

Developing and piloting a web enabled coral reef monitoring framework for evidence based management of the coral reef ecosystem.

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I. Strategic Context and Rationale

A. Country context

The Republic of Maldives is a collection of 1,190¹ small and low-lying islands grouped into 26 atolls to the south-west of Sri Lanka in the Indian Ocean. It stretches across the equator and its exclusive economic zone covers over 859,000 km² ⁱ.

Maldives's human development index (HDI) is 0.602. This gives the country a rank of 107 out of 169 countries with comparable data. The HDI of South Asia, as a region, increased from 0.315 in 1980 to 0.516 today, placing Maldives above the regional average ⁱⁱ. Maldives achieved middle income status in January of 2011 ². Tourism and Fisheries are the two most important sectors of the economy. They contribute nearly 80% of the country's gross domestic product (GDP) and depend heavily on the health of the marine environment. In addition the islands are built, protected and sustained, almost entirely, by living coral.

The total archipelagic area (all coral reefs and lagoon habitats) is approximately 21,000 km². Some 4,500km² of the exclusive economic zone are reef and 227km² are land ⁱⁱⁱ. About 193 of the islands are inhabited by native Maldivians, 93³ islands have tourist resorts, and 55 islands are reserved for industrial and agricultural use. Only 33 of the inhabited islands have a land area of more than 1 km² and only three islands have an area of more than 3 km² ^{iv}. The islands are low lying with an average elevation of only 1.5m and a maximum elevation of 2.3m. The area of land is the smallest of any Asian country and, in 2006, supported a resident Maldivian population of 298,968 ^v with an estimated population of 310,000 for 2010 ^{vi}. In addition, in 2009, there were estimated to be some 75,900 expatriate workers ^{vii}, and 655,852 tourists ^{viii}. Maldives reported to be the 4th most densely populated sovereign country in the world ⁴ and its capital island, Male' is reported to be the most densely populated urban area in the world⁵.

This geography makes this archipelagic small islands nation particularly vulnerable to the projected adverse consequences of climate change ^{ix, x, xi} including sea-level rise, increased water temperature, ocean acidification ^{xii} and an increase in the frequency and intensity of droughts and storms. To address climate related risks facing Maldives and strengthen the

¹ The figure of 1192 is given in the same report. In fact the absolute number depends on the definition of an island.

² "1st January 2011, Male; The Maldives today officially graduated from Least Developed Country (LDC) to Middle-Income Country status, in recognition of the country's strong socio-economic development over recent years"

[Source: <http://www.foreign.gov.mv/v3/?p=news&view=sep&nid=3305>]

³ The figure is now reported to be around 98 although at least one resort is closed for refurbishment.

⁴ "The Population density of Maldives is already way over the world's average population density of 45 people/km² (based on Cohen, 2003) and is already the 4th most densely populated sovereign country in the world, after Monaco, Singapore and Vatican City." [Source: SHAIG, A. 2009. Settlement planning for natural hazard resilience in small island states: The Population and Development Consolidation Approach. PhD, James Cook University.]

⁵ "Male' is believed to be the most densely populated urban settlement in the world with 47,870 persons sq km in 2006." [Source: SHAIG, A. 2009. Settlement planning for natural hazard resilience in small island states: The Population and Development Consolidation Approach. PhD, James Cook University.]

country's resilience to these risks, a multi-donor Maldives Climate Change Trust Fund (CCTF) has been established. The majority of the resources (\$ 8.6 million) will be used by the Government of Maldives (GoM), under the strict requirement of World Bank/European Union on its use, to carry out their priority projects relating to climate change adaptation and mitigation. The governance arrangements for the Trust Fund comprise the National Planning Council (NPC) and the Climate Change Advisory Council (CCAC) led by the Office of the President and a Technical Committee of national experts. The overarching implementing agency is the Ministry of Housing and Environment (MOHE) that will house the Program Management Unit (PMU). The Government of Maldives proposes to undertake a project focusing on coral reef ecosystem monitoring and management for climate change adaptation with support from the CCTF. This has been endorsed by the NPC and the CCAC.

