, solid waste regulations should seek to protect public health, the environment, and aesthetics. A practical monitoring program would also be an important part of a plan. It would allow the tracking of progress on improvements to a solid waste program and provide a basis for modifications as needed.

The Maldives also should be involved with the other member of SIDS especially those in the Pacific sector that tend to be archipelago countries that depend economically on tourism. Sharing of information may benefit the Maldives and other countries and avoid wasted efforts that have found to be unsuitable for countries in similar situations.

2. Introduction

Tourism is the dominant sector in the Maldivian economy contributing more than 30% to the Gross Domestic Product (GDP) and 60% of foreign exchange receipts. While tourism is important to the economy of the Republic of Maldives (Maldives), a negative by-product of the goods and services consumed by tourism activities is solid waste.

Proper management of solid waste is critical to public health and the environment, including the long-term health of the coral reefs and the aesthetic value of the beaches of the islands that comprise the Maldives. A more effective and environmentally sound solid waste management system is critical to maintain / grow the tourism sector.

The Maldives Ministry of Tourism, Art and Culture (MoTAC) requested assistance from the United Nations Development Programme (UNDP) to assess solid waste management practices and address the vulnerability of these practices to climate risks.

As a result of this request, UNDP developed a Terms of Reference (ToR) for a consultant to evaluate waste management practices and assess their vulnerability to climate change. Charles Peterson (Consultant) was selected to undertake the tasks in the ToR. As an integral part of the project, the Consultant traveled to the Maldives from January 13 through 27, 2013 to meet with project sponsors, national and local government officials, representatives from the tourism sector and other stakeholders. During the fieldwork, the Consultant gathered relevant information for the assignment.

Under the scope of work of the ToR, the following tasks were undertaken by the Consultant.

- Identify the type of solid waste produced by the tourism services providers (industry and dependent communities) in Maldives.
- Review solid waste management practices with particular attention given to waste collection, transfer and disposal methods being practiced and identify the solid waste in terms of production levels.
- Identify and analyze the level of vulnerability of existing solid waste management to climate risks.
- Identify and document international and national best practices for solid waste management and inform tourism industry and its dependent communities.
- Review existing laws, policies, plans, strategies and guidelines/standards for solid waste management for tourism sector in Maldives.
- Identify gaps in monitoring and reporting system for adherence to solid waste management in the tourism sector.

- Provide policy and legislative recommendations to enhance or improve solid waste management in the tourism sector to mitigate climate risks.
- Identify solid waste management options in the tourism sector to mitigate climate risks through Best Practical Environmental Options (BPEO).
- Identify and review the national commitments to international bilateral and multilateral conventions/protocols pertaining to climate change and relate this to existing waste management practices in the tourism sector.

2.1 Objective

Again pursuant to the ToR, the objective of this assignment was to:

...ascertain the level of vulnerability of ongoing solid waste management practices in the tourism sector to climate risks in Maldives.

2.2 Methodology

This assignment was undertaken on the following basis.

- Literature on waste management in the Maldives and similar small island nations was reviewed, together with relevant documents on best practice in a cross section of developed and developing countries. Available information on various technologies used in waste management also was evaluated.
- Meetings were held with national and local government officials, representatives from the tourism sector, and other stakeholders. Additionally several solid waste management facilities and tourist resorts, as selected by MoTAC staff, were visited.

3. Background

3.1 Geography / Population

Geography. The Maldives is located in the Indian Ocean (southern portion of the country) and the Arabian Sea (northern portion) about 340 kilometers (km) south-west of southern India, see Figure 3.1. The archipelago country is comprised of 1,190 coral islands in 26 atolls spread over 90,000 square kilometres (km²), see Figure 3.2. The Maldives lie about 750 km on a north-south axis and 120 km on an east-west axis.

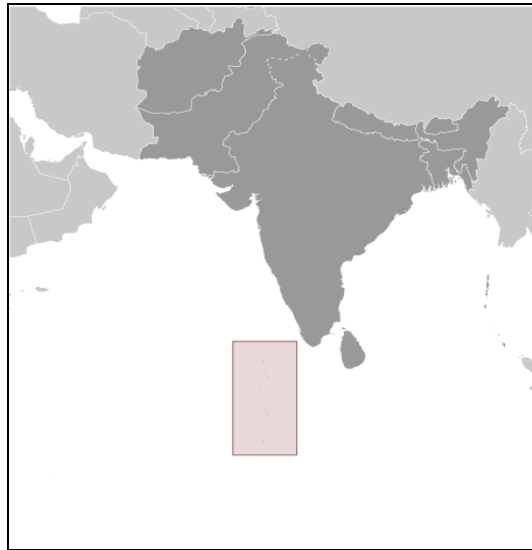


Figure 3.1: Location of Maldives in South Asia



Figure 3.2: Map of Maldives

The Maldives are comprised primarily of water, as the land area of Maldives accounts for about 1% of the country's territory. The Maldives' islands are low lying land areas with an average height of above sea level of 1.8 meters (m).

The dispersed nature of the land area into numerous islands means transport (people and goods) between islands is almost exclusively by boat. This includes delivery of people and goods to tourism resorts and related accommodations. Shipment of solid waste from tourism facilities to the Maldives central waste treatment / disposal site on Thilafushi Island (Male' area) also relies on boats. Another existing disposal site on Addu Atoll is located in the southernmost part of the Maldives, see Figure 3.2.

Population. The country's population of approximately 394,450 people (July 2012 estimate) lives on 198 of the 1,190 islands in the Maldives. An additional 80 islands have tourist resorts.

About 70% of the inhabited islands have a resident population of less than 1,000 people. The estimated (July 2012) population growth rate for the Maldives was negative (-0.127%).

Male', the urban center for the country, had, as of 2009, an estimated population of 120,000, or 30% of the country's residents. The total urban population of the Maldives is 40%. The other urban area is Addu City on Addu Atoll, see Figure 3.2, which is located in the southernmost part of the Maldives.

3.2 Economy

The GDP for the Maldives in 2011 was reported as MVR (Maldives Rufiyaa) 20,051.0 million (in 2003 constant prices), or MVR 50,830 per capita. The annual growth rate in GDP from 2010 to 2011 was 7.5%, primarily due to increased tourism after the sector's contraction following the global economic crisis in 2008-2009.

Tourism, Maldives's largest economic activity, accounted for about 30.2% of GDP, or MVR 6,061.0 million. Furthermore, more than 90% of government tax was reported to have been derived from import duties and tourism related taxes. Other economic sectors (such as fishing, agriculture, and industry) play lesser roles in the economy.

According to a recent World Bank report (Rowe, Francis, et al, 2011):

...real GDP growth was expected to slow to 3.6% in 2012, largely due to the slowdown in the tourism sector – which has a high dependence on the crisis-stricken European segment. The country's fiscal position has been under much stress following the tsunami of 2004 and continues to weaken in the face of unsustainable high public expenditures. Despite the introduction of new tax measures in 2011, revenue efforts have been compromised by far-ranging import duty rate reductions. Deficit financing has been increasingly challenging in the face of limited financing options.

3.3 Tourism Sector

In 2011 the Maldives set a record in tourist arrivals to the country with over 930 thousand visitors in a year, according to MoTAC. As important, the country had an annual average growth rate of tourist visits of nearly 18% in 2011.

Accommodations. In the Maldives, the four types of accommodations available to tourists are: resorts, hotels, guest houses, and safari vessels, see Table 3.1.

Table 3.1: Type of Tourist Facility – Number, Total Bed Capacity, and % of Bed Capacity, 2011¹

Type of Tourist Facility	Number	Total Bed Capacity	% of Bed Capacity
Resort	101	22,120	82.2%
Hotel	19	1,603	6.0%
Guest House	38	659	2.5%
Safari Vessel	157	2,514	9.3%
TOTAL	315	26,896	100.0%

1. Tourism Yearbook 2012.

Tourist Resort Location. The initial resorts, starting from 1972, were developed near Male' and the international airport on two atolls – Kaafu and Alifu. With publication (2007) of the Third Tourism Master Plan, the government expanded resort development to the whole country.

Nonetheless, 67.5% of resort bed capacity is on the two initial atolls developed, which puts the majority of resort generated waste in relatively close proximity to the treatment center on Thilafushi Island.

Tourist Capacity / Use. An increase in tourist bed capacity resulted in increased bed nights of tourists. Total tourist bed capacity in the Maldives increased by 3.5% in 2011.

More important from a tourism and solid waste perspective, the number of 'bed nights' increased by 9.1% to almost 6.53 million in 2011. This equates to an overall nationwide tourist bed occupancy rate of 73.1% in 2011. While this is an improvement over recent years, the occupancy rate is still below the level for 2007 (82.5%, the year before the worldwide economic crisis).

Tourist visits to the Maldives vary on a monthly basis with the peak period from the months of October through April when the occupancy rate in 2011 ranged from a low of about 80.0% to a high of almost

95%. The months of May through September typically have the lowest occupancy rate. The lowest occupancy rate reported for 2011 was In June (55.0%).

Nonetheless, according to a recent report by the World Bank (Rowe, Francis et al, 2011):

With the growing significance of tourist arrivals from China, Maldives tourism season is experiencing fewer seasonal fluctuations as Chinese arrivals are now filling the gap left during the European summer season.

Such a reduction in seasonal tourist visits also will stabilize seasonal variations in the quantity of tourist related solid waste.

Tourism Forecast. The MoTAC's projection for the tourism sector through 2015 forecasts continued growth in tourist visits, see Table 3.2. Correspondingly, the implication is for increased expansion of solid waste attributed to tourism.

In 2013 the forecast number of tourist arrivals is expected to exceed a million per year; the occupancy rate is projected to reach the low 80% rate from 2013 to 2015.

Again, unless an effective strategy for waste minimization is defined and implemented these projects foreshadow an increasing quantity of solid to be managed.

Table 3.2: Forecast of Tourism Capacity, 2012-2015 ¹

	2012	2013	2014	2015
Tourist Arrivals (1,000)	975	1,057	1,144	1,237
Growth in Arrivals	4.7%	8.5%	8.1%	8.2%
Bed Capacity	24,512	24,995	26,700	27,322
Bed Nights (1,000)	8,867	9,093	9,716	9,942
Occupancy Rate	77.8%	84.2%	81.9%	82.4%

1. Tourism Yearbook 2012.

4. Waste Characteristics

4.1 Quantity

Annual Average Waste Generation. The quantity of waste discarded in a given area such as a city, island community, or tourist facility depends on the per capita generation rate, which is directly correlated to income and population. Areas with higher incomes tend to generate more waste than similarly sized areas with lower incomes. People with higher incomes spend more money on goods and services, which creates waste.

One estimate of the quantity of solid waste discarded in the Maldives was 324,000 metric tons (mt) in 2012¹, or almost 890 mt per day (mtpd). These wastes include discards from residences and commercial operations such as tourism facilities.

The proceeding estimate of the annual average daily waste quantity was confirmed by a close approximation of 860 mtpd, see Table 4.1. This waste generation rate was derived from population estimates for urban area, island communities, and tourist bed nights and generation rates.

Table 4.1: Estimated Waste Generation

Waste Generators	Population	Generation Rate (kg / capita / day) ¹	Daily Waste Generation (mtpd)
Urban Areas	157,780	2.8	440
Island Communities	236,670	1.0	240
Subtotal - Residents	394,450	-	680
Tourist Bed Nights	24,995 ²	7.2	180
TOTAL			860

1. Solid Waste Management in the Maldives.

2. Tourism Yearbook 2012.

Resorts. The solid waste generated by the 101 resorts in the Maldives was estimated to total about 134 mtpd, or an average of 1.3 mtpd for an average resort. Individual resorts will have more or less waste depending on the number of guests staying at a resort.

¹ National Solid Waste Management Policy for the Republic of Maldives. 2008.

Safari Vessels. Detailed data on the characteristics (quantity, composition) of solid waste from safari vessels were unavailable. Nonetheless, it probable that the composition of the solid waste discarded on safari boats would be similar to that reported for resorts, except for the lack of garden / yard (landscaping) discards and construction debris, which were estimated to account for 38% and 9%, respectively, of discards from resorts. On this basis, the average daily generation rate for safari boats was estimated to be 3.8 kg per capita versus 7.2 kg for resorts.

The average daily solid waste generation for the safari vessel fleet (157 boats) is 8.0 mt in 2013, which was estimated using the reported bed capacity (2,514 beds) for the Maldivian safari vessel fleet, see Table 3.1, and an average tourist occupancy rate of 84.2%, see Table 3.2.

Food waste was estimated to account for 75%² (6.0 mtpd) of average daily discards (total) for the safari fleet. The daily average of food waste per vessel was estimated to be of 38 kg, based on a per tourist generation rate of 2.9 kg per day. The average solid waste generation rate of the remaining solid waste, such as glass, metals, plastics, is 0.9 kg per tourist per day, or a total of 2.0 mtpd for the safari fleet.

Seasonal Variation in Waste Generation. Due to a higher occupancy rate during the peak season (October through April) the seasonal average amount of solid waste discarded from tourist facilities would be expected to increase to almost 205 mtpd. Correspondingly, a decline in the seasonal average would occur during the slower tourist months. During this period the average tourist solid waste discards would be almost 160 mtpd.

Most likely waste from island communities will tend to be stable throughout the year as there will typically be little seasonal variation in the resident population and changes in climatic conditions that might shift consumer purchases.

4.2 Composition

The composition of waste also varies by income level. The percent of food waste tends to be highest among lower income households. However, as income increases this share generally, decreases as consumers purchase more prepared foods. Preparing fresh food tends to result in more food waste from peels, pits, and other residue.

A waste stream with a high organic content, primarily food and garden/yard (landscaping) wastes, also will have a high moisture content that can influence the suitability of certain types of treatment processes, such as incineration.

According to a World Bank report prepared for a prospective solid waste management facility at Ari Atoll:

In resorts the organic component is 80% of waste stream and is mainly due to green waste from garden and yards.

² The higher percent of food relative to resorts is a product of deleting landscaping wastes.

The amount of food waste and garden / yard refuse were estimated to be 48% and 32%, respectively, as adjusted using data in the IT Power India report. The Consultant estimated that food and garden / yard wastes comprised 40% and 38%, respectively, of total discards, as he was unable the conflicting statements above.

No data were available on the composition of the other 20% of wastes from resorts and hotels. Nonetheless, the Consultant estimated the percent of recyclables and residuals through observation. Organics are the dominate component of island community waste discards, at least for islands examined by the World Bank for the proposed Ari Atoll project, see Table 4.2. An estimated breakdown of the composition of solid waste discarded by island communities, resorts and safari vessels is also provided in Table 4.2.

Table 4.2: Average Waste Components from Island Communities ¹

Component	Island Communities¹ %	Resorts^{1, 2} %	Safari Vessels^{1, 2, 3} %
Food, Garden/Yard Wastes, and Paper Products	70%	80%	67%
Recyclables - Metals / Plastics	3%	5%	9%
Residuals ⁴	27%	15%	24%
TOTAL	100%	100%	100%

1. Republic of Maldives, Ministry of Environment and Energy. 2012.

2. Consultant estimate.

3. The different percentage in comparison to resorts is derived from the assumption that there is no landscaping discards in the safari vessel waste stream.

4. Residuals were estimated to include construction and demolition (C&D) debris (9%) - organics such as wood and paper and inorganics such as concrete, glass (4%), miscellaneous discards (2%) such as textiles, leather, rubber, and hazardous waste such as batteries.

5.

5. Current Solid Waste Management Practices

5.1 Tourist Waste Components

The different solid waste components are managed through a variety of management practices by type of tourist facility, especially resorts and safari boats. The primary solid waste components are:

- Food, including waste from meal preparation such as peels and pits.
- Garden / yard (landscaping) and paper products.
- Recyclables, including metals, plastics, glass, and paper products.
- Residuals.

