ADAPTATION FUND

DATE OF RECEIPT:
ADAPTATION FUND PROJECT ID:
(For Adaptation Fund Board Secretariat Use Only)

PROJECT/PROGRAMME PROPOSAL

PART I: PROJECT/PROGRAMME INFORMATION

PROJECT/PROGRAMME CATEGORY:	Regular
COUNTRY/IES	Maldives
TITLE OF PROJECT/PROGRAMME	Increasing climate resilience through an Integrated Water Resource Management Programme in HA. Ihavandhoo, ADh. Mahibadhoo and GDh. Gadhdhoo Island (UNDP PIMS ID 4582)
TYPE OF IMPLEMENTING ENTITY	Multilateral Implementing Entity (MIE)
IMPLEMENTING ENTITY:	United Nations Development Programme (UNDP)
LEAD EXECUTING ENTITY:	Ministry of Housing and Environment
AMOUNT OF FINANCING REQUESTED:	US$ 8,989,225.-
CO-FINANCING (indicative)	US$ 1,800,000.- (Government of Maldives, in kind)

PROJECT / PROGRAMME BACKGROUND AND CONTEXT:

Provide brief information on the problem the proposed project/programme is aiming to solve. Outline the economic social, development and environmental context in which the project would operate.

Geographic, Environmental and Socioeconomic Context:

The Republic of Maldives is an archipelago of 26 natural atolls and 1,192 small, low-lying, coral islands distributed along a chain that extends over 860 km from north to south in the Indian Ocean. The country has a combined land and sea area of 115,300 km^2 and an Exclusive Economic Zone (EEZ) of 859,000 km^2.[1] With an area in excess of 21,000 km^2, the Maldivian atolls are the seventh largest reef system in the world, and the largest in the Indian Ocean. Administratively, the country is divided into 7 regions/provinces, 20 atolls, 192 inhabited islands[2] and the capital Malé. The total

[1] Statistical Yearbook of Maldives, 2006, http://www.planning.gov.mvl

[2] Inhabited islands are where the main population lives and distinguished from islands used for tourism and other purposes, of which there are a further 168. The capital Malé is always treated separately and is not included among the inhabited islands.

population in 2008 was estimated at 298,968 people[3], over a third of which live in Malé.

The Maldives has a tropical monsoon climate, dominated by two monsoon periods: the northeast monsoon from January to March and the southwest monsoon from May to November. The southwest monsoon is the wetter of the two monsoons and is typically the period when most severe weather events occur. Average annual rainfall is 2,124 mm, with a gradient of increasing rainfall from north to south that varies between 1,786 mm and 2,277 mm, respectively. Daily temperature varies between 23^{o}C and 31^{o}C, with a mean daily minimum temperature of 25.7^{o}C, and a mean daily maximum temperature of 30.4^{o}C. Humidity ranges between 73% and 85% (National Adaptation Program of Action, 2007).

The only conventional water resources available on islands in Maldives are confined shallow groundwater aquifers, rainwater and small brackish/salt/fresh water ponds on some islands. The non conventional water resources include desalinated water, bottled water both from importation and local production. The main source of drinking water across Maldives still is rainwater and desalinated water especially on Male (capital of Maldives). In Villinigili and Hulhumale (two extended wards of Male), piped desalinated water is supplied to households on a 24hr basis and accounts for 25% coverage of safe secure water provision for a floating population. In outer atolls, the main potable source of water is rainwater harvested on roof tops. However, the main concern is absence of water quality monitoring and assurance of water security measures on islands. Groundwater aquifers on islands from north to south are severely contaminated with untreated domestic wastewater discharged into ground due to absence of appropriate wastewater disposal systems on islands. For example, from 20 samples tested in north Ha.Dhidhoo, 30% of samples were identified with faecal coliforms; In tests from Ha.Nolhivaram, out of 17 samples 33% were found polluted by faecal coliforms.

The technology used in Maldives for water supply management includes low to high technology, ranging from roof top rainwater harvesting to seawater desalination. Water supply systems on outer islands are mainly from individual shallow hand dug groundwater wells, household and community rainwater tanks and water transportation on boats. Besides, there are no wastewater collections and treatment systems, except on a number of newly built resorts. Sewage treatment systems that are currently being designed and built are expected to minimize groundwater contamination. These schemes i are financed mainly from national budget (public sector investment-PSIP), loans, grants, development assistance and private sector investments.

Problem Statement: The Climate Change-induced Problem

The primary problem addressed by this project is climate change-induced decline of freshwater resources that is affecting the entire population of Maldives. Freshwater resources are scarce in the Maldives. As surface freshwater is generally lacking throughout the country (with the exception of a limited number of brackish water swampy areas in some of the islands), the key problems pertaining to freshwater

[3] MPND 2008. Maldives at a Glance. July 2008.

security relate to the management of increasingly saline groundwater and increasingly variable rainfall patterns.
Groundwater is a scarce resource in Maldives, due to the hydrogeology of the country. The freshwater aquifer lying beneath the islands is a shallow lens, 1 to 1.5m below the surface, and no more than a few meters thick. The thickness of the groundwater aquifer in the islands is determined by the size of the island and the permeability of the soil column. Adding to this is the critical determinant of **net rainfall recharge,** which is becoming more variable in a changing climate. Over the last few years the National Disaster Management Center has transported potable water to many islands facing acute water shortages due to prolonged dry periods costing over US$ 2 million every year.

Many freshwater aquifers are already stressed from over-extraction and face the risk of total depletion. This already precarious hydrological system is further aggravated by climate change-induced effects of sea level rise and flooding during extreme weather events, which increases saltwater intrusion into the freshwater lens. **Salinization of groundwater** is affecting the quality of life in the islands, as people depend on groundwater for washing, bathing and other non-potable uses. Saltwater intrusion is also affecting soil and vegetation, causing impacts on agriculture and terrestrial ecosystems.

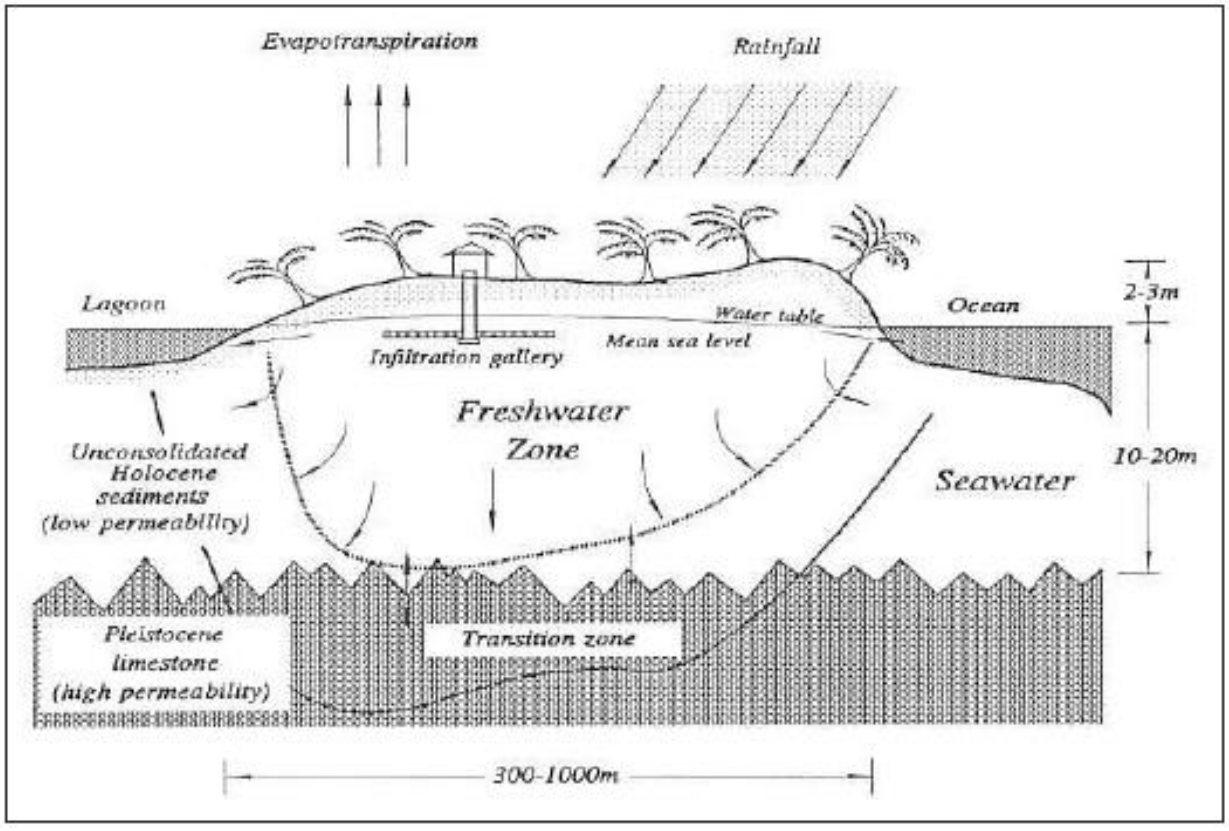

Fig.1: Typical groundwater lens on a small coral island, prone to salinization (Falkland et.al., 2007)

Roof top harvested rainwater is the main source of drinking water available on islands across Maldives. Overall, 77% of people in Maldives and more than 92% of households in outer atolls use rainwater for drinking (MPND 2006). However, due to limited storage capacity within house plots, householders can collect and store only a small quantity of water (the average household storage capacity on islands across Maldives is 2500L). In dry periods, many householders experience a shortage of drinking water, which is due to shifting weather patterns and prolonged dry periods. In such instances, the government is called upon to transport potable water to the affected islands. Apart from water scarcity in dry periods, another major concern associated with rooftop harvested rainwater on islands is the absence of means to check water quality and employ biological or chemical water security measures: At present, no facilities are available on islands to test rainwater quality. In addition, the setup and design of existing rainwater storage facilities on many islands has proven to be vulnerable to loss and damage from flooding and high wave incidences, as demonstrated during events witnessed in 1987, 1991 and 1993.

Although the global average precipitation is projected to increase during the 21st century, a marginal decline in precipitation is projected for the Indian Ocean region (Nurse and Sem 2001). The predicted changes in precipitation have the potential to impact on rainwater harvesting across all the atolls. Drinking water shortages during dry periods will therefore prove to be a significant challenge for the atoll population.