B. Sector Context

B.1 Significance of Coral Reefs

Coral reef statistics produced by the United Nation Environment Programme (UNEP) in 2003 ranked the Maldives as having the seventh largest coral reef system within its territorial boundaries. The Maldives is estimated to contain 3.14% of the total coral reef area of the world^{xiii}. Maldives coral reefs are a major driver, at the national level, for key economic sectors such as tourism and fisheries. A 2009 study, of the economic value of biodiversity to the Maldives^{xiv}, highlights this significance since the majority of biodiversity assets within the Maldives are in the marine environment. The study indicates that 71% of national employment (78,500 jobs), 49% of public revenue (Rf 2.5 billion⁶), 62% of foreign exchange (US\$ 435 million), 98% of exports (Rf 1.7 billion) and 89% of GDP (Rf 135 billion) are biodiversity dependent.

The study states that the **Tourism** sector employs, directly or indirectly, 64,000 people, or 58% of the workforce, contributes 34% of all government receipts, brings in 70% of all foreign exchange earnings and accounts for 29% of all investment. The current upstream contribution of tourism to the economy is US\$ 764 million or 67% of GDP. With respect to the **Fisheries** sector the study indicates that Fisheries “create” 14,500 jobs and produces 99% of all visible export earnings. A 2007 conservation investment study for Maldives indicates how important fish, water and coral quality are to the sustainability of the tourism sector^{xv}. The study states that “*an average visitor would undertake 1.42, 2.31 and 3.76 times more number of trips with improvement in the environmental attributes namely fish abundance, water and coral quality of marine resources respectively during the next 5 year period. Further, the tourists would experience a total of US\$2554 increase in the direct use value (consumer surplus) per trip*”. By implication the opposite will happen if quality deteriorates resulting in a cruel bind of deteriorating resources and associated falling revenue. Indeed the National Adaptation Plan of Action (NAPA)^{xvi} specifies the reduction in the over-dependency on coral in the tourism sector as a required action.

Coral reefs are at significant risk from climate change. However, if they prove to be resilient then they will play a major role in mitigating the adverse effects of climate change. Coral reef derived ecosystem goods and services include: (i) the reef food fishery; (ii) the bait fishery that underpins the environmentally friendly pole-and-line fishery; (iii) the production of coral

⁶ The current exchange rate is around Rf15:\$US1

sand that sustains the beaches of the Maldives; (iv) a living physical defence from erosion and storm surge; (v) tourism attractions; (vi) cultural and aesthetic value.

B.2 Status of Coral Reefs in Maldives

The key driver of coral reef degradation in the Maldives is considered to be unsustainable economic development manifested by the unmanaged burning of fossil fuels. This unmanaged burning of fossil fuel is projected to have led to elevated greenhouse gasses in the atmosphere and to an increase in the frequency of elevated sea surface temperatures above historic norms. The negative impact of these elevated sea surface temperatures is the bleaching of hermatypic, reef building, corals as described below. Such bleaching, which went virtually unreported until the 1980s, has become increasingly frequent. A second projected consequence of elevated greenhouse gasses is ocean acidification due to the uptake of carbon dioxide gas (CO₂) which, if it occurs, will make it more difficult for corals to lay down their calcium carbonate skeletons.

Coral reefs have been under significant pressure in the Maldives since the start of the tourism boom in the mid 1970's. Large areas of shallow water coral reef were mined to provide materials for construction. Dredging from coastal development has resulted in increased localised sedimentation. Untreated sewage, whilst rapidly dispersed, can cause localised negative impacts. Local fish populations, such as grouper spawning aggregations, may be at risk from overfishing. Given effective management most of these impacts can be managed. However, when the projected adverse impacts, particularly from climate change from elevated sea temperatures and ocean acidification are factored in, the prognosis is poor (see the box below).

Bleaching: A comprehensive review of such information as is available concerning the status of coral reefs in the Maldives was produced in 2010^{xvii}. Corals build calcium carbonate skeletons that, in turn, form reefs using symbiotic plants (algae) that live in their tissues. These algae are expelled when the coral is stressed and this means that the colouring provided by the algae is lost and the coral turns white. The phenomenon is called bleaching. Stress can result from pollution and also from elevated water temperatures. If the stress is not too extreme, and is of only a few days duration, the coral can be re-colonised by the algae and should survive. If the stress is too intense and prolonged the coral will die. A major, historically unprecedented, Indian Ocean bleaching event, due to raised sea-surface water temperatures, occurred in 1998. It had a devastating negative impact on shallow-water coral reefs in the Maldives with estimated live coral of 40-60% pre-bleaching falling to less than 3% 6 months later^{xviii}. Only limited recovery was observed in the 10 years following bleaching with at least two further minor bleaching events reported. Indeed 7 of the 12 resorts that responded to a questionnaire sent in May 2011 reported bleaching of more than 10% in the last year. Fortunately, it is understood that coral recovery, at least for certain species, has also accelerated in the last couple of years. It is not known whether the 1998 bleaching event has had a significant adverse impact on tourism and fisheries. There are three reasons for this. Firstly there has only been limited investigation into possible cause-effect linkages, secondly there is large natural variability masking any trends and thirdly there are possible multiple and independent contributing factors that would need to be excluded. A 2000 report^{xix} on the effects of the 1998 bleaching event on tourism is inconclusive as to the links. However, responses to a questionnaire, at the time, indicate that “37% of all tourists found the dead corals the most disappointing experience, while the price of food and beverages had an equal score (also 37%)”.