Food Waste. The 101 resorts and 157 safari vessels were assumed to generate the same amount of food waste per tourist. The amount of food waste generated per capita per day was estimated to be 2.9 kg. Additionally, resorts and safari vessels account for 90% and 10% of tourist bed capacity, respectively, excluding hotels and guest houses. Resorts, therefore, discard an estimated total of 54 mtpd of food waste; whereas, safari vessels discard an estimated total of 6.0 mtpd of food waste. On average the reported 101 resorts, each dump an estimated 0.53 mtpd (530 kg) of food waste in the sea. The 157 safari vessels discard an estimated average of 0.04 mtpd (38 kg) of food waste per day per boat.

Assuming 90% of food waste is separated for sea disposal, the per capita daily amount is about 2.9 kg for tourist facilities. (NOTE: The 90% estimate is based primarily on the lack of data that hotels and guest houses dump food discards in the sea.) About 19,700 mt (average of 54.0 mt per day), or 90% of total food discards, of food waste was projected to be dumped in the sea from resorts and safari vessels into the sea in 2013.

Garden / Yard (Landscaping) and Paper Products. Regulations enforced by the MoTAC, see Annex B, require that all tourist resorts are to have an operational incinerator. Incinerators are an effective option for reducing the volume of combustible discards by up to 90%. Nonetheless, incineration, while an effective means to reduce the volume of wastes for disposal, can generate air emissions, especially with small units such as those used at resorts that have no air pollution control systems.

Incineration is a complex technical process that requires well-trained personnel for proper operation. Not only is the risk of high air emissions greater with inadequate operation, incomplete combustion will decrease the amount of volume reduction from incineration. The cost of employing trained operators and maintenance for low throughput incinerators would be expensive items for resorts. Furthermore, combustion of garden / yard waste that may have a high moisture content could require a supplemental fuel to have a sufficient heating value for incineration to occur.

Recyclables, including Metals, Plastics, and Paper Products. Compactors are required under regulations issued for the tourism sector, see Annex B. Most resorts compact metal and plastics discards, which are

taken either taken to disposal or recycled. The commodity price for these materials has an effect on the quantity of materials recycled. In periods of low commodity prices some recyclables can be stockpiled until material value increases. Nonetheless, the relatively minor quantities generated at individual resorts and community islands and even for the entire country combined with the transport distance to scrap material consumers, recycling is inherently a limited economic proposition.

According to the Maldives Customs Service¹, 6,324.4 mt of metals (ferrous, aluminum) that may have originated from municipal solid waste were exported from the Maldives in 2009. These exports and other materials, such as cast iron, copper, and waste oil, may include materials from industrial sources. No scrap plastics or paper products were exported that year.

Also as reported from the same source,

Wastes transported to Thilafushi are manually sorted by foreign guest workers to remove recyclable wastes. Although periodically a wider range of recyclable wastes have been collected, PET and recyclable metals are predominantly the wastes streams stockpiled at Thilafushi. Scavenging rights over all waste received on the island have been issued to a private company who periodically crush and export the stockpiled recyclable wastes. Data from Maldives Custom Service indicates that there has been an increasing trend in the tonnage of recyclable metals exported over the last five years. Although the overall trend is positive there is, however, significant annual variation in the figures.

Recycling in the Maldives has not gain a significant attention. However, a study conducted on the feasibility of recycling in the Maldives in the year 2009 indicates that some materials are currently being recovered from the waste stream for recycling. Some of them are processed locally but most of them are exported. The following are the materials currently salvaged from waste:

- 1) Between 300-400 tons of metals / month are recovered and exported to India.
- 2) Approximately 30 tons of PET / month are recovered and exported to India (NOTE: The report states that plastics were exported in 2008 but at a much lower rate than that provided above. The Consultant was unable to reconcile these differences in reported plastics (PET) recycling rates. PET, or polyethylene terephthalate, is a plastic used primarily for packaging typically designated with the code number "1").

While paper products also are recyclable, there were no data that indicate paper recycling activity at resorts or in the country as a whole. At resorts paper products appeared to be burned in incinerators.

¹ Mohamed, Ibrahim. Country Analysis Paper: Maldives. Presented at: Third Meeting of the Regional 3R Forum in Asia. Singapore, 5-7 October 2011.

Residual. Residual waste includes construction and demolition (C&D) debris (organics such as wood and paper and inorganics such as concrete), glass, miscellaneous discards such as textiles, leather, rubber, and hazardous waste such as batteries.

In most developed countries construction and demolition, including residue from remodeling (C&D) debris, accounts for 20% of municipal solid waste². This waste component is generally evenly divided between construction and demolition wastes.

While no estimation was found on the quantity of C&D debris related to the tourism sector or overall solid waste discards in the Maldives, the Consultant estimates that C&D debris comprises an estimated 9% of resort facility solid waste based on visual observation at a limited number of sites. The debris is primarily construction-related waste as there appeared to be limited demolition debris at resorts and island communities.

Some of this waste, such as aggregate from concrete, can be used for clean, structural fill. The balance appears to be disposed of at on-site pits, a common management practices in many countries. Additionally other existing options at resorts such as incineration may be used to reduce the volume of wood (lumber) and paper products associated with construction and remodeling activities.

The tourism sector regulations require resorts to have bottle crushers, which reduces the volumes of glass bottles for transport for recycling or disposal. While glass cullet can be recycled, there was limited evidence of such activity in the Maldives, except for some use as a construction material at resorts. Lack of glass recycling may be a result of a combination of the following:

- Glass is produced in several colors - clear (flint), brown, and green, increasing the difficulty of recovery non-color contaminated recyclable cullet for use in the manufacture of new bottles.
- Weight of cullet.
- Low market value for secondary glass.
- Glass comprises a small percent of solid waste.

Other miscellaneous waste components were estimated to be primarily managed through disposal.

5.2 Tourist Facilities

Resorts. Food discards typically are separated from other wastes and dumped in the sea. Combustible waste components including garden / yard trash and paper products are incinerated. Combustion under suitable process systems can reduce waste volume up to 90%. Since the incinerators at resorts do not operate under ideal conditions a lesser volume reduction would be expected. Bottles (glass) waste is required to be crushed which reduces the volume to be managed. Crushed glass typically is sent for disposal unless used as a construction material.

² Municipal solid waste (MSW) is generally defined to include discards from residential, commercial, institutional, and industrial (non-hazardous) sources.

An estimation of solid waste management arrangements by resorts throughout the Maldives is provided in Figure 5.1.

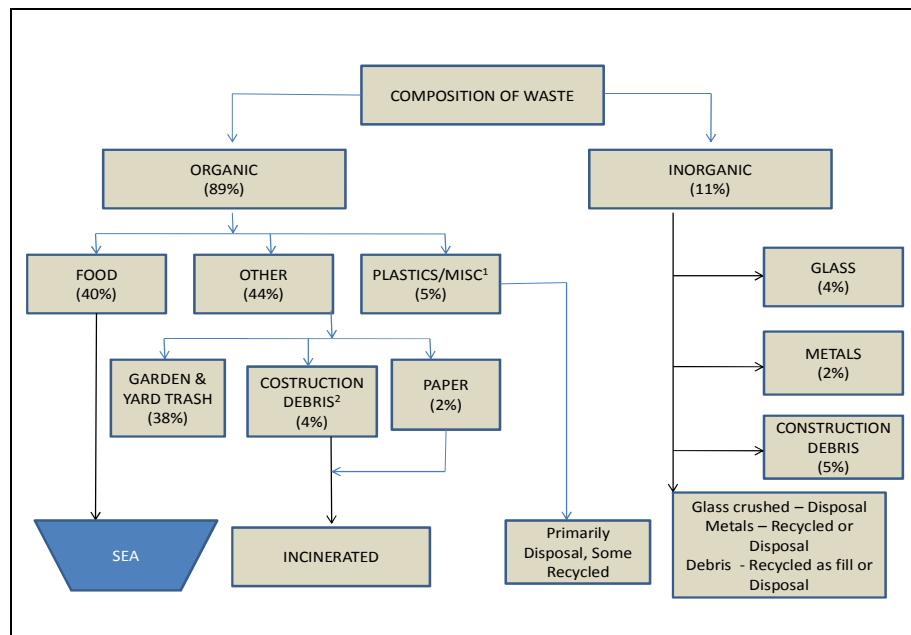


Figure 5.1: Waste Management Practices at Typical Tourist Resort

1. Miscellaneous includes other organic residuals such as textiles, leather, and rubber. Additionally, hazardous waste (1%) was included in this component.
2. Organic construction debris includes wood and paper products.

An example of the solid waste management operations at a resort (Equator Village) on Gan Island in the Addu Atoll³ is provided in Box 5.1.

Box 5.1: Operation at a Resort (Equator Village) and Addu Atoll Disposal Site

The Equator Village resort, which is located on Gan Island, has beds for about 150 guests.

Food Waste. Food waste is segregated from other discards and stored in buckets in a stand-alone building near the kitchen. The building has a small air conditioned room about one by two meters, see Figure 5.2. The food waste is stored here until it is disposed of, which is done on a daily basis. The food discards are taken at about 06:00 in a resort boat about 4 to 5 km out to sea and then are dumped into the water. The food is consumed by fish.

³ Addu Atoll includes Addu City (an urban area), a group of inhabited islands connected by causeways and bridges plus additional resort and uninhabited islands. The only other city (urban area) in the Maldives is Male’.



Figure 5.2: Food Waste Storage Containers in Store Room

Other Wastes. Other types of refuse such as glass, plastics, metal and garden / yard wastes are roughly segregated, see Figure 5.3. These materials are not recycled. Segregation was reportedly done to improve operations at the Atoll's disposal site. Additionally, glass bottles are broken in a bottle crusher in order to reduce the volume of 'air space' needed for disposal. Incineration is not used to reduce the volume of solid waste for disposal. The resort sends a load of these dry wastes to the disposal site on a daily basis.



Figure 5.3: Storage Area for Garden / Yard Waste and Other Discards

Beach Cleaning. The resort cleans its beach on a daily basis. The facility manager reported that clean-up was done to remove sea weed that washes ashore. No litter such as plastics was stated as being found in the daily beach cleanings.

Waste Management Center. The Center, see Figure 5.4, serves four inhabited islands plus the resort islands on Addu Atoll. The inhabited islands and the island of Gan are connected by causeways and bridges. The Equator Village resort on Gan is connected by road to the Center. Additional waste is delivered by boat from resorts on other area islands.



Figure 5.4: Waste Disposal Site – Addu Atoll

The 4.9 hectare (ha) site was originally developed as a regional facility intended to serve four atolls. In the absence of an effective collection and transfer system, the site receives only waste collected on Addu Atoll. A private contractor, selected by the local government, has operated the facility since 2003. The operator uses a dozer to spread waste delivered to the Center. The dozer was provided to the operator when the contract was initiated. It is beyond its normal useful life. There is no open burning or recycling to reduce the waste volume. Household wastes delivered to the disposal site are requested to pay a fee. The fee for residential discards is voluntary. Businesses and tourist resorts that deliver waste to the disposal site are charged a gate fee.

In addition to its disposal operations, the contractor collects solid waste from the four islands. Collection is provided once per week. The contractor operates six days per week. Households pay MVR 65 per month for this service. The fee charged commercial businesses depends on type of business and size.

Combustion residue (ash) and other residual waste may be containerized in plastic bags for transport to the waste management facility at Thilafushi Island, which is near Male'. Male' is the dominant port of importation into the Maldives, and origin of imported supplies for the resort. Supply boats, which deliver the imported supplies to resorts, are a common means for the transport of waste to Thilafushi Island.

The treatment and disposal site at Thilafushi operates on a six days per week basis. The facility is closed on Fridays. The facility receives both recyclables and waste. The Thilafushi disposal site is a non-engineered, low-lying facility operated by the Male' City Council.

The facility operator reported that the recyclables received are given to a private contractor who brokers the materials to buyers outside of the Maldives. The recyclables received from resorts includes paper, metals, plastics, and glass. This differs from the data provided in Section 5.1 on recyclables. Some

resorts reportedly separate selected materials (metals) for recycling and work through private contractors to market the recyclables recovered.

Waste from resorts is delivered to Thilafushi in a variety of boats, see Box 5.2. A random example of waste from a resort shipped to the facility is provided in Figure 5.5. The Thilafushi site was reported to receive a minimum of 10 boats per day from resorts and a weekly average of 16 boats per day, which equates to a weekly total of 96 boats (six days per week).



Figure 5.5: Representative Vessel Delivering Waste from a Resort to the Thilafushi Facility

The waste received at Thilafushi is not measured by weight (as there is no weigh scale). The operator also does not make a volume estimate. Nonetheless, it was reported that the amount of waste delivered per boat ranges from a half to a full lorry load.

Some resorts generate enough waste to justify waste delivery on a daily basis. Obviously other resorts send waste to the Thilafushi site less frequently. Sixty-nine resorts (68% of the 101 resorts in the Maldives as stated in Table 3.1) send waste to the treatment and disposal site on a regular basis.

The waste shipped to Thilafushi is not required to be covered by a net or other device to prevent the spillage or blowing of waste into the sea.

A recent (2010) sample overview of solid waste arrangements, including transport / disposal for a group of atolls (North and South Ari) is provided in Box 5.2.

Box 5.2: North and South Ari Atolls¹

A survey (2010) of waste management practices on North and South Ari Atolls provides an example of arrangements for solid waste management at resorts in the Maldives.

Incineration. Incinerators were reported at all of the resorts (21) surveyed, but not all of the systems were in-operation. (Three of the five systems not in operation were closed due to resort renovations.) The material combusted was primarily garden / yard (landscaping) waste and paper products. Some of the resorts (43%) sent incinerator ash to Thilafushi for disposal; while the balance disposed of the ash elsewhere including a compost garden and burying or stockpiling on-site.

Compactors. Compactors used for bundling metals (aluminum, ferrous) and shredders for garden / yard waste were reported to be used by a few resorts. There was reportedly limited interest in selling compacted metals because of the relatively small volume of such materials discarded at individual resorts.

Bottle Crushers. During this assignment, two resorts visited by the Consultant were observed to have bottle crushers. These units, as required by regulation (see Annex B), are used to reduce the volume of glass for recycling or disposal. Minor quantities of glass cullet were reported to be recycled, mostly as a building material.

Food Waste. Kitchen (food) waste typically is discarded at sea. Such waste should be taken a sufficient distance at sea so that the waste does not wash back onto to an island beach. There are no data that improper disposal practices for food waste are being used. Furthermore, safari boats were speculated in the report as being a source of food waste washed onto resort beaches, although no substantive data to support this claim was provided.

Waste Transport. All the resorts (21) surveyed reported sending waste to Thilafushi. The three types of transport arrangements made and the percent of each were:

- o Supply dhoni – 43%.
- o Outsourced to a contractor's supply dhoni – 33%.
- o Larger vessels (landing craft, barges) – 24%.

¹ Jameel, Ahmed. Resort Waste Survey at Ari Atoll. Environmental Protection Agency, Male, Maldives, January 2010.

It was suggested that some transporters are failing to deliver their full loads to Thilafushi, as waste is inadvertently and/or intentionally allowed to spill into the sea. The mandatory use, under a national regulation, of covered containers or tarps / nets would seem a suitable means to prevent accidental / intentional waste spillage from boat decks. For further information on marine transport of solid waste see Section 7.3.

An on-going solid waste management program (implemented in 2011) on the island of Ukulhas in the Alif Alif Atoll was identified as an environmental model for the island communities in the Maldives, see Box 5.3.

Box 5.3: Island of Ukulhas in the Alif Alif Atoll

Waste Collection. An important part of the island's program is regularly scheduled collection of household and commercial wastes. Additionally, containers have been placed at convenient locations so that residents can deposit their discards in a container rather than littering it.

Waste Segregation. Residents are required to separate waste into three categories: (1) recyclables including aluminum, copper, steel, plastics, papers, (2) food discards, and (3) garden and plant wastes. The discards are collected daily, except on Friday. The island council provides pick-up of household wastes to eliminate the need for residents to take their refuse to the treatment center. The island council charges MVR 100 per each house, per month for waste management services.

Treatment Approaches. The three primary methods used on the island of Ukulhas for the treatment of solid waste are: recycling, pyrolysis, and composting (aerobic).