Project Target Area:

The proposed initiative will increase the resilience of freshwater resources through an integrated management of ground- and freshwater resources in the islands of Mahibadhoo (Alifu Dhaalu Atoll), Ihavandhoo (Haa Alifu Atoll) and Gadhdhoo (Gaaf Dhaal Atoll). These three islands represent different geographical locations across the country, are densely populated and have a flat topography varying between 0-0.5m MSL. The geographical location and island settings are depicted in Fig.1.

	Longitude	**Latitude**	**No. of families**	**Population**
ADh. Mahibadhoo	72.969066	3.75722	361	2609
HA. Ihavandhoo	72.926103	6.953145	360	2819
GdDh. Gadhdhoo	73.456435	0.289472	543	2781
			1264	**8209**

Tab.1: Target sites of the proposed project

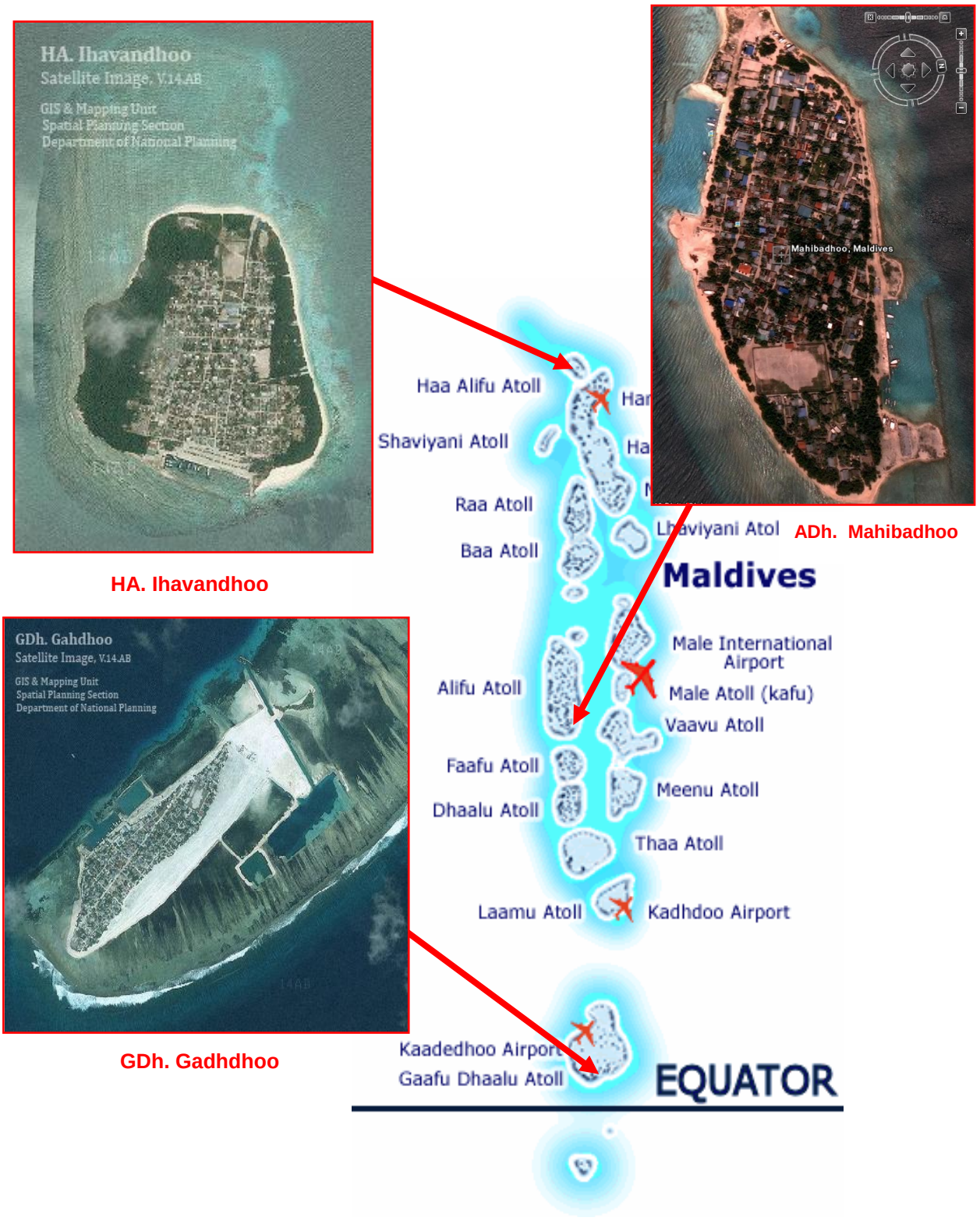

Fig.2: Target sites of the proposed project

At present, the inhabitants of Mahibadhoo, Ihavandhoo and Gadhdhoo rely solely on rain water for their drinking water needs and on ground water for other purposes. However, due to shifting rainfall patterns, the available quality and quantity of drinking water has been declining. Poor sanitation facilities have increased the contamination of ground water sources and rendered this source of water virtually unusable. In addition, ground water salinity is increasing markedly as an effect of sea level rise and high wave impacts. In consideration of these climate-related factors, the Government of Maldives is obliged to introduce a systematic approach to the integrated management of freshwater resources in a changing climate.

Barriers to addressing the Climate Change-induced Problems:

In Maldives, similar to many other small island states, the limited natural water resources have not been properly managed. There is no appropriate mechanism at present for sustainable management of these resources. Freshwater undoubtedly is a scarce resource which requires planned and regulated management. One of the major issues that have continued for decades on islands is inappropriate wastewater disposal and inefficient rainwater harvesting practices. MWSA (2001) reported that there are significant problems with the currently used technologies used for waste water disposal and also with the robustness of rainwater harvesting practices.

With regards to adaptive, integrated water resource management in Maldives, the following barriers seem apparent:

1) *Public financing shortfalls lead to insufficient coverage of islands with integrated, climate-resilient water management systems*

The Government of Maldives has undertaken substantial efforts to improve freshwater security in a number of islands, using different financial mechanisms. These include funding from the national budget (public sector investment-PSIP), loans, grants, development assistance and private sector investments. Key players who contribute loan and grant financing to water management projects include WHO, UNICEF, UNDP, the World Bank, the Asian Development Bank, the Islamic Development Bank, JBIC, JICA, and the Kuwait Fund.

With the exception of Male', Vilingili and Hulhumale, inhabited islands on Maldives do not have a functioning water supply and distribution network available that can ensure sufficient supply of safe freshwater during dry periods. This situation is rooted in a lack of financial resources to ensure comprehensive coverage in such a widely spread island nation; high initial investment costs for alternative water supply (e.g. desalination); high initial investment costs for wastewater treatment installations; and high operation and maintenance costs in connection with centralized water supply and management schemes (with state subsidies required to keep them going).

At present, water utilities are being established in seven provinces across the country, with utility managers in charge of developing and providing water supply, sewerage and

electricity services. However, these utility companies lack the capacity to address the issues mandated to them by the government. As a result, the target islands under this project do not have a functioning freshwater management system that can buffer the effects of climate variability and change.

2) *Lack of awareness about the impact of climate change on freshwater resources*

Besides general aspects of environmental awareness (e.g. the impact of environmental pollution on protective ecosystem services, the relationship between water quality and public health, and the benefits of a clean environment to the economy and society as a whole), there is limited awareness in most communities about how climate change is affecting the reliability and quality of freshwater supply. According to a stocktaking report by ADB (2005), capacity-building and awareness raising activities across Maldives were more concentrated on hygiene education rather than on an inclusive environmental health and management program to develop widespread understanding of the interdependence between human activity and fragile ecological and natural resources. In order to advance climate change adaptation objectives, awareness programs need to propagate the following messages:

- Freshwater is a natural resource which will become much more variable in a changing climate;
- Interconnected freshwater collection and storage systems can be an effective community-based climate change adaptation measure;
- Improper management of wastewater reduces the effectiveness of the ecosystem (especially with regards to the filtration capacity of the groundwater aquifer and the health of the coral reef) to buffer against the impacts of extreme weather events; and
- Water users on inhabited islands, which are currently using decentralized, individual systems, can benefit from interconnected, more robust and integrated water management systems that can effectively buffer supply bottlenecks in dry periods.

Key reasons why these messages are not yet propagated include weak political coherence for the message of integrated adaptation planning; lack of trained resource people available at island level who can guide inclusive participatory processes on water management issues; lack of local NGOs/CBOs with experience on integrated water resource management; and lack of adequate resource materials that addres water resource management questions at the interface with climate change and environmental protection.

3) Current practices of wastewater management undermine the resilience of natural freshwater storage against climate change

Shortages of clean and safe freshwater during dry spells are common across the country, As dry spells are becoming more pronounced with global warming, the water stored in rainwater tanks and the natural groundwater lens is crucial. In addition to unregulated extraction of groundwater from shallow aquifers, a major challenge for the conservation and protection of valuable groundwater resources during dry periods is the

absence of appropriate means for domestic wastewater disposal. Sewerage systems built on islands discharge frequently untreated onsite and near shore, through brick masonry septic tank systems and near shore sewage outfalls, which heavily pollute island groundwater aquifers and the coastal environment with sewage. As such, these practices undermine the potential of the aquifer to buffer against climatic extremes and store sufficient freshwater for the affected island to make it through a dry spell without having to import bottled water.

Across Maldives, there are no large scale wastewater collections and treatment systems, except on a few newly built resorts. After the 2004 tsunami, with loans from development banks and support by donor agencies, sewerage systems have started to be built with fair treatment (e.g. gravel bed filters, vacuum systems etc) and central collection facilities with ocean outfalls. No considerations are still given to the relationship between growing freshwater stress in a changing climate and opportunities of wastewater reclamation and reuse. Hence, it is essential to connect wastewater treatment planning to considerations of long-term freshwater supply, and to make sure to treat the management of wastewater and the management of freshwater in an integrated manner. If this connection is not made, the lack of proper wastewater management planning will undermine all efforts of adaptive rainwater harvesting and groundwater management schemes to buffer against climate-related hazards.