Tsunami: A report on the impacts of the 2004 tsunami ^{xx} states that “*direct damage to the reefs from the tsunami was minor*”. However, the report specified that the mission was hampered by a critical lack of adequate historical data on the biodiversity and ecosystem status, and past changes to, coral reefs of the Maldives. The report recommended that the existing monitoring programs for reef resources be continued and extended.

The 2011 “*Reefs at Risk Revisited Review*” ^{xxi} highlights the sensitivities of, and risks to, coral reefs as shown in the box overleaf. The report indicates that, in the Indian Ocean, more than 65 percent of reefs are threatened by local activities, with nearly 35 percent under high or very high threat. The Maldives, the Chagos Archipelago, and the Seychelles have the largest area of reefs under low threat in the region. Overfishing is the most widespread threat, but land-based pollution and coastal development also elevate overall pressure.

Thermal stress

“Our (the review) projections suggest that during the 2030s roughly half of reefs globally will experience thermal stress sufficient to induce severe bleaching in most years. During the 2050s, this percentage is expected to grow to more than 95 percent. These projections assume that greenhouse gas emissions continue on current trajectories and local threats are not addressed. Although coral reefs can recover from infrequent and mild bleaching, this degree of high, regular stress presents a significant risk of irreversible damage.”

Rising acidity

“Rising levels of CO₂ in the oceans are altering ocean chemistry and increasing the acidity of ocean water, reducing the saturation level of aragonite, a compound corals need to build their skeletons. By 2030, fewer than half the world’s reefs are projected to be in areas where aragonite levels are ideal for coral growth, suggesting that coral growth rates could be dramatically reduced. By 2050, only about 15 percent of reefs will be in areas where aragonite levels are adequate for coral growth.”

Combined impacts

“The combined impacts of ocean warming and acidification will increase the threat levels on more than half of all reefs by 2030, pushing the percentage of threatened reefs to more than 90 percent by 2030. By 2050, nearly all reefs will be affected by warming and acidification and almost all reefs will be classified as threatened, assuming there is no change in local pressure on reefs”

B.3 Current Research on Coral Reefs

The Marine Research Centre (MRC) of the Ministry of Fisheries and Agriculture (MoFA) is tasked with the monitoring of coral reefs in the Maldives. A report on the status of Maldivian coral reefs was produced, by MRC, in 2010 and includes reference to significant research ^{xxii}. There are numerous historic research activities relating to coral reefs in the Maldives. However, these were not co-ordinated and the legacy is not readily available. Current monitoring by MRC is sporadic. The last coral reef monitoring survey by MRC was in November 2010 when 3 sites were monitored in Addu Atoll. The last time that all the 15 sites forming the basic national coral reef monitoring framework were monitored was in 2009. This may not seem to be a cause for concern. However, 15 sites is a fraction of the sites that should be monitored and government downsizing will severely compromise public sector capacity to monitor. It is understood that the data from the monitoring has been processed into Microsoft Excel. Results have been used to inform the last international status report on coral reefs produced in 2011 ^{xxiii}. Three MRC staff are assigned full-time for coral reef monitoring. The budget for monitoring this year is approximately \$3,700 and is reduced from

last year. This is scarcely enough for four days of boat hire. To do 15 sites once a year would require a minimum of 15 days and at least five times this amount of money.