Recycling. Recyclables such as non-ferrous metals (aluminum beverage cans, copper wire), ferrous metal (aerosol cans, steel furnishings), and plastics (polyethylene, PET beverage bottles), glass (beverage bottles and jars) are separated. Recyclable items are sold once or twice a month.

Pyrolysis. The thermal unit, defined as a pyrolysis system, converts combustible organics (wood, paper products) into charcoal and ash in an oxygen-starved chamber.

Composting. Organic matters (garden and yard waste, food waste) are converted into humus (soil conditioner and low-grade fertilizer). The composting process uses a 'windrow' system in which organic discards are placed in elongated piles. The piles need to be watered to maintain the composting process. More importantly, the pile must be turned periodically to keep the decomposing waste properly aerobic. The composting process in a windrow typically takes about 30 days for initial decomposition. An additional 30 days with minimal turning leads to a more organically stable product. After the breaking down into humus, the organic materials are packaged and labeled for the sale.

Safari Boats. The 157 safari boats that operate in the Maldives (see Table 3.1) are primarily based at Hulhumale Island when not in-use carrying tourists to different locations in the country. There is a jetty available for the boats to off load their solid waste.

Until recently (January 2013), a ferry delivered waste in up to five loaded lorries to Thilafushi. The ferry docked near the passenger ferry terminal for boats from Male' and the lorries were driven to the treatment and disposal site where the wastes were unloaded. The waste delivery included residential and commercial waste from Hulhumale as well as from the safari boats.

The ferry boat service was terminated because the boat was taken out-of-service due to lack of maintenance on an old piece of equipment. The retired vessel was replaced under a contract with a private operator. The operator is using barge with a reported capacity of 150 lorries, or 30 times more than the ferry service. Even so, waste dump on the beach were observed near the ferry site on Hulhumale. The waste was burning and producing an acrid smelling smoke.

The barge must dock at the treatment and disposal site jetty and be unloaded using an excavator, see Figure 5.6, which can be a time consuming task and more importantly during such an unloading process the dock and excavator may be unavailable to unload waste from other boats.



Figure 5.6: Excavator at the Thilafushi Treatment and Disposal Site

The entire safari vessel fleet was estimated to generate 9.0 mt per day of solid waste. Food waste was calculated to account for 67% (6.1 mtpd) of these discards; while other wastes (metals, plastics, glass) comprise the balance of the waste stream (3.0 mtpd), see Section 4.1. On average the trash discarded per boat, excluding the foods waste dumped in the sea, amounts to about 19 kg per day.

It was suggested during several of the meetings for this project as well as in some reports that some safari vessels dump waste, in addition to food, into the sea. The primary reason for such a practice is supposedly limited storage space for waste on-board the boats. Alternative management options such as waste storage areas at islands visited by safari boats could be developed to provide land-based waste storage. Further information was solicited from the Liveaboard Association of the Maldives, but no response was received.

5.3 Island Communities

At the island communities waste may be collected from households by a private operator, often using a truck. On smaller islands, waste may be carried by householders to an Island Waste Management Center (IWMC). A number of such centers have been constructed but unfortunately a program for gathering waste from the centers for shipment to a suitable location in the Maldives does not exist.

As these centers have reached capacity due to a lack of an organized program for waste collection from the IWMCs, island resident stop delivery of waste to the centers that typically are located at inconvenient distances from island household. Instead discards are left on a beach or discarded in low lying areas in woody sites. The waste put on the beach is the most visually unsightly both for island residents and people on other nearby islands especially tourist resorts. Periodically, the waste piles may be burned creating air emissions such as particulates (smoke) and, possibly, toxics.

Aside from the aesthetics on the island where the waste is generated, waste thrown on beaches below the high tide line can be entrapped by rising water and float into the sea.

This floating waste may sink to the bottom of the sea and become entangles in the reef or eventually wash ashore on adjacent islands. This can be a problem on islands with resorts. The resort needs to assign staff beach clean-up. This task can be labor intensive and time consuming.

A summation of current waste management practices on Ari Atoll, according to a World Bank report prepared for a prospective solid waste management facility, stated that:

The most common method of reducing waste volume is open burning using various methods. Few Islands do recycling of scrap metal while two islands have been reported to segregate metals, plastic and glass for recycling markets. In most islands burning is carried out without proper segregation and the resultant ash and any residual from burning is either buried or with 20 spread over in remote bushy areas of the islands. Also in some islands this residue is used for reclamation of land by filling the lagoons. Most islands have an accumulated waste pile and while some islands lift out waste regularly to Thilafushi others have not done a back log of waste. As for the collection, most islands have no organized collection system, while few of them conduct regular household collections daily by a truck with employed labor. According to most islanders the most difficult waste for managing is disposable nappies.

An example of an island community waste management program, in addition to the ones provided in Box 5.1 and Box 5.3, is given in Box 5.4.

Box 5.4: Solid Waste Management Operation at an Island Community (Rasdhoo Island)

Community. The community of Rasdhoo Island, the capital of North Ari Atoll, has a population of about 1,700 residents.

Waste Generation. About four to five mtpd of waste are reportedly discarded on the island. Although seemingly a high waste quantity (assuming a per capita waste generation rate of 1.0 kg per person per day, see Table 4.1), it was stated that the high estimated quantity of waste is due to the addition of construction debris.

Collection. The residents carry their waste to the island's disposal area. Previously there was a household waste collection service, but it was discontinued.

Disposal Site. Rasdhoo's disposal site is the beach opposite on an opposite side of the island from a nearby resort (Kuramathi) on South Ari Atoll. The waste was piled in a long row parallel to the sea, see Figure 5.7.



Figure 5.7: Rasdhoo Island Community Waste Dump

The waste piled on the beach is burned periodically to reduce the volume of discards. Open burning was reported to be done only when the wind is blowing out to sea; otherwise smoke from the fire is blown into residential neighborhood adjacent to the sea. As the prevailing wind has been from the sea for the past month, the waste has not been burned since mid-December.

Waste piled beyond the high tide line tends to be washed into the sea. Evidence of such floating waste washed onto nearby beach on Rasdhoo Island is provided in Figure 5.7. Additional floats beyond the island's reef where it may sink to the sea bottom or other nearby reefs. Community officials reported that there have been complaints about floating debris and waste on the reef of a nearby dive site.



Figure 5.7: Waste Washed Ashore on Rashdoo Island

5.4 Thilafushi Treatment and Disposal Site

Since the early 1970s, waste has been used to fill the lagoon on Thilafushi Island. The constructed island is being used for industrial activities. A portion of the island is used as waste management treatment and disposal facility for Male' and other areas of the Maldives that choose to deliver waste to the site. The land for the solid waste site is leased from the Thilafushi Corporation. The site is currently leased to the Male' City Council (MCC).

The site was reported to have a total surface area of 230 ha with a remaining area to be filled of 20 ha. It has been estimated to have a useful life of 25 years with proper waste management practices. Among the practices proposed for the near term is development of system to use the waste to produce energy; while at the same time to reduce the volume of discards for disposal.

A contractor – Tatva Global Renewable Energy (Maldives) Private Limited, an Indian and German consortium – was selected to develop a waste management service for Greater Male', which will include a waste-to-energy project at the Thilafushi site (IFC, 2011). The project has been hindered by contractual issues that have led to a renegotiation of the Tatva's proposal. This process was initiated in December 2012.

Current operations involve the delivery of waste to the site by boat. Discards from Male' are loaded into lorries and ferried to the island. The lorries are uncovered so that the waste may be blown or slide off a lorry. During passage to Thilafushi on a barge, waste may end up in the sea.

Waste from resorts and other islands generally are shipped in bulk to Thilafushi. Again, there is a risk for waste to end up in the sea.

At the treatment and disposal site, there is a jetty dedicated to receiving bulk waste, see Figure 5.8. This jetty was reported to be 10,000 feet in length. The staff and equipment are maintained at the jetty by the city of Male'.



Figure 5.8: Jetty at Thilafushi Treatment and Disposal Site

Waste is unloaded from delivery vessels by an excavator that also puts the solid waste into a site lorry. The lorry is driven a short distance to the disposal area, see Figure 5.9, where the lorry is unloaded. The site is being operated as an open dump. Currently, the volume of waste for actual disposal is reduced through open burning.



Figure 5.9: Open Dump at Thilafushi

While open burning did not present a dark smoky plume of particulates on the day the site was sited (January 20, 2013), see Figure 5.9, visible smoke was reported by others in the context of giving a poor aesthetic quality to tourists and residents in the Male' area alike.

While some of the waste was burned, the more common combustion observed was smoldering, which indicates incomplete combustion. A by-product of smoldering waste can be toxic air emissions and particulates that are indicated by the presence of smoke.

5.5 Proposed Solid Waste Management Facilities

Ari Atoll. The Government of Maldives (GOM) is working on the development of a pilot solid waste management system (collection through disposal) to be implemented in the Ari Atoll, see Annex A. The project cost (US\$ 1.32 million) will be provided by the European Union (EU) under the Maldives Climate Change Trust Fund (CCTF). The World Bank will administer the financing.

The project will cover five selected islands of the Ari Atoll. The islands of Dhangethi, Dhigurah, Fenfushi, Thoddoo, and Ukulhas within the atoll have been identified to serve as model islands for a solid waste management system and demonstration sites for expanding the island level integrated waste management system to surrounding inhabited islands.

The first phase of the project will be implemented in three islands – Dhigurah, Fenfushi, and Ukulhas,. Thereafter, the pilot project will be expanded to the islands of Dhangethi and Thoddoo. Eventually, it is anticipated that all inhabited islands in the atoll will participate in an atoll-based solid waste management system, although at this stage, such expansion is not part of the project due to time and resource constraints.

North Central Region. The Maldives Environmental Management Project (MEMP) has been divided into four components. One of the components involves a regional solid waste management program for the North Central Region².

The project has two development objectives, which are:

- The first seeks to improve and develop a socially and environmentally sustainable system of solid waste management that reduces the associated environmental and public health risks and that can be replicated and scaled up across the country.
- The second aims to strengthen the national technical capacity and quality of local expertise in environmental management/monitoring.

To facilitate construction and management of environmentally sustainable and economically viable solid waste management systems at island and atoll levels is one expected outcome of the project. A second outcome is that the community participatory approach developed and implemented, while designing and implementing island waste management centers and regional waste management facility(s), would enhance the sustainability of these initiatives.

The project status according to a recent (December 2012) World Bank report³ is:

Implementation progress of the project's most significant component, i.e., regional solid waste management (RSWM) has improved since last year following the restructuring and September 2011 amendment to the Financing Agreement. The amendment has made possible the introduction of a pilot program in five North Province islands to demonstrate the benefits of a proper solid waste management (SWM) system. Nevertheless, a number of RSWM activities are still moving more slowly than expected.

During the June 2012 implementation review mission, the Minister of Environment and Energy (MEE) agreed to focus the implementation of the RSWM component initially in 26 islands of the North Province that received relatively high ranking in terms of commitment to participate in the project's RSWM approach consisting of: (i) construction and/or operationalizing of island waste management centers (IWMCs) for waste segregation, recycling, composting and storage of residual waste by the communities in the targeted islands; and (ii) final treatment, transfer

² North Central Region encompasses four atolls: Baa, Lhaviyani, Noonu, and Raa.

³ http://www-wds.worldbank.org/external/default/WDSP/SAR/2012/12/23/090224b081837b74/1_0/Rendered/PDF/Maldives000Mal0Report000Sequence010.pdf

and disposal of residual non-degradable waste to a Regional Waste Management Facility (RWMF).

The Maldives Association of Tourism Industry was contacted several times for information the perspective of the on the MEMP program and the amount resorts have agreed to pay for the solid waste management program.

6. Vulnerability of Solid Waste Facilities to Climate Risks

The Republic of Maldives is especially vulnerable to climate-related hazards, including extreme rainfall events, droughts, rising sea levels, damaging winds, and elevated water and air temperatures. Nonetheless from a solid waste perspective, the primary climate risk to waste management facilities appears to be primarily related to the effects from severe storms, including sea surges that lead to flooding, and damaging winds. Other causes of flooding such as sea level rise are longer-term in nature and have broader implications to the Maldives that transcend solid waste management.

Flooding and winds due to severe storms would have different affects on the two key sectors of the solid waste system:

- Tourist facilities, especially resorts.
- Island communities.

6.1 Tourist Accommodations

During severe storm events, it is unlikely that resorts and other tourist accommodations will have many guests, as the guests will either delay their visit to the Maldives due to a forecast storm of such magnitude that could cause flooding from storm surge and/or heavy rainfall or guests already at tourist facilities will likely be evacuated. This scenario would apply to the four types of tourist facilities.

To the extent that there are guests at a tourist facility, they will continue to generate discards that will need to be managed. Temporary storage may exist given the expected lesser number of visitors. Medium-term storage may be needed at resorts, as an example, as there will likely be limited opportunity to discard organic waste to the sea due to unsafe conditions. Additionally, food waste dumped into the sea might likely be washed back into the resort itself, depending on the prevailing wind and sea direction.

Resorts and other types of accommodations should develop a contingency plan for temporary waste storage at either a land-based location that has a higher elevation near the resort complex or a constructed emergency storage area on a platform at sufficient height and distance from the sea to minimize the effect of storm flooding. Such a temporary / emergency site should probably be at a separate location then the regular waste storage site. The regular site will likely be adjacent to the water to reduce transport to a boat to ship waste off-island for disposal. This regular waste storage / loading area will likely be most affected by storm flooding.

After a storm flood there will likely be a need for continued use of a temporary storage area to contain debris, especially landscaping debris from gardens / yards, until it is sufficiently dry enough to be incinerated or otherwise properly managed.

If there is not an adequate site for a more secure temporary storage site the facility could elevate a portion of the regular waste storage area to a sufficient height to minimize storm flooding from

effecting solid waste. The storage capacity for solid waste was estimated to be sufficient to stockpile refuse for a week. For an average resort, the daily quantity of solid waste discarded, including food waste, is 1.3 mt. A week storage capacity should be sufficient to hold 9.1 mt. While this estimate is based on an 82.4% occupancy rate, an unlikely scenario for the reasons stated above, it is a conservative parameter. The space needed for this quantity of waste would be slightly more than 33 cubic meters, based on an assumed density of 300 kg / m³.

6.2 Island Communities

Unlike tourist facilities, which will likely have fewer guests with a forecast severe storm that may lead to flooding, island communities will be more likely to have the same population, as under normal circumstances. Additionally the residents will likely generate about the same amount of waste as under normal circumstances, except to the extent that flood water damages personal effects that are then discarded.

The temporary storage options for island communities are similar to those available to resorts. These options include designation of a temporary storage area at an island site that is sufficiently high enough above an expected high water level to minimize the effect of flooding. Additional height can be gained through the construction of an elevated storage platform. The area of such a temporary storage area should be sufficient to hold the waste generated over several days (say a week), which would include a few days before a storm, during and after to allow sea surge flooding to drain away.

Most likely a temporary storage area would be located at a separate site from an Island Waste Management Center (IWMC), or other usual waste accumulation site. An IWMC will likely be located near the water for expedient loading of waste onto a vessel for transport to another island for treatment and/or disposal.

The primary focus of the temporary storage area is to minimize the risk of storm flooding from washing stored waste into the sea where it would contaminate the sea bottom and reefs as well for waste that does not sink to eventually float onto beaches within the Maldives.

7. Best Practices for Solid Waste Management

7.1 Maldives

Best Practical Environmental Option (BPEO). The BPEO to address climate risks in solid waste management for the tourism sector is the hierarchy of options provided in Figure 7.1. This hierarchy applies to all types of waste management situations including solid waste in the tourism sector and island communities.