4) Institutional Capacity Barriers

Outside the capital Malé, the Maldives has a shortage of professional capacity in all sectors and at all levels of environmental management, especially at the level of atoll and island administrations. The Climate Change and Energy Department (CCED) has limited staff and budget and its main role to date has been to develop climate change & energy policies, programs, projects, oversee implementation of climate change related projects and engage in the international climate change negotiations, in which the Maldives is actively and successfully engaged. The Water and Sanitation Department (WSD) is the lead government agency dealing with water and sanitation policies and programmes in the country. The Environmental Protection Agency (EPA), which is mandated to oversee the Environmental Impact Assessment (EIA) process, amongst other functions, has greater human resources than the CCED, but also suffers from severe technical capacity constraints. The EPA has few staff who can evaluate the implications of proposed water management projects in the context of a changing climate, or identify locally appropriate adaptation options in the field of water supply management. Generally, there is little knowledge available about the possible range of locally appropriate adaptation options for water resources planning, including the costs and benefits of different high-tech and low-tech options and how to combine them. These capacity gaps in climate risk planning are even more apparent with authorities at the atoll and island levels, as historically all development planning was done at the national level. Such capacity is increasingly critical, given that many national planning and decision-making functions will be devolved to the atolls and islands through a decentralization programme.

5) Insufficient Policy Implementation and Enforcement

Despite the existence of an Environmental Act adopted by the Peoples Majilis in 1993 for environmental protection, the apparent gap in the country's legal framework is the absence of relevant laws and regulations that enforce better environmental governance. Major causes of these weaknesses are the lack of stability within the government system and absence of institutional mechanisms for environment management at the community level. Written policy statements related to water resources (e.g. groundwater aquifers) protection in the country have for the first time been documented in 1989 in the First National Environment Action Plan, followed by other policy level documents namely the Second National Environment Action Plan 1999, the First Health Master Plan 1996 – 2005, the Fifth National Development Plan 1997 – 2000, the Sixth National Development Plan 2001 – 2005, the Seventh National Development Plan 2006 – 2010, the Five Year Activity Plan (MWSA) 2006 – 2010, the Water and Sanitation Master Plan 2008, the Maldives National Strategies for Sustainable Development 2009, and the Third National Environment Action Plan 2009.

Despite the fragmentations, the key national policy on water and sanitation has always been to provide access to safe drinking water and improved sanitation to all Maldivians. Provision of access to safe water and adequate sewerage system to people in Maldives became a constitutional right for the first time in 2008 under Article 23 of the new constitution in Maldives that came into effect in 2008. Yet, despite the availability of proper policies, policy compliance and enforcement is still weak across the country, which is mainly due to a lack of infrastructure for pollution monitoring, trained resource people at island level, and a shortage of finance for decentralized enforcement of compliance with environmental and water management guidelines. The country needs to find a comprehensive approach to the implementation of national water policy in highly decentralized settings, giving proper consideration to good practices of climate-resilient water governance that are suitable and appropriate for the situation in outer islands.

PROJECT / PROGRAMME OBJECTIVES:

The proposed project is responsive to objectives spelled out in the Government of Maldives Strategic Action Plan 2009, the 3rd National Environment Action Plan (NEAP - 3, 2009), the National Sustainable Development Strategy (NSDS 2009), and the National Adaptation Programme of Action (NAPA, 2007). For details on policy coherence, please see Part II, Section D of this project concept.

Project Objective:

The objective of this project is to ensure reliable and safe freshwater supply for Maldivian communities in a changing climate.

Project Strategy:

The primary problem addressed by this project is a significant, climate change-induced decline of freshwater security that is affecting vulnerable communities in Maldives. As surface freshwater is generally lacking throughout the country, the key problems pertaining to freshwater security relate to the management of increasingly saline groundwater and increasingly variable rainwater resources. In order to reduce the aforementioned barriers to effective climate change adaptation in the water management sector, it is essential to reinforce the perspective of Integrated Water Resources Management (IWRM). This will ensure that measures responding to additional, climate change-related risks (such as greater rainfall variability, unreliable recharge of aquifers, longer dry periods, and increasing damage to infrastructure from extreme weather events) are addressed in concert with a response to basic development problems (such as insufficient sewage and wastewater treatment, lack of environmental awareness, lack of water conservation, and lack of comprehensive stakeholder participation in the design and monitoring of water management schemes).

Through the rollout of an integrated water resource management programme in HA. Ihavandhoo, ADh. Mahibadhoo and GDh. Gadhdhoo, the project will ensure consistent, safe and equitable access of all island communities to safe freshwater in a changing climate. Through a targeted mix of the following investments, the project will address the effects of variable rainfall, extreme weather events, salinization and pollution of aquifers:

- Establishment of a sustainable freshwater supply system that incorporates desalination and rainwater harvesting technology;
- Establishment of a sustainable groundwater management system that incorporates groundwater recharge and wastewater management technology;
- Increasing community participation in the development, allocation and monitoring of freshwater use in a changing climate;
- Replication and up scaling of climate-resilient freshwater management

PROJECT / PROGRAMME COMPONENTS AND FINANCING:

The following table has been prepared in alignment with the Adaptation Fund Strategic Results Framework. Project components relate to three main Outcomes, and the Outputs identified to achieve them. For details of Outputs and indicative activities, please refer to Part II, Section A of this concept.

PROJECT COMPONENTS	EXPECTED OUTCOMES	EXPECTED CONCRETE OUTPUTS	AMOUNT (US$)
1. Establishment of integrated, climate-resilient water supply and -management systems in HA. Ihavandhoo, ADh. Mahibadhoo and GDh. Gadhdhoo	1. Ground water aquifer rehabilitated and freshwater supply ensured in HA. Ihavandhoo, ADh. Mahibadhoo and GDh. Gadhdhoo to provide reliable, equitable and cost-effective access to safe freshwater in a changing climate	1.1 Artificial groundwater recharge systems established to protect groundwater resources from salinization and improve aquifer yields in dry seasons	1,100,000
		1.2 Rainwater harvesting schemes redesigned, interconnected and structurally improved to buffer climatic extremes and ensure equal water supply for all households during dry periods	1,200,000
		1.3. Production and distribution system for desalinated water supply established	3,500,000
		1.4. Existing wastewater management systems redesigned and improved to ensure sufficient quantities of safe groundwater during dry periods	1,900,000
2. Increase participation in the development, allocation and monitoring of freshwater use in a changing climate	2. Strengthened local awareness and ownership of integrated, climate-resilient freshwater management	2.1. Communication campaign designed and implemented to create nation-wide awareness of public, private and communal stakeholders about their roles, rights and responsibilities in the adaptive management of freshwater resources in a changing climate	50,000
		2.2.Targeted training events conducted in all atolls to strengthen water user participation and skills in adaptive, integrated water resource management	30,000
3. Replication and up scaling of climate-resilient freshwater management	3. Improved institutional capacity to promote and enforce climate-resilient freshwater management on all inhabited islands	3.1.Training of technicians in operation and management of IWRM system	30,000
		3.2 Institutional mechanisms created to integrate adaptive management of freshwater resources into the design and rollout of new water management projects and schemes	30,000

		3.3. Action plan developed and financing mobilized to replicate integrated, climate-resilient freshwater management on at least 4 additional islands	20,000
		Project/Program Execution cost	425,000
		Total Project/Program Cost	8,285,000
		Project Cycle Fee charged by the Implementation Entity (if applicable) [4]	704,225
		Amount of financing Required	8,989,225

PROJECTED CALENDAR:

Indicate the dates of the following milestones for the proposed project/programme

MILESTONES	EXPECTED DATES
Submission of Concept to AF	October 2010
Approval of the Concept by the AF Board	December 2010
Commence Development of a Full Project	January2011
Submission to AF of a Full Project Proposal	June 2011
Start of Project/Programme Implementation	November 2011
Mid-term Review (if planned)	October 2013
Project/Programme Closing	October 2015
Terminal Evaluation	July 2015

[4] On the request of the Government of Maldives, the project will be implemented by UNDP using the MIE modality. UNDP is able to provide the following implementation services through its country office, regional and headquarters networks: project identification, formulation, and appraisal; determination of execution modality and local capacity assessment of the national executing entity; briefing and de-briefing of project staff; oversight and monitoring of AF funds, including participation in project reviews; receipt, allocation and reporting to the AF Board of financial resources; thematic and technical capacity building and backstopping; support with knowledge transfer; policy advisory services; technical and quality assurance; and troubleshooting assistance to the national project staff. Further details on the types of specialized technical support services which may be provided are articulated in the table provided to the AFB Secretariat on 14 May 2010 (see Annex A).

PART II: PROJECT / PROGRAMME JUSTIFICATION

A. Describe the project / programme components, particularly focusing on the concrete adaptation activities of the project, and how these activities contribute to climate resilience. For the case of a programme, show how the combination of individual projects will contribute to the overall increase in resilience.

COMPONENT 1: Establishment of integrated, climate-resilient water supply and -management systems in Mahibadhoo, Ihavandhoo and Gadhdhoo

Component 1 focuses on the establishment of integrated water supply and -management systems in Mahibadhoo, Ihavandhoo and Gadhdhoo to meet the demand of reliable and safe freshwater supply in a changing climate. This effort will involve

a) the planning and installation of *groundwater recharge* systems that will be fed by rainwater and treated wastewater;
b) the redesign of existing *rainwater harvesting* schemes, including optimization of total storage capacity to meet supply needs in dry periods; interconnection of isolated units to ensure equitable water supply in dry periods; improvement of structural integrity of rainwater collection and storage systems against extreme weather events; integration of filter elements to improve safety of freshwater supply
c) the redesign of existing *wastewater management* schemes to ensure sufficient quantities of safe groundwater during dry periods and prevent polluted wastewater to undermine freshwater stocks in time of climate-induced water scarcity
d) the application of *desalination* technology in the context of a diversified, integrated water supply and distribution infrastructure

The appropriate mix of these components for each target island will be defined over the course of the project preparation phase. It will match the domestic and economic needs of 1264 families, thereby covering the water needs of all island communities and benefiting 8209 people directly. This covers 17% of all Maldivians who are currently dependant on individual household systems outside of the capital zone that is covered by 24 hours of desalinated water supply. Through close integration of Component 1 with Component 3, the project will develop a follow-up action and financing plan for project replication and upscaling in 4 other islands, thus creating direct benefits for at least 30% of all Maldivians who are presently dependent on insufficiently safe and reliable freshwater supply.