The Maldives Environment Management Project (MEMP) funded the development of a National Coral Reef Monitoring Framework in 2009^{xxiv}. 15 scalable protocols (that allow for collection by different skill groups and subsequent integration of this information) were developed and 13 were technically tested in 2009. The coral and reef fish protocols primarily reflect the international Reef Check^{xxv} Programme which is endorsed by the Convention on Biological Diversity⁷. A subset of these protocols was further refined into the MEMP monitoring and evaluation (M&E) framework in 2010^{xxvi}. However, the full coral reef monitoring framework, as reflected in the current proposal, will not, be further developed and implemented without this proposed Project. At the time of writing of this document there are plans to monitor a number of sites in the MEMP area in the next month. The monitoring will use government staff and the MRC recurrent budget subsidised with funds from the MEMP M&E budget and the Darwin Initiative Project. The MEMP has also funded the collection of baitfish data from 2008-2013. More than 100 forms have been filled though the data have not been processed or analysed. MEMP is also investing in a National Geographic Information System (NGIS)^{xxvii} that will use ArcGIS and that will be accessible by the public sector through a local area network. The proposed coral reef web enabled database will be designed to allow import into, and export from, this NGIS.

MRC is also collecting data under the Darwin Initiative Project “*Managing coral reef fisheries for biodiversity, ecosystem and economic benefits*”^{xxviii}. The Project started on April 01st 2009 and is due to end on March 31st 2013. It employs two extension officers who currently work with ten resorts, with plans to expand the number, to enable these resorts to collect reef fish monitoring data. Four resorts have supplied data so far on visual assessments of coral reef fish populations under the Darwin Initiative “*Fishwatch*” scheme. The data are managed in Microsoft Excel and are not readily available. The Darwin Initiative Project is proposing to develop management plans for the reef, grouper and aquarium fisheries. In addition a large data set is maintained on the export of small ornamental fish from the Maldives. The fishery is managed on a species quota established in the 1990s^{xxix}.

The Atoll Ecosystem Conservation Project (AECF) covers Baa atoll in the north of Maldives. The Project commenced in 2008 and is due to end in early 2012. A rapid ecological baseline was undertaken early in the Project^{xxx}. It is understood that there are no permanent transects and no plans to do regular monitoring. The baseline data have been provided to MEMP.

There are a number of private sector monitoring initiatives by researchers and resort operators. A Maldivian consulting firm, SEAMARC, reportedly employs 10 marine biologists working with both Four Seasons at Kuda Huraa and at Landaa Giraavaru, the Beach House at Manafaru, Waldorf Astoria Collection, and the Holiday Inn, Kandooma. SEAMARC is also initiating a large project in collaboration with the International Union for the Conservation of Nature and Natural Resources (IUCN) to run from June 2011 at least until the end of 2012. This project will work with resorts to roll out the “*BleachWatch*” scheme for monitoring coral bleaching and reef resilience assessments^{xxxi} to determine the ability of coral reefs to adapt to and recover from thermal stress. The Maldivian firm, CDE consulting, is assisting some 5 resorts to monitor the environment. Additional Resorts are reported to

⁷ A review of the decisions⁽⁰¹²⁰⁾ of the Conference of the Parties (COP) to the International Convention on Biological Diversity (CBD) identified support for coral reef monitoring using the Global Coral Reef Monitoring Network (GCRMN) procedures^(0113,0114) and/or Reef Check⁽¹⁰¹¹⁾.

have marine biologists including Six Senses, Coco Palm, Anantara, Baros, Diva and the Banyan Tree Ihuru/Vabbinfaru. Six Senses Resorts and Spas have contributed from its Social and Environmental Responsibility Fund to expand Reef Check activities in the Maldives in the period 2011-2013⁸. To date some 50 sites in Maldives have records deposited in Reef Base under the Reef Check scheme⁹, some from as early as 1997. However, this is a limited data set considering the number of initiatives.

98 Resorts were sent a questionnaire, by the Ministry of Tourism Arts and Culture, at the request of the Marine Research Section on 09th May 2011. The questionnaire concerned the coral reef monitoring in their diving and snorkelling areas, fish landings on the resort, and beach erosion on the resort. The questions were designed to support the development of this Project preparation paper and to act as a baseline against which to measure Project delivery effectiveness. 21 resorts have replied to date (02nd June 2009). This response suggests there is a real need to build monitoring capacity and responsiveness in the tourism sector. **Coral reef monitoring**: 12 of the 21 resorts that responded monitor coral reefs with 9 of them using permanent transects. The longest period of monitoring is reported as 10 years. 3 resorts indicated a good current condition of coral reefs, 8 mixed and 2 bad. 5 resorts indicated a good future (in 5 years) for coral reefs, 6 mixed and 2 bad. 7 resorts reported significant (more than 10%) bleaching in the last year, 1 did not report significant bleaching and 5 did not know. Of the 13 resorts that responded only 3 used Maldivian staff for monitoring and 1 did not know. **Fish landings**: 9 of the resorts sample reef fish landings with only one monitoring for more than 5 years. The quality of fish landings was reported to be good for 4 of the resorts, mixed for 5 and did not know for 1 of the resorts that responded. The future for fish landings was reported to be good for 4 resorts, mixed for 2, bad for 1 and don't know for 3. **Beach erosion**: 13 of the 21 resorts that replied monitor beach erosion with the longest monitoring period being 5 years. 4 of the resorts report bad erosion and 10 mixed. 2 resorts indicated a good future with respect to erosion, 9 a mixed future, 2 a bad future and 1 did not know.