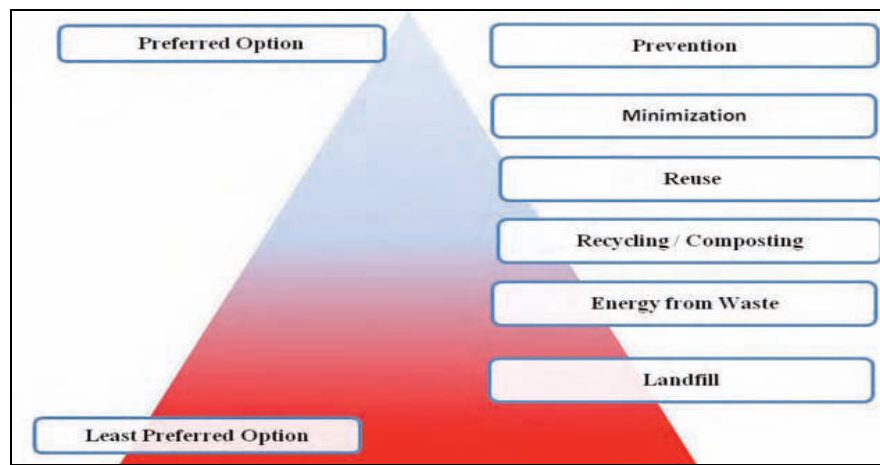


Figure 7.1: Hierarchy of Solid Waste Management Options¹

Under the hierarchy, waste prevention is the preferred option at the top of the pyramid, while waste disposal is the least favored option at the pyramid's foundation. Waste prevention and minimization are equivalent to waste reduction and involve the prevention of waste at the source by redesigning products or changing patterns of production and consumption².

Waste reduction (that is, prevention and minimization) comprises demand management practices such as the creation of durable products with longer lives. Reuse describes products that may be used more than once, unlike disposable or single-use products such as diapers and soft drink containers. The recycling option includes composting. Energy recovery includes technologies, such as methane capture, that harness waste or by-products to generate usable energy.

Tourism Sector. A comprehensive survey of waste management practices by the tourism industry in the Maldives was exceeded the work scope for this project. Nonetheless, a recent report³ that addresses

¹ Peterson, Charles. "Sector Note 4: Cities and Solid Waste," In: Ecological Cities as Economic Cities. World Bank. Washington, DC. 2009.

² Peterson, Charles. "What Does 'Waste Reduction' Mean?" Waste Age, January 1989.

³ Jameel, Ahmed. Resort Waste Survey at Ari Atoll. Environmental Protection Agency, Male, Maldives, January 2010.

solid waste in the North and South Ari Atolls provides an assessment of the state of waste management by the industry.

Most of the resorts seem to be nominally in-compliance with the MoTAC's regulations on solid waste management by the tourism industry. There is an on-going concern about proper solid waste management on the safari boats, in general. One resort that was mentioned by officials in government and the industry as seeking an innovative solid waste management program is the Kuramathi Resort.

One initiative of the Kuramathi waste management program is an in-vessel aerobic pre-composting technology that accelerates the decomposition process. Conventional aerobic composting such as the windrow approach requires a significant land area. The window approach needs about 30 days for the initial phase with the compost piles being turned on a regular basis to provide oxygen to the waste mass; otherwise the decomposing organics will enter an anaerobic phase rather than aerobic. A foul odor, such as hydrogen sulfide, is a notable side effect of organic material decomposing in an anaerobic stage.

An overview of the solid waste program at the Kuramathi Resort is provided in Box 7.1. The resort has yet to fully commit to the pre-composting process, pending the results of a laboratory test of the quality of the process product which is more a mulch than compost. A test will likely take place in January or early February 2013.

Box 7.1: Solid Waste Management Operation at a Resort (Kuramathi Resort)

Resort. The Kuramathi Resort, which is located on Kuramathi Island on the Rasdhoo Atoll, has beds for about 700 guests. The resort is owned Universal Resorts, which also owns three additional resorts and a safari boat. All these tourist sites are located in the Maldives.

Food Waste. Food waste (400 to 500 kg per day) is segregated from other discards and stored in containers in an air conditioned room, see Figure 7.2. Prior to start-up of the composting system, the food waste was discarded into the sea, where it was consumed by fish. Food waste is now mixed with other organic discards (garden / yard waste) in the composting system.

Organic Wastes – Food and Garden / Yard (Landscaping). In early October 2012, the resort started-up a system to process organic waste into mulch, as an initial stage in the transformation to compost (humus). The system was developed by a Japanese firm (Nakamori), see Figure 7.3. The system processes shredded garden / yard waste as well as food waste.



Figure 7.2: Food Waste Storage Room and Empty Containers

Organic wastes are lifted by crane and then fed into an opening in the top of the mixer unit. The in-put organic wastes travel down the inside of the processing vessel; then back to the top by a vertical Archimedes screw. The unit components are powered by electricity.

Some of the organics are pushed through openings in the pipe containing the screw, further reducing the particle size of the waste. The organic wastes are exposed to oxygen at the top of the process chamber, which is important to keep the process aerobic. The process continues for two hours during which time significant heat is generated from decomposition.



Figure 7.3: Nakamori Composting System

The organics are removed from an opening near the base of the unit after two hours of processing, see Figure 7.4, and are moved to a nearby area under roof for seven days for additional stabilization of the compost. The Nakamori process reportedly differs from conventional aerobic composting that takes 30 days plus an additional 30 days for curing. The volume reduction of 66% with the Nakamori system is similar to the amount that would be achieved with conventional aerobic composting.



Figure 7.4: Organics after Two Hours of Processing

The process relies upon a bacteria mixture that was developed from local vegetative material. When the composting vessel is unloaded about 25% of the product remains for use as a starting feedstock for the next batch of raw organics to be processed.

The resort decided to try composting as a means to manage its organic discards for several reasons, including a reduction in the amount of waste shipped to the Thilafushi treatment and disposal site, which cost the resort MVR 500,000 per month for shipping alone. Additionally up to 30% of the material produced can be used by the resort for landscaping purposes. The resort anticipates that a portion (ideally the balance) of the material will be sold to communities on other nearby islands for agricultural and horticultural purposes.

A follow-up email was sent to Nakamori Limited (Sri Lanka), the system supplier, concerning system performance, specifically to time needed to convert the mulch product produced by the system into humus (compost). No response was received from the supplier.

From a biological perspective mulch is a suitable landscaping product. However, mulch is a biologically active material with a high carbon content. If tilled into the ground, mulch will draw nitrogen from the soil as it further decomposes into humus. This will have an adverse effect on plant growth as nitrogen is need for plant growth. There is a significant difference between mulch and compost. While mulch may be well suited as a top coat for landscaping / weed control, humus is needed for plant growth in a garden / agricultural application. This difference will be reflected in the price that would be expected for mulch and compost.

A video of a Nakamori system in operation is available at: <http://www.youtube.com/watch?v=iqhFCExogKY>

Inorganic Discards. Other types of refuse such as glass, plastics, metal and old corrugated cartons (OCC) are segregated. The glass is crushed and some is used to make tiles. The other materials are bundled.

Incineration. Non-OCC paper products are incinerated. The incinerator, see Figure 7.5, is batch fed on a daily basis. The combustion process requires about three hours and is done at night. Ash from the incinerator is mixed with the organic waste in the composting process.



Figure 7.5: Incinerator

7.2 International – Small Island Developing States (SIDS)

Mauritius Strategy. In 2005 a UN conference was held in Mauritius to review the 1994 Barbados Programme of Action (BPoA) for the Sustainable Development of SIDS. At the conclusion of the UN conference on SIDS, the official statement concluded that:

Efforts to recognize small islands' vulnerabilities and to support their sustainable development received a solid encouragement today with after the unanimous adoption of both a pro-active Strategy to further implement this programme of action, called Mauritius Strategy, and of a political declaration, The Mauritius Declaration.

Waste management was one of the topics addressed in the Mauritius Strategy, which in part states that:

While some small island developing States have made significant progress in both planning and implementation of waste management policies, programmes and strategies, most of them have serious difficulties in terms of financial and technical capacity in dealing with waste

management issues. Marine debris and other forms of waste threaten the ecological integrity of small island developing States.

Further action is required by small island developing states, with the necessary support of the international community, to:

- Form regional partnerships to draw on best practices and develop innovative solutions to waste management, seeking international assistance in this effort.
- Work to strengthen the control of the transboundary movement of hazardous wastes, especially through the enhancement of activities under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, and, where it applies, the Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region (Waigani Convention)’
- Promote sustainable waste management, including by:
 - Identifying cost-effective and environmentally sound waste management systems.
 - Exploring and engaging in innovative forms of financing of waste management infrastructure, including the creation of appropriate national environmental trust funds
 - Promoting reduction, reuse and recycling of waste and waste management initiatives.
 - Developing projects appropriate to small island developing states for the use of waste as a resource, including for the production of energy as a waste management solution.
- Promote national, regional and international cooperation to reduce the quantity of waste disposed of at sea, including by working with others in the international community to strengthen regimes relating to the disposal of waste at sea, particularly those regimes established by the International Maritime Organization, the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention of 1972), and the International Atomic Energy Agency.

Furthermore, the importance of waste management to the BPoA and the Mauritius Strategy for further Implementation (MSI) is summarized below as well as in Annex C and D, respectively

Pollution prevention and the management of waste is both a critical and complicated issue for small-island developing States. Small land mass and limited availability of other resources, combined with an increase in polluting and hazardous substances due to population growth, are

contributing factors to the difficulty of managing waste. Waste in SIDS tends to be highly visible, but due to their limited capacity to monitor the waste stream the true extent of the problem remains poorly understood. For small island developing States, the disposal of wastes is a serious constraint to sustainable development: both land and sea-based sources of pollution require urgent attention. The basic principles and specific actions that are required at the national, regional and international levels to support sustainable development in small island developing states in the area of waste management are outlined in Chapters 3 of the BPoA (Barbados Programme of Action) and the MSI.

While the Mauritius Strategy lays out an ambitious approach for management of hazardous and radioactive waste, few examples applicable to the Maldives were identified through a data search.

UN SIDS Network. Maldives is one of 40 members of SIDS that are UN members. Additionally, five islands groups that are non-UN member are associate members of SIDS. The SIDS members are divided into three geographic groups, which are:

- AIMS (Atlantic Ocean, Indian Ocean, Mediterranean Sea, and South China Sea), which includes the Maldives.
- Caribbean.
- Pacific.

See information below on the training programs for the SIDSs in the Pacific that will be sponsored by the Secretariat of the Pacific Regional Environment Programme.

A review of waste management conditions within selected SIDS countries, as reported on the UN's SIDS website, shows no excellent example of suitable solid waste practices, see information provided below.

AIMS Countries. Four countries that have similar background conditions to the Maldives are: Cape Verde, Comoros, Sao Tome and Principe, and Seychelles. None of these countries were reported to have implemented programs that are an improvement to the solid waste management practices that exist in the Maldives. A summary of the waste management programs in all of the AIMS countries is provided below.

- Cape Verde. Cape Verde has ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Currently, the Government of Cape Verde is seeking support from the EU to help implement a water and environmental infrastructure framework. An agreement was made to concentrate resources in the water and sanitation sectors, particularly for the supply and distribution of drinking water, collection and treatment of residual water, and solid waste control.

The accumulation of waste in Cape Verde is having a negative impact on the environment and consequently on those economic sectors, such as tourism and fisheries, which rely on a healthy environment for success. The quality of tourism

services that focus on the sun and the sea are at risk of becoming unsustainable in the long run, as current waste management practices and pollution decrease the aesthetic value of the environment. In particular, there is urgent need for sanitation systems and recycling of sewage water, as well as for improving systems for collecting solid waste. The main indicators for environmental pollution are the presence of used oil in the soil, the dispersion and accumulation of non-biodegradable solid waste in waste dumps, the accumulation of vehicle exhaust gases (mainly in urban centers) and of aerosols (dust and sand) in the air. All these aspects of environmental pollution are on the increase in all municipalities. The only exception is São Vicente, partially due to the involvement of an NGO that collects and stores used oil.

- Comoros. The Comoros lacks an organized system for the proper collection and management of waste and sanitation. This constitutes a major health risk.

Population growth and urbanization have brought a substantial increase in the amount of household refuse, untreated hospital waste, and transportation-related trash such as waste oil and dumped cars. Management of waste water and rain water is becoming a major source of concern in both urban and rural environments. The problem is particularly acute in the majority of towns that have not been able to devote the necessary resources to deal with the difficulties caused by these factors. Piles of rubbish in town centers also constitute a form of visual pollution that creates foul and fetid smells which are bothersome to inhabitants.

- Guinea-Bissau. Waste management is addressed in the Guinea-Bissau National Poverty Reduction Strategy Paper (PRSP) produced with the IMF in 2007.

A private company and several NGOs have been involved in the collection of garbage in the capital. However, waste management continues to be a problem and is exacerbated by annual population growth rates of 3%. There is no organized system for urban waste been pursued by the central government in response to the incapacity of municipalities to deal with increasing amounts of waste.

- Mauritius. Waste management in Mauritius is directed by the Ministry for Local Government. The National Programme for Sustainable Consumption and Production (SCP) is a government strategy which integrates waste into the greater sustainable development policy with a focus on Integrated Waste Management and Recycling.

The relatively rapid economic growth of Mauritius has created an increase in its annual amount of solid wastes collected and disposed of. Waste minimization, reuse and recycling are high on the national agenda and the target is to recycle 25% of municipal solid wastes. Mauritius has already embarked on its National Programme for SCP, which creates a framework for further sustainable development policy. Projects implemented under one of the priority areas of the Programme, namely Integrated Solid Waste

Management and Recycling, focuses on waste management and public involvement in this. Activities included in the National Programme for SCP include looking at producer responsibility, local authority action plans and the promotion of backyard composting. All the wastes collected by local authorities and private companies transit through a network of transfer stations (on mainland Mauritius) where they are compacted and conveyed through cost-effective bulk transportation to the island's only engineered sanitary landfill at Mare Chicose. In 2008, household waste constituted 93% of the total solid waste landfill. All waste carrier lorries, such as those for household wastes, recycling, effluent and hazardous wastes, are licensed.

- Sao Tome and Principe. Sao Tomé e Príncipe has not ratified the Basel Convention. Although lacking a waste-specific master plan, the need for one is recognized: the development of a National Master Plan for the Management of Urban Solid Waste is to take place within the National Environment Plan for Sustainable Development (PNADD), although this document is ten years old.

The sector is characterized by the absence of adequate infrastructure for the collection, transport and depositing of waste, poor training of staff who work directly in the waste sector, and low awareness in the general population as to the importance of waste management and sanitation. The District Boards and the Regional Government, which are responsible for the management of waste, do not have adequate facilities for this purpose and are mainly dedicated to (poorly) cleaning and collecting that waste which is collected from the population. In addition to the institutional and organizational problems that hinder the proper management of municipal solid waste in the country, rural exodus to urban areas has also contributed much to the degradation of sanitation and the environment. In six districts of the Sao Tomé et Príncipe Region, there is a characterized lack of control in the dumping of waste that occurs in various areas fully accessible to the public. The absence of the minimum screening of materials causes biodegradable and non-biodegradable materials to be deposited together along with hazardous medical waste, encouraging the proliferation of mosquitoes and other vectors of disease, which creates a significant public health problem. One major achievement by the government and civil society organizations in addressing some of these issues has been to encourage a heightened public awareness of the harmful effects on human health and the environment posed by urban solid waste. Initiatives in the country have focused on resolving the waste problem and on highlighting the education and training of members of NGOs and officials of the District Boards responsible for waste removal. Training in the areas of recycling and recovery of waste has been conducted in several communities, and there already exists programmes to process waste into manure to enrich the soil.

- Seychelles. A regional initiative by UNEP-GEF called "Addressing land-based activities in the Western Indian Ocean" (WIO-Lab) has been implemented in the Seychelles. The

institutional frameworks at the national level include the Environment Protection Act (EPA) 1994 and the Ministry of Environment.

Although the population growth rate of the Seychelles is relatively stable, the capacity of the Government in sectors such as housing and infrastructure, potable water and sanitation services, and solid waste management is currently stretched. One key challenge facing the urban planners of the Seychelles is raising sufficient capital to provide centralized services such as sewerage and solid waste management. Initiatives such as composting to reduce solid waste and the banning of non-biodegradable plastic bags have been undertaken in the Seychelles. The need to turn waste into a resource due to land restrictions has also been recognized.

- Singapore. Waste management in Singapore is overseen by the Inter-Ministerial Committee for Sustainable Development.