For all water resource planning purposes under this programme, the demand of water will be calculated for a 50 year time horizon, integrating factors of population and economic growth, as well as migratory trends to the targeted islands. Proper buffer allowances for institutional and commercial demand, as well as basic pipeline losses will be factored into the demand calculations. This means that the beneficiaries of the project do not only include the current population of the target islands, but also people who migrate to these islands in search of economic opportunities or for reasons of increasing vulnerability.

The project will demonstrate application of the following technologies:

Output 1.1: Artificial groundwater recharge systems established to protect groundwater resources from salinization and improve aquifer yields in dry seasons

Artificial recharge of groundwater is the process of adding water to an aquifer through human effort. Under this project, the method of artificial recharge with rain- and treated wastewater will be used to control sea water intrusion into aquifers and reduce the salinisation as well as pollution of groundwater. Artificial recharge is recognized by many countries with recurrent water scarcity problems (including Indian ocean islands, Caribbean and Pacific SIDS) as an effective method to raise the ground water level and counter the intrusion of saline water into aquifers. Groundwater recharge reduces surface runoff which chokes storm water drains, and reduces flooding of roads. This reduces soil erosion and improves the overall quality of groundwater. Finally, groundwater recharge improves energy savings from groundwater extraction that is driven by electrical pumps: A one meter rise in water level saves about 0.40 KWH of electricity.

In the context of the 3 islands targeted under this programme, the following methods are potentially applicable to recharge aquifers and thereby increase groundwater supply in a changing climate:

- Recharge Pits: Recharge pits are constructed for recharging shallow aquifers. These are constructed 1 to 2 m wide and 2 to 3 m deep which are back filled with boulders, gravels & coarse sand.

- Recharge Trenches: These are constructed when the permeable strata is available at shallow depths. A trench may be 0.5 to 1 m wide, 1 to 1.5 m deep and 10 to 20 m long, depending upon availability of water. These are back filled with filter materials.

- Dug wells: Existing dug wells may be utilised as recharge structure. Water should pass through filter media before putting it into a dug well.

- Hand pumps: Existing hand pumps may be used for recharging shallow aquifers, if the availability of water is limited. Water should pass through filter media before diverting it into hand pumps.

- Recharge wells: Recharge wells of 100 to 300 mm diameter are generally constructed for recharging deeper aquifers. Water is passed through filter media to avoid choking of recharge wells.

- Recharge Shafts: For recharging of shallow aquifers which are located below clayey surface, recharge shafts of 0.5 to 3 m diameter and 10 to 15 m deep are constructed and back filled with boulders, gravels & coarse sand.

- Lateral shafts with bore wells: For recharging the upper as well as deeper aquifers lateral shafts of 1.5 to 2 m. wide & 10 to 30 m. long depending upon availability of water with one or two bore wells are constructed. The lateral shafts are back filled with boulders, gravels & coarse sand.

- Spreading techniques: When permeable strata start from the surface then this technique is used. Spread the water in streams by making check dams, bunds, cement plugs, gabion structures or a percolation pond.

- Treated sewage water to Irrigation water techniques: Waste water and sewage water can be treated up to the quality of irrigation water and used for both irrigation and recharge of ground water.

Over the course of the project preparation phase, a detailed assessment will be undertaken which techniques are most suitable in the context of each target island. This will be done in conjunction with the land-use planning department in the Ministry of Housing and Environment, which will ensure that appropriate space for recharge mechanisms is designated on each island. This will be done in conjunction with an Environmental Impact Assessment (EIA)

<u>Output 1.2:</u> Existing rainwater harvesting schemes are redesigned, interconnected and structurally improved to buffer climatic extremes and ensure equal water supply for all households during dry periods

The prevailing rainwater harvesting technique in Maldives is the collection of rainwater in simple vessels at the edge of the roof. Variations on this basic approach include collection of rainwater in gutters which drain to a collection vessel through down-pipes constructed for this purpose, and/or the diversion of rainwater from gutters to containers for settling particulates before being conveyed to a storage container for domestic use.

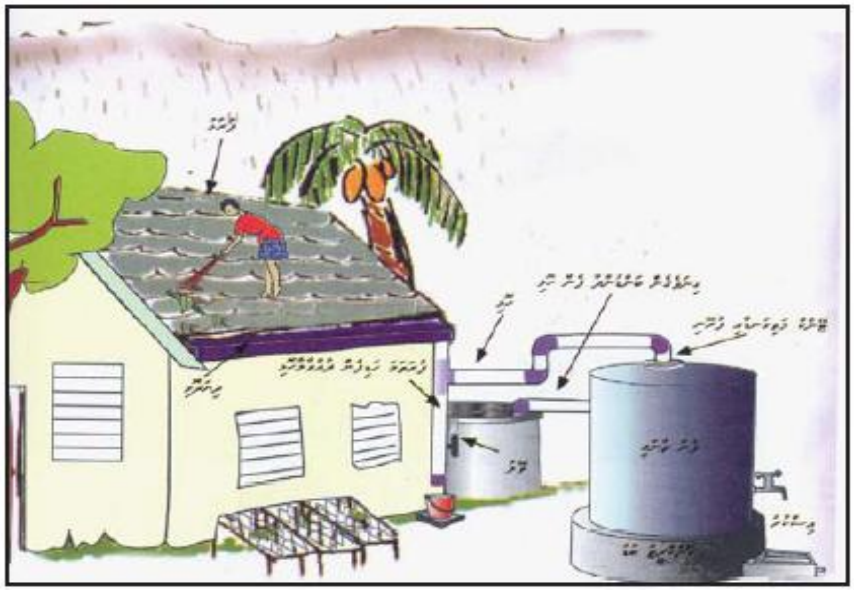

Fig.3:
Basic elements of a domestic rainwater harvesting scheme in the Maldivian context (WHO, 2007)

When analyzed vis a vis the challenges posed by a changing climate - most notably longer dry periods and more frequent and extreme weather events - the existing rainwater harvesting systems in Maldives display a number of important drawbacks:

- They are not yet systematically laid out to incorporate greater water resource needs and more uneven supply in a changing climate;
- They are largely disconnected from each other, thereby creating unequal distribution of available freshwater during dry periods;
- Not all rainwater harvesting installations are making full use of the available roof catchment area, thereby reducing freshwater yields;
- Public buildings are not yet systematically connected to central rainwater storage units;
- Not all rainwater harvesting systems are robust enough to withstand the impact of extreme weather events, such as storms and swell waves.

The proposed project will address these shortcomings by incorporating proper demand-side analysis (including projections for economic and population growth and incorporation of additional buffer capacities to address greater climatic variations) into the optimization of communal rainwater harvesting schemes.

Over the course of the project preparation phase, a detailed assessment will be conducted that describes the current layout of the rainwater harvesting infrastructure in each target islands. This will include assessment of:

- Design aspects (based on rainfall data, roof area, water storage capacity and daily consumption rate);
- Water quality aspects;
- Water treatment aspects;
- Daily operation and maintenance aspects

Output 1.3: Production and distribution system for desalinated water supply established

Seawater desalination is an alternative water supply option that will be considered under this project, based on the findings from the project preparation phase. This is based on the realization that in Maldives, the identification of an appropriate and reliable raw water source with acceptable quality, adequacy in quantity and optimal distance from the service area is of paramount importance to development of any cost-effective water supply system. As the availability of raw water in adequate treatable quantities is a major constraint in many islands, extraction of sea water and desalination is sometimes the only viable alternative to complement harvested rainwater and groundwater that is not yet fit for consumption. Under this project, the rehabilitation of groundwater aquifers and the optimization of rainwater harvesting schemes will be complemented by desalination technology in order to achieve the required degree of resilience and diversification. Without a backup in times of drought, there is little option for the government than to transport water from the capital to the affected islands, which

presently costs 2 million USD per year. As this option is not sustainable, the project is considering the integration of desalination technology where appropriate and technically feasible to reduce these recurrent costs and provide an additional safety net for freshwater supply. Under this project, it is expected that desalination will constitute an integral part of an integrated water management system in at least one target island.

In this context, Containerized Water Treatment Systems are a potentially viable technical option. Such water treatment systems are designed to provide clean and safe drinking water from almost any seawater source. One system is completely contained inside an ISO shipping container, making it easy to move, install, operate and maintain. A single system can provide up to 100,000 gallons per day of clean, safe and fresh drinking water in even the harshest environments. Larger volumes can be produced using multiple systems operating in parallel. These units can be deployed, installed and operating in hours instead of days or weeks. In terms of a distribution network, such a system can incorporate a storage tank, pump and distribution loop to several distribution points located on the outside of the container. The loop maintains a constant cycle of water from the storage tank to the distribution points, ensuring that distributed water is always fresh, clean and safe. The chlorine level of the distribution system is constantly monitored, and the distribution system allows multiple users to access clean water at the same time.

Output 1.4: Existing wastewater management systems are redesigned and improved to ensure sufficient quantities of safe groundwater during dry periods

The safe disposal of domestic and municipal wastewater/sewerage in densely populated communities has always posed a challenge in the Maldives. Although septic tanks are acceptable means of safe discharge of wastewater/sewerage to the environment, the improper use of septic tanks or use of improperly used septic tanks can pose potentially hazardous environmental effects to the communities, causing communicable diseases such as Cholera, Diarrhea, and Typhoid. Moreover, the use of septic tanks to dispose wastewater/sewerage safely can pose a serious challenge to communities having congested populations and may lead to serious pollution of ground water sources to a level that it cannot be used for water needs of the communities.

The Maldivian context in the target islands of Ha Ihavandhoo and Gdh. Gadhdhoo is no exception to the above phenomena. The ground water sources in the above islands have been badly deteriorated and become unfit for any domestic purpose due to contamination from sewage and salinization. Therefore, it has become imperative to find durable and lasting treatment process to dispose wastewater/ sewerage generated by the communities in these islands to the environment with safe BOD and COD levels. Without a systematic coupling of freshwater supply and wastewater disposal systems, as demonstrated by this project, the wastewater problem will continue to undermine any efforts of adaptive freshwater management. Hence, it is crucial to demonstrate how such coupling can be undertaken, from the design and planning to the maintenance and monitoring stages.