Coral reef monitoring data are collected by private sector contractors for the many tourist and government infrastructure developments required under the Environmental Impact Assessment (EIA)¹⁰ process. An example is the EIA for a harbour at Kurinbi in Haa Dhaalu Atoll^{xxxii}. However, the raw data are not readily available. There is little evidence of follow-up monitoring in many EIAs. Such data as there are provides a valuable untapped resource. The 11th of 12 proposed NAPA Projects^{xxxiii} is titled “*Increase resilience of coral reefs to reduce the vulnerability of islands, communities and reef dependent economic activities to predicted climate change*”. It is not yet funded. As far as is known there are no, significant, current research activities relating to coral reefs in the Maldives other than those that are presented above.

Limited monitoring in terms of frequency and spatial resolution, difficulties in accessing the information that there is and limited objective evidence for links between ecosystem goods and services, social and economic use of these goods and services, and the sensitivity of these links to climate change are all constraints that will start to be alleviated by the pilot project.

⁸ Biosphere Expeditions Ltd (2010). Application for funding from Social & Environmental Responsibility Fund. Sonevafushi. 13 May 2010.

⁹ www.reefbase.org

¹⁰ EIA Regulation of the Maldives – May 2007. www.epa.gov.mv [Accessed May 2011]

B.4 Policy Context

The table below summarises key international and national policy with respect to coral reef management in the Maldives.

No	Instrument	Target	Gap
1	Convention on Biological Diversity (see description below)	Target 6: Effective management of marine life by 2020	Limited capacity to manage
		Target 10: Anthropogenic pressures on coral reefs from climate change minimised by 2015	Transboundary in nature and requires strengthening of evidence based advocacy
		Target 16: 10% of important coastal and marine areas protected by 2020	Only 2% in Maldives currently legally recognised as protected areas.
2	Species protection (www.epa.gov.mv)	Collection of corals, shark fishing, turtle catching, and a number of other regulations aim to conserve coral reef associated species.	Lack of effective enforcement.
3	Maldives protected areas (www.epa.gov.mv)	34 Coastal and marine Protected areas legally recognised. Most contain coral reef.	Lack effective management.
		274 Environmentally Sensitive Areas recognised.	Lack of effective management
4	Maldives Environmental Impact Assessment (EIA) regulations (www.epa.gov.mv)	Requires a full EIA for relevant activities in an Environmentally Sensitive Area. Many of the Environmentally Sensitive Areas contain coral reef.	Limited implementation of environmental management plans following approval of EIAs.
5	National Adaptation Plan of Action ^{xxxiv}	Coastal protection services (Priority Rank 1 of 30) Enforcing a ban on coral mining (Rank 13 of 30) Protection of reefs from development (Rank 17 of 30) Protecting house reefs (Rank 23 of 30).	No targets and limited capacity to deliver objective targets.
		Proposed NAPA Project <i>“Increase resilience of coral reefs to reduce the vulnerability of islands, communities and reef dependent economic activities to predicted climate change”</i> .	Funding not forthcoming. Coral Reef Project could be a pre-cursor to this.
6	Planning directive	National Planning Council and the Climate Change Advisory Council have endorsed the Coral Reef Project for funding under the CCTF	Coral Reef Project is pending initiation.