All solid wastes in Singapore are collected and disposed of by incineration or recycling by one of four plants. Singapore recycles 56% and incinerates 41% of all waste, which avoids methane emissions from landfills. The waste heat generated is then used to generate electricity, and accounts for 2 to 3% of the country total electricity supply. Only 2% of waste generated ends up in landfill, occupying Singapore's only landfill on Samakau Island. This is a manmade offshore landfill site opened in 1999 and was created by enclosing sea space between two islands.

Caribbean Countries. Two countries that have similar background conditions to the Maldives are: the Bahamas and St. Kitts and Nevis. None of these countries were reported to have implemented programs that are an improvement to the solid waste management practices that exist in the Maldives. A summary of the waste management programs in all of the Caribbean countries is provided below.

- Antigua and Barbuda. Solid waste disposal on land in Antigua and Barbuda is limited to a single sanitary landfill disposal site located on the outskirts of the capital. A large part of the waste is burnt. Waste management at the private level is piecemeal and is not regulated by specific criteria for levels of treatment, recycling, disposal, etc.
- Bahamas. The Bahamas promulgated the country's Pollution Control and Waste Management Regulations in 2000.

As part of the Solid Waste Management Programme, the Bahamas is in the process of building sanitary landfills. Glass and plastic recycling efforts in the Bahamas are largely limited to private individuals collecting and returning beverage bottles with return deposits. There is also cardboard and paper collection by commercial firms.

- Barbados. No information was available on www.sidsnet.org, as of April 7, 2013.

- Belize. No information was available on www.sidsnet.org, as of April 7, 2013.
- Cuba. No information was available on www.sidsnet.org, as of April 7, 2013.
- Dominica. In Dominica, the National Solid Waste Management System is operated by the Solid Waste Management Corporation, a statutory entity established by the Solid Waste Management Corporation Act 17 of 1996. The Corporation is charged with the responsibility of providing facilities for the collection, transport, treatment and disposal of solid waste and matters incidental thereto. It is also the executing agency for the National Component of the OECS Solid and Ship-Generated Waste Management Project. A gasification unit has been procured by the Corporation in the Princess Margaret Hospital in Dominica to treat biomedical waste in a more environmentally safe manner. The Corporation currently provides waste collection and transport services to the entire western coast of the island. The waste treatment operation is mainly taken in the two existing landfills namely the Stockfarm Landfill, which received approximately 75% of waste, and the Portsouth Landfill, which received 25%. The skip system continues to be the main facility for the collection and transportation of general waste. There are still small-scale, illegal open dumps scattered in the rural areas. The disposal of untreated sewerage and solid waste along the coast is a prime source of marine pollution, which can disease human beings and kill off coral reefs and sea grass beds.
- Dominican Republic. No information was available on www.sidsnet.org, as of April 7, 2013.
- Grenada. No information was available on www.sidsnet.org, as of April 7, 2013.
- Guyana. No information was available on www.sidsnet.org, as of April 7, 2013.
- Haiti. The rapid increase in migration of the rural population to cities in recent years has aggravated the situation of waste management in Haiti, with the elimination of solid waste being one of the major challenges facing the municipal government. Household waste and garbage in Haiti is not treated by reliable and technologically approved systems. There are no organized landfills at the national level, with waste collection generally being the responsibility of the town halls, and is carried out to vastly different standards from one municipal health unit to the next. Household wastes are deposited in open dumps during the collection. The report of "Status of Haiti NBSAP" emphasized the management of medical waste in particular.
- Jamaica. No information was available on www.sidsnet.org, as of April 7, 2013.
- St. Kitts and Nevis. St. Kitts and Nevis adopted the Pesticides and Toxic Chemicals Control Act in 1999. The Act provides for the regulation and control of the importation, storage, manufacture, sale, transportation, disposal and use of pesticides and toxic chemicals. The Solid Waste Management Act was passed in 2000. Solid waste disposal in

the Federation is limited to two sanitary landfills at Conaree and Roundhole in St. Kitts and at Lowground and Gingerland in Nevis. A large part of the waste is buried for decomposition. In rural areas, there are small and uncontrolled open dumps scattered about.

- St. Lucia. In St. Lucia, waste management policy and regulation addresses various specific sectors, including: biomedical waste, waste oil, ship waste, asbestos and used lead acid batteries. Traditionally, effective waste management in St. Lucia has been confronted by a number of barriers. Modern, efficient collection and disposal systems for solids have been instituted in St. Lucia since the mid 1990s. The Deglos Sanitary Landfill and the upgraded Vieux-Fort Solid Waste Management Facility have ensured the progress of waste management in St. Lucia. Presently, St. Lucia has 100% coverage for waste collection through a privatized waste collection service. A waste recycling plan has also been implemented in St. Lucia; however, efforts have been constrained by relatively small quantities generated at a national level, high cost of transportation, and lack of economic instruments to encourage diversion.
- St. Vincent and the Grenadines (SVG). SVG has relevant waste management policies and legislations. The Central Water and Sewerage Authority acts as the National Solid Waste Management Authority of SVG. The two primary sources of emissions from waste products are municipal solid waste and human waste. There are extant waste management facilities in SVG: for example, there are currently 7 solid waste disposal sites on St. Vincent and 3 managed sites operating in the Grenadines. The absence of a national sanitary landfill has resulted in several open dumps located without good siting criteria. Moreover, the link between waste disposal and poverty has been addressed by the local authority. The need for access to a basic waste treatment facility has been addressed in the country's poverty reduction strategy.
- Suriname. No information was available on www.sidsnet.org, as of April 7, 2013.
- Trinidad and Tobago. No information was available on www.sidsnet.org, as of April 7, 2013.

Pacific Countries. Four countries that have similar background conditions to the Maldives are: Federated States of Micronesia, Nauru, Niue, and Palau. None of these countries were reported to have implemented programs that are an improvement to the solid waste management practices that exist in the Maldives. A summary of the waste management programs in all of the Pacific countries is provided below.

- Cook Islands. No information was available on www.sidsnet.org, as of April 7, 2013.

- Federated States of Micronesia (FSM). The FSM has a National Solid Waste Management Strategy (NSWMS) for 2010-2014.

No state has a sanitary landfill and most communities lack access to any form of management dump site. As a result, illegal dumping is a major issue. Littering is also a widespread problem. At one time or another, all states have had recycling schemes, notably for aluminum cans, but in all instances these have failed. Currently no states has a waste recycling scheme, but there are some attempts to sort and store scrap metal for later export

- Fiji. Fiji has a National Solid Waste Management Strategy, which was approved in 2006, an Environment Management Act, which was approved in 2005, and a National Liquid Waste Management Strategy, which was approved in 2007.

The natural environment is an integral part of Fiji's products and services and the quality of nature plays a significant role in the success of any socioeconomic development. As such, the generation and disposal of waste has a direct and an indirect impact on the socioeconomic development of the country.

- Kiribati. One of the important environmentally-minded documents addressing waste management issues in the country is the Kiribati National Environmental Management Strategy (NEMS).

Pollution from solid waste, liquid and hazardous/toxic waste is widely recognized as one of the major threats to human health and the environment, and thus sustainable development in Kiribati has a direct influence on the quality of people's lives. Poor waste management is one of the major environmental problems in Kiribati, particularly in South Tarawa. Every year the 40,000 people living in South Tarawa generate 6,500 tonnes of waste – threatening the health and wellbeing of everyone living on this low-lying atoll. The environment in Kiribati has also been adversely affected by metals and chemicals from mining activities, and agricultural chemicals have polluted coastal waters. Like other Pacific islands, Kiribati is sensitive to the dangers of pollution and radiation from weapons tests and nuclear waste disposal.

- Marshall Islands. A working draft of a National Waste Management Strategy has been developed for the Marshall Islands.

In the past, solid waste was disposed of near homes, and left to decay on the ground. At the time, population density was low and most of the waste was biodegradable, presenting few ecological problems. Now, however, high birth rates and inward migration from the Outer Islands have contributed to high population densities in Majuro and Ebeye Atolls. This in turn has necessitated importation of basic foodstuffs that are usually canned, or packaged in other non-biodegradable materials. When combined with the mentality and habit of disposing of solid waste indiscriminately, this

trend has led to households producing substantial quantities of both biodegradable and non-biodegradable solid waste. In recent years, waste management on Majuro has improved with the creation of the Majuro-Atoll Waste Management Company. Through the support of health grants from 'Compact Funds,' the company has solidified relationships with development partners and other external funders and has developed a waste management regime for most of the main urban areas of Majuro including distribution of recycling bins. facilities, however disposal of septage complies with the recommended distance from water bores. Potential health risks are thereby minimized.

- Nauru. Work is being carried out in finalizing the National Solid Waste Management Strategy which was developed late in 2008.

Waste is a serious problem on Nauru. The country is so small that the impacts of waste are easily seen. Most Nauruan families generate more waste than the Nauru Island Council service collects. Once bins are full, households have to find other ways to dispose of extra waste. Many households throw rubbish straight into the environment. There is no household sorting or recycling of waste in Nauru.

- Niue. Niue has an active Waste Management Plan in place.

With regard to solid wastes, the bulk of biodegradable wastes are recycled via mulching/composting in an effort to return valuable nutrients to the soil and to enhance soil fertility and structure. Food scraps are fed to the pigs or domestic pets, which are kept by most households. Niue has a very effective aluminum can recycle scheme, which compacts and ships cans to New Zealand for recycling. A main issue of concern is the lack of control measures with regard to which products can safely be disposed of, as there is a potential risk of toxic wastes entering the underground water lens.

- Palau. With regard to solid wastes, since 2002, there has been progressive improvement in management of solid wastes in Koror albeit little improvement in most rural states. Outside of Koror, state governments operate their own dump sites, none of which meet the standards for a sanitary landfill. With regard to hazardous and chemical wastes, these have yet to be addressed including consumer goods (household chemicals, electronics, and computer wastes) and industrial wastes. The relatively small volume of wastes generated by Palau is a constraint to management because there are no economies of scale that can support a market in the sale and/or recycling of hazardous wastes.
- Papua New Guinea. Papua New Guinea's (PNG's) waste management issues are addressed in the National Water Supply and Sewerage (NWSS) Act, the Public Health Act and the Environmental Contaminants Act.

Similar to many other developing countries, PNG is facing problems with managing its waste in striving for economic prosperity and political stability. This includes municipal

solid waste as well as hazardous and infectious waste. Large sections of urban society suffer from service inadequacies in waste management and unsanitary conditions, with the poor suffering disproportionately more. In PNG, the health and environmental risks from the poor management of health care waste are high and need immediate attention. The lack of management of health care waste in PNG is reaching an alarming level. Furthermore, open dumping of waste on land without adequate control, as occurs in Port Moresby, can result in serious public health and safety problems and severe adverse environmental impacts.

- Samoa. The Government of Samoa has developed fiscal and policy incentives and other measures to encourage environmentally sustainable imports and local products with low waste or degradable waste content. Samoa has also ratified and implemented relevant Multilateral Environmental Agreements (MEAs) or conventions relating to waste and pollution control.

Municipal waste in Samoa has several features that make it unique from municipal waste found in larger industrialised nations. As the economy of Samoa develops and moves towards a cash-based, consumer goods society, the volume and complexity of waste products increases. Much of the modern waste stream generated within the wider urban area of Apia may take years to break down, and some components of these wastes may also be harmful or hazardous to humans and the environment. There is concern about the use and disposal of various chemicals, agricultural pesticides and herbicides, empty containers, and household chemicals.

- Solomon Islands. The Solomon Islands have recently finalized a National Waste Management Strategy.

Solid waste is a growing problem, particularly in urban areas such as Honiara. Public attitudes and existing policies prevent execution of a comprehensive approach to waste management. Due to poor public awareness and policy absence, a great amount of household-compostable solid waste continues to be added to the landfill waste stream, overburdening the waste collection and disposal function of the Honiara City Council. Similar problems exist for other population centres in the country. Plastic waste is increasingly evident in sea pollution, and is again related to public attitudes towards waste and the high availability of cheap plastic packaging materials. In addition to this, there continues to be concern about the potential of oil leakage from bunkering in sunken World War II vessels throughout the Solomons.

- Timor-Leste. No information was available on www.sidsnet.org, as of April 7, 2013.
- Tonga. No information was available on www.sidsnet.org, as of April 7, 2013.
- Tavalu. No information was available on www.sidsnet.org, as of April 7, 2013.

- Vanuatu. No information was available on www.sidsnet.org, as of April 7, 2013.

Secretariat of the Pacific Regional Environment Programme (SPREP). Several of the Pacific island countries were reported by the SPREP to have used innovative funding mechanisms to support their solid waste management programs.

The Maldives might use similar programs to raise funds for its solid waste programs particularly those at the island community level, as waste from inadequate dumping (such as on beaches) tends to become washed into the sea where it may either settle to the bottom or become trapped in coral reefs. Both routes can lead to complaints from tourists, especially those involved in scuba diving and snorkelling. Additionally floating debris can wash onto resort beaches creating unsightly conditions and requiring additional labor and cost to clean-up.

SPREP also will be conducting an education for officials and staff involved in solid waste management that the Maldives might attend and/or emulate.

Innovation Funding Mechanisms. Two funding mechanisms used by a few Pacific island countries are deposits on beverage containers (Cook Islands) and advanced disposal fees, also known as product charges (FSM).

Deposits. Consumers pay a deposit on each container when purchasing the product (such as soda, fruit drinks, water). The deposit is refunded to the consumer when a container is returned. The returned containers can be accumulated and returned along the supply chain thus aiding in recycling of containers manufactured from plastics, glass, or metal. The deposit value needs to be set at a level sufficient high enough to encourage returns, but not to discourage product sales.

The deposit will give individuals a financial incentive to collect littered beverage containers or discarded containers to retrieve the deposit. More importantly from a solid waste perspective, uncollected deposits should be turned over to the government and used to provide funds for solid waste management capital investment (CAPEX) and operational expenditures (OPEX).

In addition to beverage containers deposits can be used with other products to encourage their return. Such products could include potential toxic / hazardous wastes for example batteries. This could keep batteries out of dump sites where open burning could lead to the air borne dispersion of undesirable chemicals.

Advanced Disposal Charges. This mechanism seeks to incorporate the cost of waste management into the price of a product. The revenue generated should be directed to a solid waste management fund that would provide revenue for CAPEX and/or OPEX costs. As the charge would only apply to products, other waste items, such as garden / yard debris, would not be assessed a fee.

The SPREP program also provided information on improvements to solid waste management programs in two countries: Kiribati and Samoa.

- Kiribati. By the late 1990s Kiribati was in a waste crisis. The primary problem was on South Tarawa, the capital, and home of approximately one half of the country's people. There were no engineered landfills, and litter was extremely common and thick, in all built up areas and surrounding beaches. Piles of waste often remained uncollected in the streets for weeks. Programmes were instituted by the Ministry of Environment, the ADB, and SPREP to turn the situation around. By 2002, a programme called SAPHE1 was underway, building two landfills, funded through an ADB loan to the Government, and FSP Kiribati had completed a programme called KEEP (Kiribati Environmental Education Programme) which focused on home waste management, and laid the basis for a more integrated approach. The Ministry of Environment coordinated closely with both these projects. Some analysis of these programmes was conducted by SPREP in the report for the WASTE project Community-Based Waste Management.
- Samoa. Semi-aerobic (Fukuoka) Landfill Management in Samoa - The Tafaigata waste disposal site in Samoa was transformed from a messy, smelly dump to a clean and sanitary semi-aerobic landfill structure using the Fukuoka Sanitary landfill method, which is the typical landfill method in Japan. The transformation process was funded by the Japan International Cooperation Agency (JICA), at a cost of only US\$400,000 (consultant supervisor not included).

The transformation took place in two phases. The first one involved setting up waste cell bunds, consolidating the soil "floor", installing the air ventilation / leachate collection pipes, a leachate collection pond, and all-weather access roads. The second phase included setting up the leachate treatment facilities. At the completion in December 2005, the project was handed over from JICA to the Samoan Government.