The selection of appropriate wastewater / sewerage treatment processes suitable for the above communities will be evaluated in the context of cost, volume of wastewater/ sewerage to be treated, the availability of land for treatment facilities, the bad environmental effects such as undesirable odors final effluent is likely to produce, and the quality of the final COD & BOD levels of effluent. While it is a standard practice to correlate the volume of wastewater/sewerage to that of treated water consumption close to 1:1 proportions, such a practice cannot be adopted in the target sites of this project, due to the fact that a portion of water consumption by communities will be met by non-conventional means such as rainwater harvesting.

In an integrated water supply/wastewater management system, the following options have been considered for wastewater treatment:

- Anaerobic digester with wetlands and drying beds;
- Conventional wastewater treatment plant involving aeration, sedimentation, clarification;
- Package plants with Membrane Bio Reactor (MBR) technology.

In the context of the targeted islands, the construction of drying beds and wetlands is not feasible due to the lack of land in highly congested islands and the likelihood of bad odors emanating to the digester. The construction of a conventional wastewater treatment plant involving aeration, sedimentation and clarification is facing the same constraints, in addition to substantive maintenance efforts on the part of the communities. Therefore, a package wastewater treatment plant based on Membrane Bio Reactor (MBR) may be the only viable option. The main advantage of an MBR plant is that it is guaranteed to produce a higher quality effluent than an anaerobic digester or conventional treatment plant, which can be readily disposed to the environment. Further, the treated wastewater produced can be used for irrigation or to replenish already over-exploited and badly contaminated ground water sources.

Over the course of the project preparation phase, an assessment will be undertaken to define the most viable options for sewage and wastewater treatment that can sensibly be coupled with an optimized rainwater harvesting, groundwater recharge and desalination setup. Such an integrated water management system will be carried out in at least one of the three proposed target islands under this programme. An active effort will be made to mobilize co-financing for wastewater management in all 3 target islands under this project.

COMPONENT 2: Increase participation in the development, allocation and monitoring of freshwater use in a changing climate

While the bulk of project inputs will be programmed for tangible adaptation measures that ensure adaptive management of freshwater resources on three densely populated islands, the project is also aiming to develop capacity at government, atoll and island

level to increase water user participation in the planning, monitoring and maintenance of climate resilient freshwater management.

Component 2 of the project will introduce a range of communication, awareness and training activities which will enable public, private and communal stakeholders (including water suppliers, planners and users) to effectively engage with each other and participate in the inclusive development, allocation and planning of water resource use on their home islands. Activities under Component 2 will incorporate the following tools and approaches:

- Local media news items in local language;
- Public & school presentations;
- School field visits;
- Public debates, focus group sessions;
- Briefs with industry;
- Government briefs;
- Awareness actions for parliamentarians;
- Awareness actions for water utilities;
- Short training workshops and courses for community officials;
- Field excursions;
- Best practice IWRM guidance materials and tools;
- Websites and virtual fora; and
- Email, discussion platforms and user group listings.

Apart from consultative meetings and processes, the project will prepare brochures, leaflets and posters on the effects of climate change on freshwater resources, and the relationship between water management practices and the health of the coral reef ecosystem. Existing awareness materials on IWRM will be adopted from existing sources (such as the global project “Implementing Integrated Water Resource and Wastewater Management in Atlantic and Indian Ocean SIDS”, see section F).

Stakeholder participation under the project will involve four steps:

1. Identifying the key stakeholders from the large array of groups and individuals that could potentially affect, or be affected by, changes in water management;
2. Assessing stakeholder interests and the potential impact of the project on these interests;
3. Assessing the influence and importance of the identified stakeholders; and
4. Outlining a stakeholder participation strategy (a plan to involve the stakeholders in different stages of the project).

The results of such analyses at island level are expected to become part of a national communication strategy to improve the management of water resources in a changing climate. It will underpin the formulation and implementation of government policies related to water regulations, investment plans, environmental management, and the

linkages among them. A supportive legal framework and adequate regulatory capacity are required, as well as a system of water charges to endow water entities with operational autonomy and some financial autonomy for efficient and sustainable service delivery.

In all activities related to awareness, communication and training, the project will adopt the principles of Integrated Water Resources Management (IWRM). IWRM is widely recognized as a basis for the sustainable development, allocation and monitoring of water resource use in the context of social, economic and environmental objectives. The approach recognizes that water is a scarce natural resource, subject to many interdependencies in conveyance and use. There is a variety of different uses of water resources, and these uses are all interdependent. The failure to recognize such interdependency, coupled with unregulated use, can lead to water wastage and the unsustainability of water resources in the long term. This, in turn, will reduce resilience to the pressures exerted by a changing climate.

IWRM is cross-sectoral in nature and entails a departure from narrow professional and political boundaries and perspectives, broadening them to incorporate participatory decision-making among all stakeholders that have a stake in water supply, use and management on a targeted island. This means that different user groups (households, farmers, businesses, public and private entities) can actively influence strategies for water resource development and management. This brings additional benefits, as informed users apply local self-regulation in relation to issues such as water conservation, protection of aquifers and protection of sensitive ecosystems from water-borne pollution far more effectively than central regulation and surveillance can achieve. In all participative processes facilitated under this project, the following perspectives will be integrated (applicable for each island separately):

- All water (spatial);
- All interests (social);
- All stakeholders (participatory);
- All levels (administrative);
- All relevant disciplines (organizational);
- Sustainability (in all senses: environmental, political, social, cultural, economic, financial and legal).

Across all components, this project will treat water as both an economic as well as a social good, which is sensitive to climate-related shocks and stresses and therefore needs to be managed responsibly.

COMPONENT 3: Replication and upscaling of climate-resilient freshwater management

Building on participative processes initiated under Component 2 of the project, and drawing on the technical experiences in groundwater recharge, rainwater harvesting

and coupled wastewater/groundwater management generated under Component 1, Component 3 will introduce targeted activities to enable the analysis, replication and upscaling of the project approach on other inhabited islands. This will entail a campaign to present the findings from the project to different public entities, utilities and development partners, as well as other atolls and islands with similar degrees of vulnerability. This campaign will integrate all atolls and aim at the replication of the project approach in at least 4 other inhabited islands. Exchange programmes to the target sites in Mahibadhoo, Ihavandhoo and Gadhdhoo will be facilitated to promote learning and transfer of experience on climate-resilient freshwater management (especially with regards to the design of coupled rainwater harvesting/groundwater recharge schemes). At the level of the central government, a consultative mechanism will be created that allows the integration of project experiences into the design and rollout of new water management projects and schemes.

The project will undertake a targeted effort to mobilize financing from other sources, using AF funds as leverage to work with private utility companies and development partners to replicate the project approach. Towards this end, a financing and action plan will be elaborated to ensure that the AF-funded project can be expanded into a fully-fledged water management programme that effectively connects with various pilot initiatives in other islands.

B. Describe how the project / programme provides economic, social and environmental benefits, with particular reference to the most vulnerable communities.

In terms of social benefits, the project will provide safe and reliable freshwater supply to all 1264 families living on the 3 target islands. This comprises 8209 people, which represent 17% of all Maldivians who are currently dependent on unreliable and unsafe freshwater supply and experience water shortages in dry periods[5]. Through a dedicated Component focused on replication planning and financing (Component 3), the project is aiming to integrate at least 4 additional islands into a resilient water management programme, thereby benefiting 30% of all Maldivians who live outside the safe water capital zone.

As highlighted previously, the target islands under this project do not have integrated water supply/waste water management schemes, and the inhabitants are compelled to rely on rain water for their drinking water needs, and ground water for other needs. The lack of reliable rainfall quantities to produce adequate and reliable volumes of safe drinking water, coupled with increased contamination of ground water sources due to improper waste water and sewage disposal, have rendered drinking water unreliable and groundwater supply unhygienic.

In terms of economic benefits, the project will increase water management efficiency on all 3 densely populated target islands, reducing energy requirements for groundwater extraction and reducing the need to import/transport freshwater from other places. In

[5] Calculation based on draft MDG Maldives country report, 2010

addition, the project will reduce costs to the public health system from water-borne diseases, which are related to the use of groundwater from over-used and polluted aquifers and rainwater tanks. Recent studies conducted by the Maldives Water and Sanitation Authority (MWSA) showed that over 30% of rainwater tanks and 40% of groundwater wells on a random sample of target islands were faecally contaminated. Comparison of these data and health statistics therefore confirms a direct correlation between unsafe rainwater harvesting and diarrheal diseases. Furthermore, the project will ensure that salinisation of groundwater on the target islands will be effectively reduced, thereby diversifying the different systems of freshwater supply in times of need. This will improve the security of livelihood assets in a changing climate.

Environmental benefits of the project include greater awareness across the country about the sensitive interface between water resources and the health of coral reefs, as well as tangible measures to reduce groundwater pollution and disposal of polluted waste water on sensitive coastal ecosystems.

C. Describe or provide an analysis of the cost-effectiveness of the proposed project / programme.

As discussed previously, the project will provide direct long-term, safe and reliable freshwater supply to 17% of all Maldivians who live outside of the fully serviced capital zone that encompasses Male, Hulhumale and Vilingili. Through a dedicated replication and upscaling plan, the project will aim to systematically increase the group of beneficiaries to at least 30% of all Maldivians who currently rely on patchy freshwater supply. By integrating 50 year planning parameters for population growth, economic growth and expected migratory shifts, the project will maintain water supply efficiency for not only the present, but also future generations. This is considered a critical impact of the AF investment in a country that is extremely vulnerable to climate change impacts and continually more reliant on imports to meet its basic needs.

This project represents a substantive impact for Maldives both in terms of the overall number of beneficiaries served, but also in terms of economic return on investment. Reducing long-term water insecurity in three of the most densely populated islands reduces a number of follow-up investments, including:

- transport and import of freshwater in times of water shortage (at present valued by the MHE at about 2 million USD per year);
- Public health costs from water-borne diseases, resulting from unsafe groundwater and rainwater storage[6];
- energy costs for the extraction of groundwater from depleted aquifers; and
- Reconstruction of insufficiently robust rainwater harvesting schemes after extreme weather events

[6] According to MCST (2002) recent studies conducted by the Maldives Water and Sanitation Authority (MWSA) showed that over 30% of rainwater tanks and 40% of groundwater wells were faecally contaminated. Comparison of these data and health statistics confirms a direct correlation of unsafe rainwater harvesting and diarrheal diseases.