International Convention on Biodiversity: Maldives is a signatory to the International Convention on Biological Diversity. Maldives produced its fourth national report ^{xxxv} on delivery of its National Biodiversity Strategy and Action Plan (NBSAP) in 2010¹¹. The Conference of the Parties (COP) X Decision 2 ^{xxxvi} relates to indicators and targets. Targets 6, 10 and 11 are of particular relevance to coral reefs. Target 6 indicates that, by 2020, all fish and invertebrate stocks and aquatic plants should be effectively managed using the ecosystem approach. Target 10 specifies that “*By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.*” Target 11 specifies that “*By 2020, at least 17 per cent of terrestrial and inland-water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape.*” Maldives is moving towards this target and has gazetted 34 coastal and marine protected areas as of end 2009 covering 9597 ha ^{xxxvii} although this is only just over 2% of published reef areas and 0.46% of archipelagic area (all coral reefs and lagoon habitats). However, this is well below the 10% target. Only a handful of these protected areas have a management plan and there is little or no management. Government has also proposed a list of environmentally sensitive areas initiated in 2009 with the assistance of the local Island Offices and other stakeholders. The list of 274 locations has been produced to identify environmentally and economically significant areas to offer protection, safeguard and enhance the conservation of the biological diversity of the country ^{xxxviii}.

Mauritius Strategy: Maldives is a party to the Mauritius Strategy which is an extension of the 1994 Barbados Programme of Action for the Sustainable Development of Small Island Developing States (SIDS). The Mauritius Strategy was adopted in 2005 and comprises actions and strategies in 19 priority areas. Of particular relevance are Actions IV relating to coastal and marine areas and IX relating to biodiversity resources. Maldives produced its national assessment report on delivery of the Mauritius Strategy in 2010 ^{xxxix}. The report does not provide any substantive policy with respect to coral reefs.

Maldives National Adaptation Plan of Action: The 2006 National Adaptation Plan of Action (NAPA) ^{xl} recognises the importance of coral reefs implicitly in terms of coastal protection services (Rank 1 of 30) and explicitly in terms of enforcing a ban on coral mining (Rank 13 of 30), protection of reefs from development (Rank 17 of 30), and protecting house reefs (Rank 23 of 30).

C. Rationale for Bank Involvement

The rationale for Bank involvement in the Coral Reef Project is mandated in the Maldives Climate Change Trust Fund (hereinafter referred to as CCTF) Concept note ^{xli}. The Coral Reef Project falls under “*Component 1: Adaptation: Building a Climate Resilient Economy*”. The component description specifies the opportunity to build on the coral reef monitoring protocols developed under the Maldives Environmental Management Project.

Environmental sustainability, specifically climate change adaptation, is viewed as a cross-cutting theme in the Strategic Action Plan – National Framework for Development (2009-

¹¹ The NBSAP is a national roadmap for delivering the Convention.

2013) of the Maldives¹². In line with this, the key thrust in the World Bank Maldives FY08-12 country strategy (CAS) identifies “*improved capacity to manage the country’s pristine, but fragile, natural environment*” as one of the three strategic development outcomes. The project is in line with the strategy adopted under the CAS that seeks to support the Government’s priorities in environmental management in three ways: (i) strengthen environmental management capacity and skills in the government and of other stakeholders, (ii) build a sound knowledge base to better address the environmental risks facing the country; (iii) implement a strategy to build climate resilience and adapt to the impending risks of climate change.

II. Project description

A. Project development objective and key indicators

The development objective of the Project, hereinafter referred to as the “Coral Reef Project” is specified as “*Developing and piloting a web enabled coral reef monitoring framework for evidence based management of the coral reef ecosystem*”. This will be achieved through the development of a web enabled national geo-database for supporting the monitoring of coral reefs, the provision of information for evidence based management of coral reefs, and the building of capacity to use this system hereinafter referred to as “*the Coral Reef Monitoring Framework*”.

Due to the short duration, and pilot nature of the Project, the indicators will be intermediate outcome (process), rather than outcome, indicators. The eventual outcome should be the use of “*the Coral Reef Monitoring Framework*” nationally to effectively and objectively mitigate climate change impacts using resilience and adaptation measures. The key intermediate composite outcome indicator is specified as: “*Real pilot data are available for decision-making in the web enabled geo-database*”. The objective composite target contributing to this intermediate composite outcome is specified as “*At least five resorts each make available one set of coral reef monitoring data (to be defined) on the web enabled geodatabase*”. Subordinate indicators contributing to this composite outcome indicator are presented by component.

B. Project components

The Coral Reef Project aims to pilot a framework in which the users of resources are given the capacity to collect, and make available, information that is necessary to manage the resources they depend on in the face of projected climate change. The framework reflects principle 2 of the ecosystem approach specified in decisions made under the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) that “*Management should be decentralized to the lowest appropriate level*”¹³. The Project is also designed to help strengthen the role of government in setting standards, auditing compliance and providing advice. The Project does not depend on significant investment in equipment because it will be part of the users’ contribution. The investment is in software development, capacity building as described above, and partnership building for climate change resilience and adaptation.