Waste Management Training Programs. Two programs on waste management are scheduled. One to be held in March in Samoa will focus on various waste management techniques, including policy and strategic approaches to integrated solid waste management, hazardous waste management and other key waste management challenges facing the Pacific Region. The second session to be held in April in Fiji will focus on landfill and dumpsite management, leachate treatment and management, and environmental monitoring. The GOM should be aware of such meetings that might provide information relevant to the solid waste situation in the Maldives. Also the information provided in such seminars could be useful to a variety of waste manager at tourist facilities, island communities and at the national level.

7.3 International - Water Transport of Solid Waste

Water borne transport of solid waste is for practical purposes limited to locations where both a transfer station⁴ and a treatment and/or disposal site are water served. An exception is a transfer system at

⁴ Facility in which smaller loads of collected solid waste are consolidated into larger loads for transport to a treatment and/or disposal site.

which wastes are containerized, which allows waste containers to be trucked to loading point on a boat or off loaded and moved by truck to a treatment / disposal site. Alternatively if both the transfer station and treatment / disposal site are adjacent to water, solid waste can be loaded directly into a barge, see Figure 7.6. Note the screen around the barge to prevent waste from falling into the water. Also this barge has much more capacity than one that might be used to serve an individual island community.



Figure 7.6: New York City Waste Barge⁵

With bulk loading the waste in the barge must be unloaded by a crane or excavator. Containerized waste can be off loaded faster and more easily taken to a designated dump area. There is a cost trade-offs between bulk loaded and containerized waste loads.

In addition to the marine transfer system in New York City, other marine systems include:

- Hong Kong, China (containerized).
- Shanghai, China (bulk load).
- Southeast Alaska, USA (containerised – shipped to Seattle, loaded onto a train for transport to landfill in eastern Washington).
- Vancouver, Washington USA (containerized).

All current water transport operations control waste spillage and blowing by putting waste in containers or with bulk loads cover the waste with a tarp or net.

Another significant barge system that has been proposed, but has yet to be implemented is the containerization of waste discarded in Hawaii for barge shipment to the State of Washington (USA) for disposal.

One advantage of water-borne transport, aside from avoiding traffic congestion in large metropolitan areas, is that marine transportation is more energy efficient than either truck or rail.

⁵ Barge is designed to transport up to 650 tons per load.

A barge system in the Maldives to serve the resorts, safari boats, and island communities could be based on a 'hub and spoke' approach. Barges could be located at convenient spots for tourist facilities and island communities (spokes) in a group of islands. On a regular basis loaded barges would be collected and an empty barge positioned at the loading dock. The loaded barges would be taken to a hub where the loaded barges would be lashed together for transport to a treatment / disposal site such as Thilafushi.

A more detailed analysis of a barge based transportation system should be undertaken as a follow-up to this report.

7.4 International – Technology Options

The technology options suitable for the Maldives are limited because of the relatively small quantity of solid waste that is generated over a dispersed area. This situation is well recognized with regard to waste transport to a point(s) for consolidation prior to treatment and/or disposal.

Various entities may suggest that cost effective and technically viable solutions are available. Maldivian officials should require examples of reference facilities that demonstrate the successful operation of commercial-scale plants using waste streams similar to those found in the Maldives. A technology that successfully functions in developed countries that discard waste with a very different composition may be unsuitable for the Maldives.

There are limited technologies and systems including waste-to-energy that have been tried and found to be commercially viable for an archipelago nation such as the Maldives.⁶ Some of the options addressed in the report might be suitable for tourist resorts and island communities.

Composting. One such option is aerobic composting (including backyard or very small-scale composting including vermicomposting). At resorts an issue is that the volume of humus produced will likely be greater than the demand for on-site landscaping. It has been suggested that excess compost could be sold to island communities for gardens and/or agricultural use.

Those that raised this option were not able to provide analytical evidence on potential demand on a volume or weight basis; nor was a potential value provided on a price that mulch / compost could be sold. Humus (compost) is not fertilizer rather it is a soil conditioner that has the following benefits⁷:

- Decreases soil density/enhances seed germination.
- Slow release organic nutrients to soil.

⁶ Peterson, Charles et al. Small-Scale and Low-Technology Resource Recovery Study. US Environmental Protection Agency. Washington, DC. December 1979.

⁷ Peterson, Charles (organizer / speaker). Compost Workshop. World Bank. Washington, DC. 2008.
<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/EXTUWM/0,,contentMDK:21785702~pagePK:210058~piPK:210062~theSitePK:341511,00.html>

- Improves water retention by soil.

The differences in chemical components between a typical compost soil condition and fertilizer are provided in Table 7.1. These differences affect the market value for humus.

Table 7.1: Chemical Components – Compost and Fertilizer

Chemical Component	Compost (Humus)	Fertilizer
Nitrogen (N)	1.0	10.0
Phosphorus (P)	0.4	20.0
Potassium (K)	0.5	10.0

Composting, including food waste, can be an option for resorts and island communities to partner on project development and operation. Nonetheless, it likely will be a more expensive waste management process than dumping food waste in the sea. Additionally, a composting partnership will probably require contractual commitments on the quantity of compostables to be delivered and on the degree of contamination in the raw waste. One of the primary reasons for the failure of composting operations on a worldwide basis is an inability to deliver a marketable product, often related to poor humus quality and the presence of non-compostables contaminants (plastics, glass). Another critical issue could be the organizational structure of the partnership and the amounts each party will contribute until the composting operation becomes financially viable.

Depending on the location, composting could be financially viable in the Maldives. The amount of organic waste generated by resorts and island communities is relatively small which would tend to direct a composting operation towards a windrow system rather than forced aeration or an enclosed reactor. Windrow systems generally are the lowest cost option but require the most land area. Given the limited available land for composting the other options might be preferable, but the higher costs might make composting an uneconomic option.

International best practices for composting⁸ can be achieved by avoiding the issues outlined below.

Composting is not more wide-spread for a number of reasons. These include: inadequate attention to the biological process requirements; lack of vision and marketing plans for the final compost product; poor feed stock which yields poor quality finished compost; poor accounting practices which neglect that the economics of composting rely on externalities, such as reduced soil erosion, water contamination, climate change, and avoided disposal costs; sensible

⁸ Hoornweg, Daniel, Laura Thomas, Lambert Otten. Composting and Its Applicability in Developing Countries. Urban Waste Management. Working Paper Series – No. 8. World Bank. Washington, DC. 1999.

preoccupation by municipal authorities to first concentrate on providing adequate waste collection; inadequate pathogen and weed seed suppression; nuisance potential, such as odors and rats; poor marketing experiences; poor integration with the agricultural community; and land requirements are often minimal, but can be a constraint. All of these constraints can be overcome.

Recycling. In addition to composting, recycling could be used to reduce the quantity of waste to be managed. Nonetheless, the limited percent of recyclables and the distance the material would need to be transported for consolidation in-country and then transported to a buyer tends to work against recycling having a significant role in reducing the waste for treatment or disposal.

Recyclables (metals, plastics) were estimated to comprise 5% and 3%, respectively, of solid waste from resorts and island communities, respectively. This equates to 6.7 mtpd and 7.2 mtpd, respectively, for the resorts and island communities in the Maldives.

While the quantities of recyclables per community and resort are relatively small, there are still economies-of-scale that could be achieved through cooperative efforts between resorts and nearby island communities. On a broader basis, greater benefits might be achieved on a regional cooperative basis such as by province. Additionally there may be a market advantage with the institution of a national authority to broker the sale of recyclables to international buyers. Such an authority could be located under the governance of the Maldives Ministry of Environment and Energy.

Greater cooperation between resorts and island communities could be promoted by the Maldives Ministry of Environment and Energy, as part of a broad based recycling promotion effort, through demonstration programs in different regions of the country, promoting the success (environmental and economic) of the programs, and provision of financial assistance. One financial assistance option could be structured on an out-put based aid program, where the financial assistance would be tied to the level of recycling achieved. Such a program could have a sunset condition where the recipient's number of years it received payment also could be tied to performance to achieve recycling objectives.

The market for the use of recyclables is limited in the Maldives. Nonetheless, there are scrap brokers that sell recovered materials to buyers, typically located in India. Market prices for secondary materials are highly fluid depending on the overall state of the worldwide economy. When economic conditions are positive, a high demand for materials causes commodity prices to rise; while commodities including those for recyclables decline as the global economy cools, as has been the case with the economic situation during the past few years.

8. Institutional Factors on Solid Waste Management for the Tourism Sector

The existing laws, policies, plans, strategies, and guidelines / standards for solid waste management on the tourism sector in the Maldives are addressed in this section. Also covered in this section are international bilateral and multilateral conventions/protocols pertaining to climate change, as such agreements relates to existing waste management practices in the tourism sector.

8.1 Ministry of Tourism, Arts and Culture

Law No. 2/99. The Parliament enacted Law No. 2/99 (Maldives Tourism Act) that outlines the topics for which regulations were promulgated for the protection and conservation of environment in the tourism industry.

Regulation. The regulation promulgated in response to Law 2/99 is known as the Regulation on the Protection and Conservation of Environment in the Tourism Industry. The objective of the regulation is to protect the environment related to the tourist industry and to encourage and facilitate sustainable development of tourism. The regulation commenced on July 20, 2000.

This regulation on the tourist industry covers any island leased for the development and operation for a resort, hotel, guest house, yacht marina, and islands leased under the Maldives Uninhabited Islands Act (Law No.20/98) and all other places and facilities registered under

Among the areas covered by the regulation, in addition to waste management, are:

- Protected species.
- Tree planting, fertilizer use, and living species.
- Water storage.
- Sewage and waste water treatment.

Tourism Solid Waste. Section 5 of the regulation developed in response to the Maldives Tourism Act (Law No. 2/99) addresses the provisions concerning solid waste management for the tourism sector, see Annex B. Among the requirements of the regulation are:

- Waste collection bins with lids are to be placed for convenient use on leased tourist properties such as resorts.
- The components of discarded wastes (food, glass, metals, toxic or hazardous materials) are to be separately collected.
- Waste disposal is to be done in a manner that will have the least impact on the environment.
 - All tourist resorts are top have and use incinerators, compactors and bottle crushers.

- Waste is to be disposed in the designated in a region or, in the absence of a designated area, disposed in a manner that is least harmful to the environment.
- Food and other biodegradable wastes may be dumped in the sea In the absence of a designated area for waste disposal in a region. Ocean dumping of biodegradable waste is to be done in the sea outside an atoll. The dumping is to be done taking into account wind and water currents so that it will not land on the shores of islands.
- Waste burning is only to be done in an incinerator, which means open burning is prohibited. Combustibles such as plastics that may produce noxious emissions are not be burned but rather separately collected and delivered to a designated waste management area.
- Monitoring data on vessels, including the capacity and proper logs on trips made for waste disposal in an island or part of it leased for tourism purpose, are to be maintained.
- Tourist vessels such as safari boats are to have a system for waste collection and storage until such waste can be taken to a designated place for waste management.

8.2 Ministry of Environment and Energy

National Solid Waste Management Policy. This policy, which was released in 2008 under the previous Ministry of Environment, Energy & Water, set as a primary target that

The estimated quantity of solid waste generated in our country will increase by 30% over the next 5 years from 248,000 tonnes in 2007 to 312,000 tonnes in 2012. By 2012 our target is to reduce the 2012 figure by 25% through recycling, reuse and influencing consumer preferences.

In the opinion of EPA staff this target was not met. Furthermore, the estimated annual tonnage for the Maldives is slightly more than 312,000.

Implementation of this document is based on 11 specific policies with clearly delineated strategies for each policy. Unfortunately the strategies have yet to be fully implemented or if implemented have not been faithfully put into operation. As an example, Island Waste Management Centres were to be constructed on islands with a population of at least 1,000 or more to facilitate recycling and reuse. Reportedly while such Centres have been built there has been a breakdown in the system for collection of recyclables and discards. The IWMCs have furthermore been report to have reached capacity leading residents to discard their waste at convenient dump sites such as beaches or low lying in-land areas.

Solid Waste Regulations. Published in draft in 2010, under the former Ministry of Housing & Environment, the draft was reported to be in a state of revision. The current draft revision is supposedly significantly different from the 2010 version.

The newly revised draft is supposed to be available for public review by February 2013. A recent search on the internet for the revised solid waste regulations failed to find the new draft.

8.3 Ministry of Foreign Affairs

The key international bilateral and multilateral convention / protocol to which the Maldives are committed pertaining to climate change and relate to existing waste management practices in the tourism sector is:

- Kyoto Protocol, as modified by the Doha Amendment (December 2012). The Maldives was the fourth country to ratify the agreement on December 30, 1998.

The Kyoto Protocol set greenhouse gas emission to the United Nations Framework Convention on Climate Change (UNFCCC) is a multilateral agreement that set obligations on industrial countries to reduce emissions of greenhouse gases such as carbon dioxide and methane. As the Maldives are not an industrial nation, the Protocol does not set greenhouse emission reduction targets.

The Protocol established market mechanism for industrial nations to meet the reduction targets. One option – Clean Development Mechanism (CDM) – enables developing countries, such as the Maldives, to sell emission reduction credits to industrial countries to meet their national targets.

Emission reduction can be achieved in a variety of sectors, including solid waste management. Reduced emission in the waste sector can be achieved relative to existing practices through several means including composting, waste-to-energy, landfill gas recovery and treatment and recycling. The relatively small volume of waste generated in the tourism sector and the country as a whole limits the practicality of pursuing this option through the CDM option.

9. Monitoring of Solid Waste in the Tourism Sector

9.1 Existing Monitoring Programs

For the tourism sector on a national level there is monitoring on compliance of the MoTAC regulations. Tourist resorts are visited annually by MoTAC staff. Unfortunately, the expense of visits to resorts are paid for by the resorts, which means that the resorts have ample advance notice of a visit and are thus able to correct any non-compliance issues in advance of the arrival by MoTAC monitors.

The only other operational monitoring system identified was the waste tracking program at the Thilafushi treatment / disposal site. A program to log delivery of waste to the site was instituted by the MCC. The objective of the log is to be able to account for the use of the dock. The charge is based on a combination of dock length used and the time at the dock.

A charge sheet is completed at Thilafushi. However copies of the sheet are apparently not given to the captain of the delivery boat nor sent to the resort that shipped the waste. Additionally, although the site claimed that wastes from 69 resorts had been shipped to Thilafushi, it was unable to send an electronic version of a charge sheet. The reported reason for an inability to send a charge sheet was the termination of internet service at the facility due to non-payment.

9.2 Proposed Monitoring System

The objectives of a monitoring system are critical to the design of such a program. Furthermore, a comprehensive monitoring program might be desirable from the start-up. However, a phased-in approach might be more suitable from a data management and cost (design, implementation and operational) perspective. A proposed monitoring system to be phased-in as appropriate is provided below.

Waste Flow. An initial objective for the Maldives might be the development of a database on waste flows. Currently, available data indicates that a number of resorts send waste to Thilafushi and a few to the disposal site on Addu Atoll. Nonetheless, it is unclear where the balance of resorts and other tourist facilities as well as community islands send their wastes.

Such an initial monitoring program would require tourist facilities, especially resorts and safari boats, and all community islands to record how waste are managed. The relevant data to be tracked might include:

- Name of resort, safari vessel, community island.
- Destination where discards are sent for treatment including recycling or open burning / disposal.
- Date shipped.
- Name of vessel on which waste was shipped.

- Date received at destination (including dumped on community island; the open burning).

The monitoring form should be signed by the following parties:

- Origin. Resort manager / safari vessel captain /community island official, or designated representative.
- Transport. Captain of vessel used to transport waste to a designated site (if the waste is not managed on-site).
- Destination. Site manager or designated representative.

Copies of the signed monitoring form would be sent (electronically or by post) to the primary contact person at the points of origin and destination as well as the transport vessel. Any discrepancies in the information provided should be made known as soon as possible.

A copy of the monitoring form also should be sent to a designated person with the EPA. The EPA should compile the data received into a database, which could be used to derive an analytical assessment on the performance of the country's solid waste management system on an annual basis.