In this context, it is important to mention that at present, thousands of litres of bottled water are imported into Maldives. The 2004 State of Environment report indicates that between 1996 and 2003 there was a sharp increase in the volume of water imported into the country. In 1996, nearly 1.2 million litres of mineral water was imported; In 2003, the volume has jumped close to 6 million litres. With the effects of global warming, this trend is projected to continue in an unabated manner.

Alternative project approaches have been considered, but deemed less cost-effective and beneficial than the proposed course of action. As there are only three major resources of water in Maldives (groundwater, rainwater and desalinated water), a diversified approach that integrates all 3 types was considered the most beneficial both in terms of diversity as well as cost efficiency. An exclusive focus on desalination technology (with an upfront investment of approximately 7 million USD) would have been an alternative to an integrated approach, but such a setup would not yield a number of critical economic benefits: Exclusive, stand-alone desalination would not address rising problems with soil and groundwater salinity (which is relevant for agricultural uses as well); it would not address problems arising from insufficient wastewater management (which is a key problem for public health as well as the integrity of ecosystem services provided by coral reefs); and it would not build on existing capacity that exists with rainwater harvesting technology that is already established in all outer atolls. Considering the benefits of a diversified approach that integrates an optimized mix of technologies in line with the specific context of each target island, it was assessed that the proposed course of action would yield a more sustainable return on investment and greater chances for replication.

In terms of cost-effectiveness, it is important to highlight that the proposed approach integrates readily available, low tech adaptation options such as rainwater harvesting, which can easily be adjusted to allow effective coupling with innovative groundwater recharge, wastewater treatment and desalination technology. Rainwater harvesting does not have a technology entry barrier for the Maldivian market, and can easily be adopted in various shapes and forms to accommodate the requirements of greater robustness and adaptive design.

In addition, the project is treating water as an economic good and prioritizes the principle of community participation and ownership. Users who have been properly involved and trained in integrated water management are much more likely to apply local self-regulation in relation to issues such as water conservation, protection of aquifers, and protection of coastal ecosystems from polluted effluents. In highly decentralized settings such as Maldives, this approach is much more likely to result in policy compliance than central regulation, surveillance and policing.

At the operational level, cost effectiveness of the project concept is reflected through the following characteristics:

- Throughout the project, AF resources will be aligned with the financing and delivery of project Outputs that have competitive procurement components to ensure best

value for money. In this regard, the project will apply best practices identified by other, ongoing climate change adaptation projects (including the LDCF-funded project “Integrating Climate Change Risks into Resilient Island Planning”).
- The project will undertake a targeted effort to mobilize co-financing for wastewater management-related components of the project. This will diversify financial risks and retain focus on AF funds on activities which correspond to the principle of additionality.
- The bulk of project financing will be directed to community-level activities and connect directly to local opportunities for the procurement of goods and services.

D. Describe how the project / programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist.

The proposed initiative is responsive to the Government of Maldives Strategic Action Plan 2009, the 3rd National Environment Action Plan (NEAP-3, 2009), the National Sustainable Development Strategy (NSDS, 2009) and the National Adaptation Programme of Action (NAPA , 2007).

The National Adaptation Programme of Action of Maldives highlights 2 urgent and immediate adaptation priorities which correspond to the focus of this project:

- ‘Enhance adaptive capacity to manage climate change related risks to fresh water availability by appropriate technologies and improved storage facilities’ (NAPA priority 4), and
- ‘Enhance adaptive capacity to manage climate change related risks to fresh water availability by appropriate wastewater treatment technologies’ (NAPA priority 5).

The project is therefore fully compliant with 2 adaptation priorities which the Maldivian government has highlighted as urgent and immediate. In addition to the NAPA, integrated water resource management (IWRM) is featuring in various national policy documents, including the first Health Master Plan (1996 -2005). Some of the aspects identified include:

- Provision of sustainable freshwater on cost effective means
- Integrated water resource management and development of such strategies
- Development of water resource conservation strategies
- Establishment of groundwater protection zones on islands through land use plans

Similarly, the first (1989), second (1999) and third (2009) National Environment Action Plan (NEAP) gave emphasis to the importance of integrated water resource management across the country. The measures to manage water sector issues and

concerns through the Ministry of Housing and Environment (MHE) are outlined in the following:

Key sector goals:

a. Ensure access to safe drinking water and sanitation as a basic human right
b. Protect and preserve the country's vital freshwater resources
c. Provide legislative support to improve sector performance
d. Strengthen institutional and financial capacity to meet growing needs and challenges
e. Enhance the role of private sector participation in the provision of water and sanitation services
f. Introduce the use of renewable energy and other modern technologies to minimize the cost of providing drinking water and sanitation systems and to protect groundwater.

Key sector policies:

a. Prioritize provision of safe water and sanitation when designing developmental projects
b. Establish effective operation and maintenance procedures for water and sanitation systems in the Maldives
c. Strengthen technical, financial and human resources capacity for water and sanitation sector
d. Facilitate private sector investment in the water and sanitation sector
e. Enhance community and civil society participation in the water and sanitation sector
f. Improve water resource management to preserve environment

Key sector strategies

a. Increase rainwater and desalinated water capacity in the islands
b. Ensure availability of safe drinking water and establish adequate sanitation systems in the seven regions of the country
a. Facilitate establishment of water stocks in designated regions of the country for use in emergency or during disasters
b. Establish a system to manage and maintain the water and sewerage systems already established in islands through local governance systems
c. Create a business‐friendly environment for investing in the sector
d. Conduct research on wastewater disposal technologies and assess the health and environmental impacts of using treated wastewater for different purposes, including recharging aquifers.
g. Strengthen and enforce protocols, procedures and capacity at water and sanitation regulatory authorities
h. Enact the Water and Sanitation Act of Maldives
i. Develop land use plans, taking into consideration the protection of natural freshwater resources
j. Increase capacity at all levels for monitoring water quality, including establishing

island level monitoring capacity

k. Develop water safety plans for the islands

In addition, the project is fully aligned with UNDAF Outcome 1: “Communities have access to safe drinking water and adequate sanitation and sustainably manage the natural environment to enhance their livelihoods”.

E. Describe how the project / programme meets relevant national technical standards, where applicable.

The project will comply with the following technical standards relevant to freshwater and wasterwater management in Maldives:

- Drinking water guidelines (2006)
- Domestic wastewater guidelines (2006)
- Domestic and commercial effluent standards (2006)
- Guidelines on septic tanks and soakway construction, operation and maintenance (2003)
- Guidelines and manual for rainwater harvesting in Maldives (2009)
- Guidelines on Integrated Water Resources Management

The design of all technical elements under the project will be conducted in such a way to comply with these standards and ensure that there is thorough alignment with existing best practices. With regards to the quality of freshwater provided by this project, the following standards (approved by MHE according to WHO guidance) will apply:

No	Parameter	Unit	Maximum allowable limit
A	**Physical parameters**		
1	Colour		colourless
2	Taste & Odour		Not offensive
3	Turbidity	NTU	Less than 1
4	Electrical conductance	µS/cm	Less than 1500
5	pH		5.0 to 9.5
B	**Chemical parameters**		
1	Free chlorine	Mg/L	0.08 to 0.2
2	Chloride as Cl		Less than 250

3	Nitrates as NO_3		Less than 50
4	Ammonia as N		Less than 1.5

Tab.1: Freshwater standards applied by the proposed project

F. Describe if there is duplication of project / programme with other funding sources, if any.

A review of on-going projects funded by development partners shows that there is no duplication of the proposed project with other funding sources. With regards to NAPA follow-up, the project "Integrating Climate Change Risks into Resilient Island Planning in Maldives", which is jointly funded by the LDCF, UNDP and the Government of Maldives, focuses on coastal protection issues, thereby addressing NAPA priority 1 ('Integration of Future Climate Change Scenarios in the Safer Island Strategy to Adapt to Sea Level Rise and Extreme Weather Risks Associated with Climate Change') and NAPA priority 2 ('Coastal Protection of Safer Islands to Reduce the Risk from Sea Induced Flooding and Predicted Sea Level Rise'). At present, no projects are under way to address NAPA priority 4 ('Enhance adaptive capacity to manage climate change related risks to fresh water availability by appropriate technologies and improved storage facilities') and NAPA priority 5 ('Enhance adaptive capacity to manage climate change related risks to fresh water availability by appropriate wastewater treatment technologies'). These NAPA priorities represent the key focus of this project.

During the full project formulation process, an assessment will be made about any complementary development efforts that are currently under way in the target islands of Mahibadhoo (Alifu Dhaalu Atoll), Ihavandhoo (Haa Alifu Atoll) and Gadhdhoo (Gaafu Dhaalu Atoll). All government stakeholders listed under section H of this concept will be consulted, in order to avoid any potential duplication of efforts and geographical coverage. The project development phase will ensure that any initiatives that have been conducted on topics of rain- and groundwater management in the past, such as the work financed by WHO and UNICEF after the 2004 Tsunami, is adequately consulted and integrated into the project approach as appropriate. In doing so, specific benefits are expected in the cross-sharing of awareness materials on rainwater harvesting, waste management and IWRM.

A special effort will be made to coordinate with the GEF-funded project "Implementing Integrated Water Resource and Wastewater Management in Atlantic and Indian Ocean SIDS", which has been submitted to the GEF CEO for endorsement in September 2010. This global project, which will jointly be implemented by UNDP, UNEP and UNOPS, incorporates a technical demonstration component that is aimed at the protection of the freshwater lens of Thoddoo Island from agro-chemical pollution and salinity. The project will employ IWRM principles, and hence provide an ideal interface for coordination and cooperation. The proposed AF project will thereby be able to benefit from inter-regional IWRM networks to share knowledge, experiences and best practices, and draw on a

range of relevant awareness materials, training materials and policy guidelines on IWRM.