¹² Source: Strategic Action Plan – National Framework for Development (2009-2013)

¹³ <https://www.cbd.int/ecosystem/principles.shtml>

The proposed Coral Reef Project will build on, and complement, the work being undertaken by the MRC, the MEMP ^{xlii, xliii}, the Darwin Initiative Project ^{xliv}, and Resorts and deliver the intermediate composite outcome specified for the Coral Reef Project using three components as described below. The links and value added from the Coral Reef Project are illustrated in the box below.

No	Link	MRC	MEMP	Darwin Initiative	Resorts	Coral Reef Project
1.	Standardised Protocols	+	+++	++	+	++
2.	Training in monitoring	+		++	+	+++
3.	Monitoring	++	+	++	+	+++
4.	Data management	++		++	+	+++
5.	Data interpretation	++		++	+	+++
6.	Decision making	+		++	+	+++

The Coral Reef Project will¹⁴: 1. Roll out, through resorts, such protocols as have been developed under MEMP and approved following peer review and complement/build on the roll-out of a subset of the protocols that are being delivered by the Darwin Initiative Project. 2. Extend training for monitoring from that being delivered under the Darwin Initiative Project to all agreed Protocols. 3. Use contractors to build, operate and then transfer the capability to monitor to resorts. 4. Facilitate data management by providing a web enabled database which does not presently exist; 5. Provide basic facilities for interpretation and presentation within the web site and also provide a facility for download of data into ArcGIS compatible mode and so into the government NGIS; 6. Provide support for advocacy and decision-making using information provided by monitoring.

A strong principle will be to use existing Maldivian private sector capacity to deliver the activities. The reason for this is that users of natural resources should be responsible for monitoring and assisting in the management of the resources that they use. Government should concentrate on setting standards and auditing compliance with the delivery of the standards. Manuals, training materials (soft copy) and training will be provided in support of each of the activities and relevant subordinate activities specified in Components 1 and 2. The training materials will be prepared in a standard format to facilitate branding of “*the Coral Reef Monitoring Framework*” being implemented by the Coral Reef Project. The materials should be developed in a format that allows for revision of existing materials rather than production of new materials. All training materials and training should include pre- and post- training assessments and provide certification using objective evidence of competency achieved from training.

Delivery should be supported by public communications. This should be contracted out as a project-wide package and should include developing a branding strategy for “*the Coral Reef Monitoring Framework*” and, when agreed, ensuring that all materials that are produced reflect the brand.

¹⁴ Numbering in the table refers

B.1 Component 1: Managing coral reefs for climate change

The objective of this component is to pilot mainstreaming for decision-making, of “*the Coral Reef Monitoring Framework*”. The activities will be delivered by relevantly qualified contractors reporting to the CCTF PMU. The Component will be supported by training and public communications. Four key activities are proposed:-

(1.1) **Lessons to be applied workshops**: Supporting workshops to show how “*the Coral Reef Monitoring Framework*” can be used to inform management including workshops to socialise the system for possible extension to the regions to local resorts, local government and civil society and one international regional workshop in Maldives to share lessons learned with other countries. The indicator for this is number of workshops (4). The Public communications activities should prepare lessons to be applied from the pilot testing of “*the Coral Reef Monitoring Framework*” to be presented at the various workshops.

(1.2) **Decision support tools**: Developing guidelines/tools to facilitate decisions using “*the Coral Reef Monitoring Framework*” including software development support for interrogating the geo-database to provide data to the NGIS and uploading meta-data from the NGIS to the web. Decision support tools are proposed to include a data detection “proximity” tool and a decisions tracking tool. The data detection “proximity” tool would be a software tool that could be used to acquire data on the web site in the proximity of a proposed development in support of the EIA process and/or in support of downloading a data set within a particular area for analysis in ArcGIS. The decision tracking tool would be a software tool that would allow progress in decisions to be followed.... for example monitoring in support of an EIA environmental management plan. Indicators are the availability of these tools on the web site.