Waste Quantity. Another objective could be a quantitative assessment of the waste collected by individual generators such as resorts, safari vessels and community islands. The information derived could be used to determine a range of actions such as the loss of waste during transport from spillage or blowing refuse

A formal program would rely on weigh bridges at both point of origin and destination. No weigh bridges were identified at either waste origins or destinations at present. Installation and operation of weigh scales would be a costly undertaking both for CAPEX and OPEX (operation, maintenance, and calibration).

A less reliable means of tracking waste quantity is an estimate on waste volume managed at both the point of origin and destination and a reasonable assessment of waste density based on the composition of waste collected for transport at the point of origin and destination.

The entities involved in the waste flow process, as defined above, would need to record the surface area used on a transport vessel and average depth of the solid waste as well as an approximation of the composition of the solid waste.

EPA is the most likely entity to be responsible for applying density factors to the waste streams being managed. The EPA also could apply a data check on the calculated waste quantity using the following formula.

$$Q = BC * OR * (GR - [FW + OM] * D)$$

Where:

- Q = Quantity. Amount of waste for disposal and off-site treatment.
- BC = Bed Capacity. At a resort or safari vessel or the population of an island community.
- OR = Occupancy Rate. For a resort or safari vessel.
- GR = Generation Rate. Expressed as kg per capita per day.
- FW = Food Waste. Percent of total discards that are food waste discarded into the sea. For resorts as an example the percent of food generated was estimated to be 40% of which 90% is managed through disposal in the sea.
- OM = Other Material. Materials that are recycled or composted or in some other means are diverted from the waste destined for disposal.
- D = Days. Number of days since waste was previously shipped to a disposal site.

This formula will only provide an approximation of the waste quantities from resorts, safari vessels, and island communities. Nonetheless the product (Q) will provide a basis to track waste flows and potential lost waste in the management system. These calculations may provide a basis for monitoring progress in addressing solid waste management program implementation.

10. Conclusions and Recommendations

10.1 Conclusions

The conclusions reached on this assignment are:

- Tourism is a critical part of the Maldivian economy, as it accounts for 30.2% of GDP. Proper solid waste management is an important element to maintaining and even expanding tourism's role in the economy. Visitors to the Maldives are seeking a pristine environment, not one with garbage floating in the sea and trapped on the reefs.
- The amount of solid waste generated in the Maldives at the tourist facilities (180 mtpd) and island communities (240 mtpd) are manageable. Nonetheless, the waste is dispersed over a wide area leading to logistically challenging and expensive options for the collection and treatment / disposal. Failure to implement a rational solid waste program will have a long-term deleterious effect on the tourism sector.
- Safari vessels have been blamed for dumping waste, in addition to food, in the sea. Nonetheless, the total estimated average daily solid waste generation for the safari vessel fleet (157 boats) is 8.0 mt in 2013. Food waste (6.0 mtpd) was estimated to account for 67% of average discards for the safari fleet, or an average daily generation rate of food discards per vessel of 38 kg. The average solid waste generation rate of the remaining discards (glass, metals, plastics) is 0.9 kg per tourist per day, or 2.0 mtpd for the safari fleet. This is a small quantity of solid waste.
- The potential for recycling of metal, plastics, and glass from tourist facilities and island communities is limited due to the relatively low percent of these materials in the waste streams from these generators. Additionally, the dispersed nature of tourist facilities and island communities presents a logistics obstacle to consolidate the materials for market. Finally, the Maldives are remote to potential users (India) of recovered materials. Even with these limitations recycling is a high priority Best Practical Environmental Option (BPEO), given the positive benefits inherent in recycling.

Incineration of garden / yard (landscaping) waste and paper products could reduce the volume for disposal by 90%. However, there may be a tradeoff between volume reduction and air emissions. Small-scale incinerators used at resorts may result in emissions of particulates (smoke) and toxics. If such conditions exist it could be attributed to inadequate operations staff training and lack of equipment maintenance as well as the high moisture content of the materials (landscaping waste) combusted.

Composting of landscaping and food waste might offer an alternative to incineration. Low technology composting systems (windrow) are land intensive; whereas higher technology options will reduce the need for land area but an increased CAPEX investment in equipment.

One resort instituted a pre-composting mechanical mixer on a trial basis; the product produced after a couple hours of mixing was homogeneous mulch that would require additional days of aerobic composting in piles to become suitable for use. The resort indicated that it had a need for only part of the product and hoped to sell the balance for agricultural / horticultural uses to buyers on other nearby islands.

- The Thilafushi waste management center reportedly has 20 ha of capacity remaining for disposal, which could last for another 25 years. This assumes that suitable treatment processes are put in-place to reduce the volume of waste for disposal. Further disposal capacity could be made available by an increase in the elevation for waste disposal. A mounded landfill would limit future uses for the disposal site. Nonetheless, disposal capacity is needed and there seems to be a consensus that there are limited areas to develop additional disposal capacity in the Male' area.
- Development of treatment / disposal centers in additional areas, such as the Ari Atolls and the North Central Region, in the Maldives are important components to a comprehensive solid waste management system.
- A transport structure to transfer waste from tourist facilities and island communities is a challenge to development of a comprehensive, cost effective treatment and disposal network for the Maldives. Fortunately, 67.5% of resorts, which comprise the majority of tourist bed capacity, are located on the two atolls (Alifu and Kaafu) near Male'. The wastes from these resorts are discarded in close proximity to the waste management center on Thilafushi Island.

A transport option suggested that might be suitable is a transfer / transport system that would use barges to store waste at tourist facilities and island communities. The barge could be moved periodically to a hub point, where the barges could be bundled together for shipment to a waste management center in Thilafushi or another location.

One recommendation of this report is that this transfer approach and other options be studied further to assess the technical, cost, and operational elements of such systems.

- Severe storms, including sea surges that lead to flooding, and damaging winds, are the primary climate risks to the Maldivian solid waste management system in the near term. Rising sea levels also pose a risk in a longer term basis.
- The other 39 SIDS countries have not reported success in managing their solid waste under conditions similar to those found in the Maldives. Nonetheless, although no contact with other SIDS members was mentioned during meetings with Maldivian officials, it might be worthwhile for the Maldives to establish / participate in a communications network to share information on institutional laws, regulations, enforcement programs, and policies; operational practices; funding mechanisms; and related considerations for the mutual benefit SIDS members.

- An advanced waste disposal charge was one innovative program implemented by a SIDS country in the Pacific region. The charge is designed to cover the cost of solid waste management in the purchase price for the product. Inclusion of the cost of waste management in the product price gives consumers an economic incentive to adjust their purchasing habits and possibly reduce the amount of waste discarded.

The Maldives might use a similar programs to raise funds for its solid waste programs particularly those at the island community level.

- The draft National Solid Waste Management Policy (released in 2010) defines policies and strategies for a sound solid waste management system. For various reasons the Policy has not been implemented to the determinant of the national waste management program and the tourism sector in particular.

Of particular importance from an aesthetic perspective is promulgation of a regulation to require that waste loads transported by mechanical means on land (truck) or sea be either put into enclosed containers or covered by a tarp / net to prevent spillage / blowing of solid waste along waste transport routes.

- A formal system for tracking waste flows would be useful for development of plans / programs to manage solid waste in a more organized manner. However, given the relatively small total quantity of waste discarded in the Maldives and, more importantly from individual resorts, safari vessels, and island communities, a more formal and sophisticated monitoring system might be cost prohibitive. At least that is the impression provided given the seeming lack of financial resources dedicated to solid waste management, overall, and monitoring, in particular.

10.2 Recommendations

A realistic plan and implementation schedule that can be met is needed for waste management in the tourism sector and the island communities. The implementation plan should be phased-in in incremental steps such as pilot programs to sort out logistics and costs. A reliable revenue source that will cover costs is a critical component for a long-term sustainable program that enables the Maldives to maintain its natural aesthetics. It is this natural beauty that draws tourist to the country and makes an important contribution to the economic health of the Maldives.

A nationwide plan should also include detailed studies such as a cost effective transfer operation that might include a 'hub and spoke' approach. As addressed in Section 7.1, to manage a barge based transport system for the collection and delivery of waste to a treatment / disposal facility. Additionally such plans should be part of an overall plan for waste management in urban areas (Male' and Addu City).

Suitable regulations on waste management activities also should be part of a plan. Among the activities to be regulated, one important one from a tourism perspective, would be a rule on the use of enclosed containers or tarps / nets to prevent waste spillage or blowing into the sea. Overall, solid waste

regulations should seek to protect public health, the environment, and aesthetics. A practical monitoring program would also be an important part of a plan. It would allow the tracking of progress on improvements to a solid waste program and provide a basis for modifications as needed.

The Maldives also should be involved with the other member of SIDS especially those in the Pacific sector that tend to be archipelago countries that depend economically on tourism. Sharing of information may benefit the Maldives and other countries and avoid wasted efforts that have found to be unsuitable for countries in similar situations.

Annex A: Proposed Pilot Solid Waste Management Project on Ari Atoll to be Financed Through the World Bank ¹

A.1 Project Summary

The project will cover five selected islands of the Ari Atoll. The islands of Dhigurah, Fenfushi, Ukulhas, Thoddoo and Dhangethi within the Ari Atoll have been identified to serve as model islands for SWM and as demonstration sites for expanding the island level integrated SWM system to surrounding inhabited islands. The first phase of the project will be implemented in three model islands, i.e., Ukulhas, Dhigurah and Fenfushi. Thereafter, the pilot project will be expanded to the islands of Thoddoo and Dhangethi in the Ari Atoll. Eventually, it is anticipated that all inhabited islands in the Ari Atoll will participate in an atoll-based SWM system, although at this stage, such expansion is not part of the project due to time and resource constraints.

A.2 Project Objectives

The development objective of the project is to build technical and human resource capacity to effectively manage solid waste generated in selected inhabited islands of the Ari Atoll, thereby reducing the environmental risks to marine habitats and greenhouse gas (GHG) emissions. The pilot project will develop and implement an integrated solid waste management (SWM) system in selected inhabited islands of the Ari Atoll and also build the capacity of the Island Councils and communities to manage solid waste.

A.3 Safeguards

Because nature-based tourism is the primary driver of the economy, the economic and social well being of the population depends largely on maintaining a high level of environmental integrity. Sound environmental management in Maldives is, therefore, essential to ensuring continued growth and development. In recognition of such linkage, Maldives established a regulatory and institutional framework for environmental protection in 1993 by enacting the Environmental Protection and Preservation Act (EPPA). A National Environmental Action Plan (NEAP) and an update to the EPPA were completed in 1999. Several NEAPs have been implemented and they have served as GOM's comprehensive framework for ensuring environmental protection and sustainable development during the years of implementation.

Environment plays a key role in national development articulated in the Strategic Action Plan. A ministry responsible for environment was established in 2004 with a mandate for environmental protection and management. The EPA was established in December 2008 as the environmental regulator. While the institutional and regulatory framework for environmental management in Maldives is in place, the institutional capacity for effective regulation and enforcement is weak. One of the components of the IDA-financed Maldives Environmental Management Project (that

¹ Source: ISDS. July 2012.

is currently under implementation) -- the capacity building program -- is addressing this weakness directly and good progress is being made in implementing the component. One of the greatest threats to public health from environmental-related issues is the ad hoc disposal of solid waste on the inhabited islands. It is envisaged that the Ari Atoll SWM pilot project will provide a model for replication in other islands/regions of the Ari Atoll, the Central Province and even the entire country.

In order to identify adverse social and environmental issues, the client has conducted an environmental and social due diligence (ESDD) study. As mentioned above, the outputs include protocols for screening, guidelines for mitigation of environmental and social risks, a generic environmental and social management plan (ESMP) and guidance on the development of Environmental Management Plans (EMPs) and Resettlement Action Plans (RAPs)

The Project Management Unit (PMU) in the Ministry of Environment and Energy will include an ESDD Coordinator who will report to the Project Manager and will work closely with the SWM Coordinator. The ESDD Coordinator will be responsible for overall implementation of the environment and social management plan and will liaise with other agencies at the island level to implement safeguard mitigation measures, monitoring and evaluation of implementation and report on compliance and status of performance indicators. In addition, EPA staff posted in the islands will guide and oversee the operations of the IWMCs.

A.4 Project Description

The proposed project will have three components that have been designed in consultation with the GOM, civil society and other stakeholders, as well as technical assessments undertaken and lessons learnt from the EU-financed, partially abandoned South Ari SWM Project.

Component 1: Development and implementation of an island level integrated SWM system

This component aims to build the institutional capacity of the Island Councils and communities in the five islands to plan and implement an island level integrated SWM program in order to minimize the environmental risks to the country's marine and terrestrial assets while reducing GHG emissions. In addition, support will be provided to the development of a strategy to operationalize the remaining EU-financed island waste management centers (IIWMCs) in the atolls of the Central Province. The project would support the following activities: (i) community participation in source segregation of solid waste; (ii) implementation of an island level recycling and composting program at the IWMCs; (iii) institutional capacity building of the Island Councils and communities for planning and managing an effective island level integrated SWM system; and (iv) development of a strategy to operationalize the remaining EU-financed IWMCs in the atolls of the Central Province.

Sub-component 1.1: Community participation in source segregation of solid waste

The inhabited islands that participated in the EU-financed South Ari SWM Project prepared island waste management plans that called for community participation in the source separation of household solid waste prior to collection and transport to the IWMCs. Although basic community awareness was initiated under that project, virtually no source separation of household waste is taking place in the islands. This could be attributed to two factors: (i) inadequate community commitment to participate in island level SWM; and (ii) lack of a waste transfer and disposal system for residual waste from the inhabited islands for ultimate disposal. This sub-component is designed to address the lack of community commitment to participate in island level SWM while Component 2 of the project will address the issue of the transfer of residual waste from the IWMCs for ultimate disposal at the Thilafushi disposal facility.

This sub-component will create community awareness on the environment and public health implications of poor SWM in the respective islands and solicit community participation for source segregation of household level solid waste. This will be achieved through: (i) a capacity building program that involves strengthening community awareness and initiating active community participation in source separation of waste at the household level; and (ii) an effective waste collection and transport system in the inhabited islands. The program will be designed to involve the participation of all households in the selected islands as well as the Island Councils.

Sub-component 1.2: Implementation of an island level recycling and composting program at the IWMCs

Because of the high population density in inhabited islands and the dispersed geography of Maldives, conventional approaches to SWM are not applicable. Most inhabited islands have inadequate land available for solid waste disposal and therefore off-island disposal is often the only available alternative. Ocean transport is the only mode of transport for the transfer of disposable solid waste to an off-island facility. Since transport costs are prohibitively expensive in Maldives, it is in the interest of any inhabited island to minimize the waste that would require off-island disposal. Approximately 70% of the solid waste stream is composed of biodegradable organic matter and could be managed at the island level through low cost, low technology composting at the IWMCs, thereby minimizing the amount of waste that would have to be transported to an off-island waste disposal facility. The non-degradable residue would be baled and stored under a protective cover at the IWMC site until the Thilafushi Island facility is rehabilitated.

The IWMCs that were constructed on inhabited islands presently do not have provision for composting. Hence, this sub-component would finance: (i) the construction of a concrete pad for composting with a drainage system for leachate collection at each of the IWMCs; and (ii) training of staff to undertake simple windrow composting at the IWMCs.

Sub-component 1.3: Institutional capacity building of the Island Councils and communities for planning and managing an effective island level integrated SWM system

While GOM assigned the responsibility for SWM to the regional utility companies in six out of the country's seven provinces, an arrangement has not been made for the Central Province, which includes the capital island, Male'. SWM services for the Central Province have been assigned to the newly created Waste Management Corporation (WMC). The Ari Atoll is part of the Central Province and therefore, SWM is WMC's responsibility. However, the Island Councils are responsible for intra-island SWM while WMC is responsible for inter-island SWM.

This sub-component will build the institutional capacity of the Island Councils and Island Offices to effectively manage intra-island solid waste, including the development of a viable institutional mechanism for cost recovery through the introduction of user fees.