G. If applicable, describe the learning and knowledge management component to capture and disseminate lessons learned.

As discussed in Part II, Section A of this project concept, the project will employ the following learning tools (applied under Component 2 and 3):

- Local media news items in local language;
- Public & school presentations;
- School field visits;
- Public debates, focus group sessions;
- Water management briefs with industry;
- Water management briefs with tourism resorts and operators;
- Government newsletters;
- Awareness actions for parliamentarians;
- Awareness actions for water utilities;
- Training workshops and short courses for atoll, island and community officials;
- Field excursions and exchange visits between atolls and islands;
- Best practice guidance materials and tools;
- Websites and virtual fora; and
- Email groups and virtual discussion platforms.

Implementation of concrete adaptation actions on the ground will constitute the primary learning experience, which will feed into all awareness, training and knowledge management actions facilitated and conducted by the project. Apart from consultative face to face meetings and interactive events, the project will also prepare brochures, leaflets and posters on the effects of climate change on freshwater resources, and on the relationship between water management practices and the health of the coral reef ecosystem. Existing awareness materials on IWRM will be adopted from existing sources (such as the global project "Implementing Integrated Water Resource and Wastewater Management in Atlantic and Indian Ocean SIDS", see section F).

H. Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation.

The scope of this initiative was defined in close consultation with the Minister of Housing and Environment; the Maldives' Designated National Authority for the Adapation Fund; the UNFCCC focal point; the GEF Focal Point and a range of relevant UN agencies who provided baseline data and assessment information about the target islands (UNOPS, UNICEF, WHO). The initiative is based on analysis and recommendations of a number of official reports and studies, including:

- Draft technical concepts about methods of groundwater recharge, wastewater management and rainwater harvesting that are applicable to the Maldivian context (UNOPS, 2010);
- National IWRM Diagnostic Report (Environmental Protection Agency (EPA), 2010);
- Integrated Water Resource Management Report on 4 selected islands (MWSA, 2001);
- Selected case studies about water Management in Maldives (Mustafa M., 2009).

Over the course of the full project preparation, the following stakeholders will be consulted in greater detail:

Stakeholders	**Roles/Responsibilities**
1. Ministry of Housing and Environment (MHE)	Integration of water and sewerage services with new housing development projects; land use planning (relevant for recharge planning).
2. Ministry of Fisheries and Agriculture	Ground water resource management; safe disposal of agricultural pesticides and use of fertilizers; promotion of water conservation practices; use of efficient alternative technologies.
3. Ministry of Finance and Treasury	Resource mobilization and budgeting for public policy delivery
4. Dept. Of National Planning/Statistical Dept	Ensure water and sewerage services are integrated into national plans; collecting and disseminating relevant data.
5. Ministry of Economic Development (Invest Maldives)	Integrates water and sewerage delivery into public-private partnership schemes and facilitates the mobilization of investments for sector needs
6. Ministry of Health	a. Centre for Community Health and Disease Control: Responsible for disease control and improvements of community health b. Maldives Food and Drug Authority: Responsible for quality and safety of imported and locally bottled water.
6. Ministry of Tourism	Facilitates regulation of water and sanitation services by EPA in tourism resorts
7. National Disaster Management Centre	Facilitates provision of water and sanitation services and coordinates with the MHTE to ensure water security of islands during emergencies.
8. Ministry of Education (Schools)	Promotes good hygiene practices and ensures provision of safe water and sanitation services to students, also during times of water insecurity.
9. Private Sector	Provides water supply and metering services and improves access to safe water and sanitation in all parts of the country through contractual agreements with provincial utilities' company.
10. Male' Water and Sewerage	Delivery of water and sanitation services in

Company	Male', and other regions
11. Provincial Utility Companies	Provide utility style water supply, sewerage and electricity services to inhabited islands
12. Island and atoll authorities	Responsible for administrative services of inhabited islands and overseeing the operation/maintenance of public infrastructure
13. Environmental NGOs	Raise public awareness on climate change and environment; Support participative processes; improve environmental awareness

I. Funding Justification

The following section is a summary of the baseline and additionality reasoning for each project component. They will be further expanded in the full project proposal submitted for final approval by the Adaptation Fund. The full proposal will outline any baseline development activities that are currently financed out of government funds and traditional ODA, and specify the value these initiatives can add to those outcomes that are financed with resources from the Adaptation Fund.

COMPONENT 1: Establishment of integrated, climate-resilient water supply and -management systems in Mahibadhoo, Ihavandhoo and Gadhdhoo

Baseline (without AF resources):

As discussed in previous sections, the three target islands under this project are not equipped with a climate-resilient water supply and wastewater management scheme. Existing rainwater harvesting systems are largely disconnected and sub-optimal in terms of their capacity and yield. Groundwater recharge and desalination installations are absent throughout the islands. Although the government has undertaken efforts to include these islands into a utility-driven water management scheme, the responses from the private sector to date have not been positive on economic grounds (especially a lack of consistent revenue from communities paying for water management services). As a result, rainwater harvesting and wastewater drainage systems remain ill-conceived in terms of their safety and collection/storage capacity, and not able to meet the demands imposed by climate variability and change. In concert, the lack of reliable rainfall, increased salinity of soils and groundwater, and contamination of ground water sources with waste effluents have rendered drinking water unreliable and ground water supply unhygienic. Without AF support, the population of Mahibadhoo, Ihavandhoo and Gadhdhoo will not have a reliable supply of safe drinking water in the future. Wastewater effluents and sewerage will continue to damage the sensitive coral reef, which is the only protection of these islands from extreme events. Groundwater salinity will increase, affecting any agricultural use on these islands adversely. Public health will continue to deteriorate in line with current trends of diarrhoeal diseases on outer islands (MoH, 2009). Existing rainwater harvesting systems will remain disconnected, preventing some households from meeting their water needs during the dry season,

while other households are still able to cover their needs. In times of drought, potable water will need to be transported from the capital to affected islands, incurring considerable costs to the public budget which could easily be avoided.

Adaptation Alternative (with AF resources):

AF resources will be used to create a diversified, adaptive freshwater supply system in three vulnerable, densely populated islands which is suitable for replication. This system will be characterized by a) increased storage capacity to buffer the effects of less reliable rainfall and buffer water supply during longer dry periods; b) improved quality and safety of harvested rainwater based on improved collection, treatment and storage; c) Improved robustness of interconnected rainwater storage schemes, especially on public buildings; d) Improved production and supply systems for desalinated freshwater; e) improved quality and quantity of freshwater which is stored in the natural aquifer, both in terms of reduced salinity as well as human contaminants; f) reduced contamination of household effluents which are discharged to the environment and would otherwise damage the sensitive reef ecosystem. In their integration, these elements provide a compound solution to a number of critical climate and non-climate-related problems and a suitable model for replication on other islands with similar vulnerabilities.

COMPONENT 2: Increase participation in the development, allocation and monitoring of freshwater use in a changing climate

Baseline (without AF resources):

At present, although the Maldives have made some progress in improving the stakeholder linkages within their water sector (especially between the public sector and private water utilities), linkages between water planners and users are largely fragmented on all inhabited islands. On the three target islands of this project, there are only very few formal or informal linkages between different water users, and water is not treated as a common social and economic good. As a result, the drive and purpose required for integrated, climate-resilient water resources management is lost and unsupported with resources, civil society demand or government drive. Although capacity development for environmental management with stakeholders at all levels is a major component of the World Bank-supported Maldives Environment Management Programme (MEMP), there are no plans for in-depth technical training on climate change adaptation. The LDCF-funded project “Integrating Climate Risk into Resilient Island Planning” is the only project currently under implementation that has a fully resourced training and awareness component focusing on coastal zone adaptation. No equivalent capacity development activities are currently undertaken in the water management sector. The project “Implementing Integrated Water Resource and Wastewater Management in Atlantic and Indian Ocean SIDS”, which has been submitted to the GEF CEO for endorsement in September 2010, is aiming to strengthen the capacity of government officials to fulfil their role in local, national and regional

IWRM processes. As such, it represents a key baseline initiative that the proposed project can build on to create awareness about the interface between climate change and water supply, and about the relationship between IWRM and adaptive management of freshwater resources.

Adaptation alternative (with AF resources):

With AF support, communities on all inhabited islands of Maldives will be aware about the impact of climate change on the reliability and quality of freshwater supply. Freshwater will be considered as a natural resource which will become much more variable in a changing climate. The importance of maintaining functional and safe rainwater harvesting operations will be emphasized, and communities will be made aware that disposal of untreated wastewater in near shore areas reduces the ability of the reef ecosystem to filter contaminants and buffer against the impacts of extreme weather events. Households will be empowered to participate in integrated water resources planning on their home islands, and encouraged to view water resources as an interconnected economic good that is valuable and needs to be managed jointly rather than individualistically in a changing environment.

COMPONENT 3: Replication and upscaling of climate-resilient freshwater management

Baseline (without AF resources):

Despite the absence of a comprehensive policy on water and sanitation, the provision of safe water and improved sanitation to all Maldivians became a constitutional right in 2008. As a result, the government is undertaking a number of efforts to mobilize financing for desalination plants and develop partnerships with water utility companies to increase the number of islands with safe freshwater supply. Considerations of climate change and the new demands it imposes on the layout of water supply and management systems are not yet integrated in these discussions. The prevailing investment strategy is to meet baseline water supply needs with whichever means possible (both technical and financial); This, in turn, prevents a consistent perspective of integrated and resilient water resource management to be realized in new projects. As a result, the development of water management systems on inhabited islands is still patchy, both in terms of technical approach as well as the consistency of the planning process. With limited participation by different water users and without successful models of adaptive design to draw on, development of freshwater management systems on inhabited islands will continue to display a lack of integration, consistency and resilience in a changing climate.

Adaptation alternative (with AF resources):

With AF resources, Maldives will be able to draw on concrete examples of integrated water resources management which are based on principles of adaptive design and equipped to handle the stresses exerted by a changing climate. As these systems are

building on available technology, they are suitable for decentralized planning in remote settings and can be adopted by all types of islands. AF resources will enable exchange programmes between Mahibadhoo, Ihavandhoo, Gadhdhoo and other island authorities to promote mutual learning and transfer experience on how freshwater can be managed in a rapidly changing environment. AF funding will ensure that the planning and rollout of new water management projects is integrating considerations of adaptive design, diversification of freshwater sources and functions that preserve the integrity of the reef ecosystem. Finally, a fully resourced action plan will enable the replication of integrated, climate-resilient freshwater management on at least 4 additional islands.