Sub-component 1.4: Development of a strategy to operationalize the EU-financed IWMCs in the atolls of the Central Province

Under the proposed project, the results – i.e., the development and implementation of an integrated SWM system in five pilot islands – would subsequently be scaled up in the other inhabited islands of the Central Province. This sub-component would support the development of a strategy to operationalize the remaining EC- financed IWMC in the Central Province atolls. The key output of this sub-component is a strategy for operationalizing the remaining EU-financed IWMCs in the atolls of the Central Province.

Component 2: Development of institutional arrangements and implementation of a waste transfer system for off-island disposal of residual solid waste

The objective of this component is to develop an effective, working institutional model to transfer residual waste from the participating islands of Ari Atoll to the Thilafushi Island facility and to demonstrate the use of this model for residual waste transfer for all atolls of the Central Province. This would be achieved through the following activities: (i) development of a viable institutional mechanism which could include a public-private partnership (PPP) for the transfer of residual waste to the Thilafushi Island facility; (ii) development of a cost recovery mechanism for the residual waste transport system; (iii) procurement of a barge and associated equipment for the transfer of residual waste; and (iv) transfer of residual waste from the participating pilot islands to a regional SWM facility, like the Thilafushi site.

The Thilafushi facility has been identified by GOM as the ultimate disposal facility for solid waste in the Central Province until other regional waste disposal facilities are established in the future. Therefore, the residual waste from the islands participating in this project will use the Thilafushi facility for ultimate disposal of the waste. In the past, Thilafushi operated as an "open dump" with no precautions taken to minimize adverse environmental impacts from solid waste disposal. Recently, GOM assisted by the International Finance Corporation (IFC), privatized the operations and management of the Thilafushi site. The private sector operator is contractually bound to improve the site's conditions and operations in order to conform to guidelines on environmental safeguards of IFC's as well as GOM. While this project will not support nor be

involved in the operation of the Thilafushi site, the developer's legal obligation to conform to IFC's and GOM's environmental guidelines renders the use of Thilafushi for residual waste disposal from islands participating in this project acceptable.

The privatization of the Thilafushi facility provided for the rehabilitation of the site, and under current projections, the process will take another 18 months. Until such rehabilitation is completed, the non-degradable residue from the IWMCs in the five pilot islands will be baled and stored under a protective cover in the respective IWMCs. In the unlikely event that the rehabilitation of the Thilafushi facility takes longer than anticipated and storage space for the baled waste becomes a problem at the IWMCs, it is proposed that the baled waste would be transported to Thilafushi and stored on site until proper disposal is possible.

The potential adverse environmental impact of the residual waste is significantly reduced when compared with mixed solid waste because the organic fraction of the waste has been removed from the waste stream and subjected to composting at the island level. Studies have shown that the removal of the organic fraction of the waste from the residual waste stream reduces the pollution potential (as measured through the biochemical oxygen demand (BOD) of the waste) of the residual waste stream by about 90%. Therefore, the adverse environmental impact of residual waste disposal from the participating islands would be minimal compared to that of mixed waste disposal at the Thilafushi site at present.

Component 3: Project Management

The objective of this component is to establish an effective mechanism for project implementation, including monitoring and reporting of the implementation progress. An existing Project Management Unit (PMU) in MOEE manages the implementation of the IDA-financed Maldives Environmental Management Project (MEMP). While MOEE will have overall responsibility for implementing and ensuring that the project objective is met, it will execute the project through the EPA. The SWM Coordinator for MEMP in the PMU will be responsible for day-to-day technical coordination of this project with support from EPA's SWM staff. Also, implementation support would be provided by EPA staff posted at the Island Offices of the five targeted islands through technical oversight and coordination among the participating Island Councils that will have the primary responsibility for island-level implementation.

Annex B: Regulation on the Protection and Conservation of Environment in the Tourism Industry

This annex (an unofficial translation into English) provides the provisions of the waste management portion (Section 5) of the Regulation on the Protection and Conservation of Environment in the Tourism Industry.

- 5.1 Bins to collect waste shall be kept in various areas in an easily accessible manner in all resorts, picnic islands, marinas or such places leased for tourism purposes. Such bins shall be in a clean and sanitary state, with the lid closed.
- 5.2 Food and beverages, putrefying items, plastics, paper, glass, iron and items such as cans and toxic or hazardous waste shall be kept in separate bins for each type, and shall be labeled as such.
- 5.3 Waste disposal in tourist resorts, picnic islands, and marinas operating in the Maldives shall be carried out in a manner that would have the least impact on the environment, and in accordance with the laws and regulations and in accordance with the following rules prescribed by the Ministry of Tourism and Civil Aviation.
 - 5.3.1 Incinerators, compactors and bottle crushers shall be kept and used in all tourist resorts operating in the Maldives. If such equipment does not exist in any resort, such resorts shall obtain and start using that equipment within 6 months from the date of coming into force of this regulation.
 - 5.3.2 Waste shall be disposed to the designated area if there is such an area in the region, in the absence of a designated area waste shall be disposed in a manner that is least harmful to the environment.
 - 5.3.3 In the absence of a designated area for waste disposal in the region, only food waste and biodegradable waste may be dumped into the ocean. Any biodegradable waste dumped as such shall be dumped to the sea outside atoll, taking into account the wind and ocean currents so that it would not land on the shores of islands.
 - 5.3.4 It is prohibited to burn waste generated from the operation of the resort in the open areas of the resort. Incinerator shall be used to dispose such waste. Items that would cause emission of noxious gases into the atmosphere when burned (such as plastics) shall not be burned and shall be collected and delivered to a designated waste management area.
 - 5.3.5 Information relating to particulars of vessels, including the capacity and proper logs on trips made for waste disposal in an island or part of it leased for tourism purpose, shall be submitted to Ministry of Tourism and Civil Aviation.

- 5.3.6 It is prohibited to pump any sewer or waste into the lagoons or into any protected area of the ocean from any tourist vessel.
- 5.3.7 Tourist vessels shall dispose sewer and waste in a manner that is harmless to the environment.
- 5.3.8 Every tourist vessel shall have a system for collection and keeping of waste generated in the vessel until such waste is taken to a designated place for deposition of waste.

Annex C: Barbados Programme of Action (BPoA)²

The Programme of Action for the sustainable development of small island developing States outlines 14 action topics, one of which addresses waste management. The text of the BPOA on waste management is provided below.

III. MANAGEMENT OF WASTES

Basis for action

21. The shortage of land areas and resources available for safe disposal, population growth and the increase in imports of polluting and hazardous substances combine to make pollution prevention and the management of wastes a critical issue for small island developing States. Wastes in those States tend to be highly visible, but due to their limited capacity to monitor the waste stream the true extent of the problem remains poorly understood. For small island developing States, the disposal of wastes is a serious constraint to sustainable development: both land and sea-based sources of pollution require urgent attention.
22. All small island developing States share the problem of how to safely dispose of solid and liquid wastes, particularly the wastes generated by urbanization, which otherwise result in the contamination of groundwater and lagoon areas. Point source pollution from industrial wastes and sewage, inappropriately sited and poorly managed garbage dumps and the disposal of toxic chemicals are significant contributors to marine pollution and coastal degradation. Limited land area makes the option of landfill disposal unsustainable in the long term. Incineration, while reducing the volume of wastes, is prohibitive in terms of cost and still requires the disposal of ash containing potentially hazardous substances in high concentrations. Pressure on forests to provide fuelwood and to expand agricultural development together with heavy use of agricultural chemicals also aggravate downstream pollution and sedimentation problems.
23. There is also growing concern about the transboundary movement of toxic and hazardous waste, including the use of small island developing States for the disposal of waste generated by other countries. The isolation and oceanic location of small island developing States and their dependence on a marine and limited terrestrial resource base make them highly vulnerable to contamination by toxic and hazardous wastes and chemicals, and radioactive materials. The passage of ships carrying toxic and hazardous wastes, chemicals and radioactive materials is of international concern and of priority concern to small island developing States. There is a need to develop and enhance the emergency response capacities necessary to protect marine and coastal environments from accidents and incidents relating to marine transport. Emergency response

² BPoA. Source: <http://www.un.org/documents/ga/conf167/aconf167-9.htm>

capabilities and any damage compensation arrangements must not impose an unreasonable burden on small island developing States.

24. Given that long-term disposal options are limited and will constrain sustainable development, small island developing States will need to look for ways of minimizing and/or converting wastes, such as sewage, into a resource (e.g., fertilizer for agriculture). This will include action ranging from limiting imports of non-biodegradable and hazardous substances to changing community attitudes to the disposal and use of sewage. In the short term, existing wastes require effective disposal, but at the same time incentives to continue waste generation should be avoided.

A. National action, policies and measures

- (i) Develop fiscal and policy incentives and other measures to encourage environmentally sustainable imports and local products with low waste or degradable waste content.
- (ii) Develop and implement appropriate regulatory measures, including emission discharge and pollution standards, for the reduction, prevention, control and monitoring of pollution from all sources; for the safe and efficient management of toxic, hazardous and solid wastes, including sewage, herbicides, pesticides and industrial and hospital effluent; and for the proper management of disposal sites.
- (iii) Ratify and implement relevant conventions, including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal 5/ and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention of 1972), 6/ as well as relevant regional conventions.
- (iv) Formulate and implement public awareness and education campaigns designed to gain local recognition of the need to control wastes at the source; of the value of reuse, recycling and appropriate packaging; and of the possibilities for converting wastes to resources in culturally appropriate ways.
- (v) Introduce clean technologies and treatment of waste at the source and appropriate technology for solid waste treatment.
- (vi) Develop information systems and baseline data for waste management and pollution control, monitoring the types and quantities of wastes, for both sea- and land-based sources of pollution.
- (vii) Establish port reception facilities for the collection of waste in accordance with annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). 7/

- (viii) In conformity with the Basel Convention and relevant decisions taken by the parties to that Convention, formulate and enforce national laws and/or regulations that ban the importation from States that are members of the Organisation for Economic Cooperation and Development (OECD) of hazardous wastes and other wastes subject to the Basel Convention, including hazardous wastes and other wastes destined for recycling and recovery operations.

B. Regional action

- (i) Develop regional pollution prevention programmes, including regional centres for pollution prevention that would conduct demonstration projects, workshops and multimedia presentations tailored to specific groups; the development of economic incentives to further pollution prevention and waste management; relevant legislation; a coordinated and focused monitoring programme; and, where appropriate, the development of waste management and prevention trust funds.
- (ii) Remove and dispose of existing hazardous wastes, such as polychlorinated biphenyls, with the technical assistance of developed countries.
- (iii) Establish clearing-houses and increase the collection and synthesis of data and information on the sources, levels, amounts, kinds, trends and effects of pollution and waste on marine and coastal systems, as well as on processes and technologies for addressing pollution control from land and sea-based sources.
- (iv) Establish regional mechanisms, including conventions where appropriate, to protect the oceans, seas and coastal areas from ship-generated wastes, oil spills and the transboundary movement of toxic and hazardous waste, consistent with international law.
- (v) Examine ways to resolve disputes concerning waste disposal practices affecting small islands and encourage a collaborative examination of the issues of liability and redress in the context of the Basel Convention.
- (vi) Facilitate the formulation and implementation of public awareness and education campaigns designed to gain local recognition of the need to control wastes at the source; the value of reuse, recycling and appropriate packaging; and of the possibilities for converting wastes to resources in culturally appropriate ways.
- (vii) Establish, where appropriate, regional centres for the training and transfer to cleaner production technologies and the management of hazardous wastes generated at the national level.

C. International action

- (i) Support the strengthening of national and regional capabilities to carry out pollution monitoring and research and to formulate and apply pollution control and abatement measures.
- (ii) Support the strengthening of institutions to provide assistance to Governments and industry in the adoption of clean production technologies as well as in the prevention of pollution and the handling, treatment and disposal of hazardous wastes.
- (iii) Accept the right of small island developing States to regulate, restrict and/or ban the importation of products containing non-biodegradable and/or hazardous substances and to prohibit the transboundary movement of hazardous and radioactive wastes and materials within their jurisdiction, consistent with international law.
- (iv) Ensure that the international conventions and arrangements and related negotiations on marine pollution, in particular any amendments to the London Convention of 1972 but also in relation to land-based sources of marine pollution, take into account the interests and capacities of small island developing States.
- (v) Support measures to assist small island developing States in improving their capacity for the negotiation, follow-up and implementation of international conventions or arrangements, as well as for related negotiations on marine pollution, in particular any amendments to the London Convention of 1972 but also in relation to land-based sources of marine pollution.
- (vi) Assist in the implementation of monitoring and pollution prevention programmes and the establishment of port reception facilities for the collection of wastes in accordance with annex 5 of MARPOL 73/78.
- (vii) Enhance international cooperation in the establishment of waste management facilities, the control of toxic chemicals and pollution prevention as components of international investment projects, whether funded by multilateral or private sources.
- (viii) Assist small island developing States in assessing the impact of land-based sources of marine pollution and to develop mechanisms to eliminate or minimize the pollution source.
- (ix) Improve the access to resources of national and regional efforts to formulate and implement public awareness and education campaigns that are designed to gain local recognition of the need to control wastes at the source; the value of reuse, recycling and appropriate packaging; and of the possibilities for converting wastes to resources in culturally appropriate ways.

- (x) Ensure that the Basel Convention group of experts developing guidelines for monitoring the effects of the management of hazardous wastes on human health and the environment takes into account the concerns of small island developing States.
- (xi) Provide improved access to financial and technical resources to assist small island developing States in establishing regional centres for the training and transfer of cleaner production technologies and the management of hazardous wastes, and in developing inventories to register the training and technical activities of international organizations related to waste management and cleaner production.

Annex D: Mauritius Strategy for further Implementation (MSI)³

II. Management of wastes

20. While some small island developing States have made significant progress in both planning and implementation of waste management policies, programmes and strategies, most of them have serious difficulties in terms of financial and technical capacity in dealing with waste management issues. Marine debris, ballast water, shipwrecks with potential to cause environmental hazard due to leaks, and other forms of waste threaten small island developing States' ecological integrity.
20. bis. Further action is required by small island developing States, with the necessary support of the international community to:
- (a) Form regional partnerships to draw on best practices and develop innovative solutions to waste management, seeking international assistance in this effort;
 - (b) Work to strengthen the control of the transboundary movement of hazardous wastes especially through the enhancement of activities under the Basel Convention and, where it applies, the Waigani Convention;
 - (c) Promote sustainable waste management, including:
 - (i) Identifying cost-effective and environmentally sound waste management systems;
 - (ii) Exploring and engaging in innovative forms of financing of waste management infrastructure, including the creation of appropriate national environmental trust funds;
 - (iv) Promoting reduction, reuse and recycling of waste and waste management initiatives;
 - (iv) Developing projects appropriate to small island developing States for the use of waste as a resource, including for the production of energy as a waste management solution;
 - (d) Promote national, regional and international cooperation to reduce the quantity of waste disposed of at sea, including by working with others in the international community to strengthen regimes relating to the disposal of waste at sea, particularly those regimes established by the International Maritime Organization, the London (Dumping) Convention and the International Atomic Energy Agency;

³ MSI. Source: <http://www.un.org/special-rep/ohrls/sid/MIM/A-conf.207-crp.7-Mauritius%20Strategy%20paper.pdf>

(e) Promote the broad participation in and early implementation of the new International Maritime Organization (IMO) Convention on Ballast Water;

20 ter. Recognizing that there is concern with the environmental implications of potential oil leaks from sunken state vessels to marine and coastal ecosystems of small island developing States, and taking into account sensitivities surrounding those vessels which are marine graves, small island developing States and relevant vessel owners should continue to address the issue bilaterally on a case-by-case basis;

20 quat. The international community notes that cessation of transport of radioactive materials through small island developing States regions is an ultimate desired goal of small island developing States and some other countries, and recognises the right of freedom of navigation in accordance with international law. States should maintain dialogue and consultation, in particular under the aegis of the IAEA and IMO, with the aim of improving mutual understanding, confidence building and enhanced communications in relation to safe maritime transport of radioactive materials. States involved in the transport of such materials are urged to continue to engage in dialogue with small island developing States and other states to address their concerns. These concerns include the further development and strengthening, within the appropriate fora, of international regulatory regimes to enhance safety, disclosure, liability, security and compensation in relation to such transport.

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