PART III: IMPLEMENTATION ARRANGEMENTS

A. Project / programme management arrangements.

Upon the request of the Government of Maldives, UNDP will serve as the Multilateral Implementing Agency (MIE) for this project. The Project will therefore be implemented following UNDP's **National Execution Modality (NEX)**. The designated Executing Agency of the project will be the Ministry of Housing and Environment (MHE). MHE is responsible for implementing UNFCCC and water resource management policy and will hold the responsibility of overall project execution and management. MHE is ultimately responsible for the timely delivery of project inputs and outputs, and for the coordination of all other responsible parties, including other line ministries, relevant UN agencies, and local government authorities.

The MHTE will appoint a **National Project Director**, who will be designated over the course of the project preparation phase. A **Project Board** (PB) will be established, which is responsible to approve key management decisions of the project and will play a critical role in assuring the technical quality, financial transparency and overall development impact of the project. The PB will be composed of designated senior-level representatives of the MHTE and other key stakeholders as outlined in Part II/Section H of this project document. A complete list of PB members and their designated alternates will be provided after the project preparation phase has been completed.

Project assurance: UNDP Maldives will support project implementation by assisting in the monitoring of project budgets and expenditures, contracting project personnel and consultancy services, and subcontracting and procuring equipment. On the technical side, UNDP Maldives will monitor progress of project implementation and achievement of project outcomes/outputs as per the endorsed project document. A designated Programme Officer will be assigned in the Country Office in Male to provide financial and technical monitoring and implementation support services.

Project Manager (PM): He/she will be a dedicated professional designated for the duration of the project. The PM's prime responsibility is to ensure that the project produces the results specified in the project document to the required standard of quality and within the specified constraints of time and cost.

Project-Support: The PM will be supported by a core team of technical and support staff forming the **Project Implementation Unit** (PIU) located at the MHTE to execute project activities, including day-to-day operations of the project, and the overall operational and financial management and reporting. At the target demonstration sites, local coordinators will be recruited to oversee progress of technical project components.

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B. Measures for financial and project / programme risk management.

Key risks underlying the project will be analyzed and qualitatively assessed during the formulation phase and in connection with the target sites of the project. Over the course of the project, a UNDP risk log will be regularly updated in intervals of no less than every six months in which critical risks to the project have been identified.

In the present context, potential risks to the project include:

No.	Type	Description	Rating
1	Institutional	Effective engagement and consensus building by different water users, public and private stakeholders to agree on an integrated approach to freshwater and wastewater management	Low
2	Institutional	Human resources capacity issues (e.g. staff turnover) in different government offices preclude effective engagement of particular stakeholders in the project	Medium
3	Environmental	Extreme weather events during project implementation damage construction works;	Medium
4	Institutional	Delays in recruitment of qualified project staff may affect the timeframe of different project activities.	High
5	Financial	Government is not able to leverage sufficient co-financing to increase and upscale project impact	Medium

B. Monitoring and Evaluation arrangements including a budget of M&E

Project monitoring and evaluation (M&E) will be in accordance with established UNDP procedures and will carried out by the Project team, verified by the Ministry of Environment and the UNDP Country Office in Male. Dedicated support by the technical adaptation teams in the UNDP Asia-Pacific Regional Center and UNDP New York will be provided on a regular basis. A comprehensive Results Framework of the project will define success indicators for project implementation as well as the respective means of verification. A Monitoring and Evaluation (M&E) system for the project will be established, based on these indicators and means of verification. It is important to note that the Results Framework, together with the impact indicators and means of verification, will be fine-tuned during project formulation.

A Project Inception Workshop will be conducted within four months of project start up with the full project team, relevant government counterparts, co-financing partners, and UNDP. The Inception Workshop is crucial to building ownership for project results and to plan the first year annual work plan. A fundamental objective of the Inception Workshop will be to present the modalities of project implementation and execution, document mutual agreement for the proposed executive arrangements amongst stakeholders, and assist the project team to understand and take ownership of the project's goals and objectives. Another key objective of the Inception Workshop is to

introduce the project team which will support the project during its implementation. An Inception Workshop Report will be prepared and shared with participants to formalize various agreements decided during the meeting.

A UNDP risk log will be regularly updated in intervals of no less than every six months in which critical risks to the project have been identified. Quarterly Progress Reports will be prepared by the Project team and verified by the Project Board. Annual Project Reports will be prepared to monitor progress made since project start and in particular for the previous reporting period. These annual reports include, but are not limited to, reporting on the following:

- Progress made toward project objective and project outcomes - each with indicators, baseline data and end-of-project targets (cumulative);
- Project outputs delivered per project Outcome (annual);
- Lessons learned/good practices;
- Annual expenditure reports;
- Reporting on project risk management.

Government authorities, members of the Project Board and UNDP staff will conduct regular field visits to project sites based on the agreed schedule in the project's Inception Report/Annual Work Plan to assess first hand project progress.

In terms of financial monitoring, the project team will provide UNDP with certified periodic financial statements, and with an annual audit of the financial statements relating to the status of funds according to the established procedures set out in the Programming and Finance manuals. The Audit will be conducted by the legally recognized auditor of the Maldivian government. During project implementation, Annual Work Plans (AWP's) and Quarterly Work Plans (QWP's) will be used to refine project delivery targets and realign project work upon consultation and endorsement by the Project Board.

The project will undergo an independent Mid-Term Evaluation (MTE) at the mid-point of project implementation, which will determine progress being made toward the achievement of outcomes and identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; highlight issues requiring decisions and actions; and present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. A summative evaluation will be conducted 3 months before project closure.

The budgeted M&E plan is as follows:

Type of M&E	Responsible	Budget US$	Time frame

activity	Parties	*Excluding project team staff time*	
Inception Workshop	▪ Project Manager ▪ UNDP CO	4,000	Within first 6 months of project start up
Inception Report	▪ Project Team ▪ UNDP CO	None	Within one month of IW
Measurement of Means of Verification for Indicators of project performance	▪ Project Manager	Indicative cost will be finalized during project formulation	Start, mid and end-point of project implementation
Annual and Quarterly Progress reviews	▪ Project Team ▪ UNDP-CO	None	Quarterly and Annually
Project Board Meetings	▪ Project Manager ▪ UNDP CO	10,000	At least twice a year
Periodic status reports	▪ Project team	4,000	To be determined by Project team and UNDP CO
Technical reports on specific topics that arise over the course of project implementation	▪ Project team ▪ Consultants as needed	8,000	To be determined by Project Team and UNDP-CO
Mid-term External Evaluation	▪ Project team ▪ UNDP- CO ▪ External Consultants	25,000	At the mid-point of project implementation.
Terminal Report	▪ Project team ▪ UNDP-CO ▪ External Consultant	none	At least one month before the end of the project
Audit	▪ UNDP-CO ▪ Project team	8,000	Bi-annual
Visits to field sites	▪ Project staff ▪ Government representatives	40,000	At all stages of project implementation
Final Evaluation	▪ Independent external Consultants	25,000	six months prior to the terminal tripartite review meeting.
TOTAL indicative COST		**US$ 124,000**	

D. Project Results Framework Analysis

A detailed Results Framework including a logical framework, Outcome Indicators, quantified Output targets, as well as specific, measurable and time-bound indicators will be outlined in the Full Project Document at the end of the project preparation phase.

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT[7] *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

Dr. Mohamed Shareef Minister of State for Housing and Environment & Designated Authority for the Adaptation Fund Ameenee Magu Male' 20392, Maldives Email: mohamed.shareef@mhte.gov.mv Tel.: +960 300 4300 Cell: +960 7775640	Date: October 20, 2010

B. IMPLEMENTING ENTITY CERTIFICATION *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address*

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans and subject to the approval by the Adaptation Fund Board, understands that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme..	
 Yannick Glemarec Director, Environmental Finance, UNDP	
Date: October 21, 2010	Tel. and email: +1-212-906-6843; yannick.glemarec@undp.org
Project Contact Person: Gernot Laganda	
Tel. and Email: +66 2288 2644; gernot.laganda@undp.org	

6. Each Party shall designate and communicate to the Secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

ANNEX A

UNDP Environmental Finance – Specialized Technical Services

Stage	Specialized Technical Services Provided
Identification, Sourcing and Screening of Ideas	Provide information on substantive issues and specialized funding opportunities (SOFs)
	Verify soundness and potential eligibility of identified idea
Feasibility Assessment / Due Diligence Review	Technical support: provide up-front guidance; sourcing of technical expertise; verification of technical reports and project conceptualization; guidance on SOF expectations and requirements
	Provide detailed screening against technical, financial, social and risk criteria and provide statement of likely eligibility against identified SOF
	Assist in identifying technical partners; Validate partner technical abilities.
	Obtain clearances – SOF
Development & Preparation	Technical support, backstopping and troubleshooting
	Technical support: sourcing of technical expertise; verification of technical reports and project conceptualization; guidance on SOF expectations and requirements
	Verify technical soundness, quality of preparation, and match with SOF expectations
	Negotiate and obtain clearances by SOF
	Respond to information requests, arrange revisions etc.
	Verify technical soundness, quality of preparation, and match with SOF expectations
Implementation	Technical and SOF Oversight and support
	Technical support in preparing TOR and verifying expertise for technical positions. Verification of technical validity / match with SOF expectations of inception report. Participate in Inception Workshop
	Technical information and support as needed
	Technical support, participation as necessary
	Advisory services as required
	Allocation of ASLs
	Technical support and troubleshooting, Support missions as necessary.
	Project visits – at least one technical support visit per year.
	Technical support, validation, quality assurance
	Return of unspent funds
Evaluation and Reporting	Technical support, progress monitoring, validation, quality assurance
	Technical support, participation as necessary

Stage	Specialized Technical Services Provided
	Technical support in preparing TOR and verifying expertise for technical positions. Verification of technical validity / match with SOF expectations of inception report. Participate in briefing / debriefing
	Technical analysis, compilation of lessons, validation of results
	Dissemination of technical findings

Service standards:

1. initial response to communication within 2 working days
2. full response to communication (with the exception of a response requiring travel) within 10 working days