(1.3) **Policy framework**: Exploring policy measures and advocacy to support the mainstreaming and sustainability of “*the Coral Reef Monitoring Framework*” including: the setting of performance effectiveness targets for coral reef management; leasing/conceding responsibility for monitoring and maintaining coral reef assets to those that use them; making relevant use of “*the Coral Reef Monitoring Framework*” obligatory in environmental impact assessments; charging for access to and use of “*the Coral Reef Monitoring Framework*”; and incorporating relevant elements of “*the Coral Reef Monitoring Framework*” in the educational curriculum. Indicators are 5 policy briefs and evidence of consultation.

B.2 Component 2: Collecting and managing information on coral reefs

The objective of this component is to build the system and the capacity to collect data and enter it into “*the Coral Reef Monitoring Framework*”. The Component will be supported by training and public communications. It is suggested that each activity is delivered in an integrated manner by relevantly qualified contractors as discrete packages facilitating Resorts and relevant Government partners. Three key activities proposed are:-

(2.1) **Field monitoring and implementation of coral reef monitoring protocols**: The coral reef monitoring protocols developed under MEMP will be peer reviewed and revised where possible to accommodate key “Reef Check”, “BleachWatch”, reef resilience and other global initiative indicators. The list of protocols to be developed is given in the table below.

List of proposed Coral Reef Project monitoring Protocols.

Code	Title
3.1	Shoreline profile and solid waste
3.2	Shoreline survey and turtle nesting
3.3	Terrestrial transect
3.4	Terrestrial water quality (subsumed to 3.3)
3.5	Terrestrial inundation
4.1	Marine catch per unit effort (CPUE)
4.2	Marine extended swim
4.3	Marine settlement plates and quadrats
4.4	Seabed transect
4.5	Marine diet resort
4.6	Marine sedimentation
4.7	Marine surface (charismatic megafauna)
6.3	Attitude and opinion tourists
7.0	Remote sensing for coral resilience (not yet developed)
8.0	Land/sea use area characteristics (not yet developed)

Protocol 3.1 is designed to monitor shoreline erosion. Protocol 3.2 is designed to monitor shoreline type and the incidence of turtle nesting. Protocol 3.3 is designed to monitor terrestrial vegetation and key animal wildlife. It also includes the monitoring of basic water quality which was formerly covered by Protocol 3.4. Protocol 3.5 is designed to monitor the frequency and extent of inundation of the land by seawater. Protocol 4.1 is designed to monitor the health and productivity of reef fisheries. Protocol 4.2 is designed to visually assess the population of reef fish along transects linked to the seabed transect protocol and using elements of the Reef Check methodology. Protocol 4.3 relates to settlement plates and quadrats placed on/near to seabed transects. Settlement plates are placed to determine the nature and rate of settlement of marine life, particularly coral. Quadrats are areas photographed and analysed for coral type and cover. Protocol 4.4 is designed to determine the type and cover of seabed life under a transect tape and using elements of the Reef Check methodology. It also includes the monitoring of basic marine water quality. Protocol 4.5 monitors the use of fish as food on resorts. Protocol 4.6 monitors the level of sedimentation in the proximity of seabed transects. Protocol 4.7 is used to monitor the incidence of charismatic megafauna at the sea surface such as dolphins and whales, turtles, and marine birds. Protocol 6.3 is used to monitor the attitude and opinion of tourists towards the environment. Protocol 6.4 will be developed to provide any information needed to help determine resilience on coral reefs to elevated sea surface temperatures using remote sensing. Protocol 7 still has to be developed but will involve sea surface temperature analyses to determine possible areas with high coral resilience to thermal stress. Protocol 8 still has to be developed but will allow the web enabled database to support information on land and sea use area characteristics such as protected areas.

There will be an exercise to trawl and process historic data into the “*the Coral Reef Monitoring Framework*”. Pilot sites for testing “*the Coral Reef Monitoring Framework*” will be selected according to an agreed set of criteria and set-up for monitoring. Staff at partnering resorts, MRC and, where appropriate, line agencies and representatives from the regions will be trained to collect and enter/edit data within “*the Coral Reef Monitoring Framework*” and to audit use of “*the Coral Reef Monitoring Framework*”. Data will be collected and entered

by staff at partnering resorts so as to deliver the intermediate outcome indicator target. The indicator will be “*Coral reef monitoring protocols reviewed and implemented*” with the target of “*1 time dataset for each resort for each agreed protocol on the web*”. These are the same as the PDO level indicator and target.

Criteria, for selection of monitoring sites, in order of priority, will include demonstrable: (i) commitment by the partnering resort; (ii) ease of logistical access for monitoring; (iii) building on existing systems/historical data set; (iv) opportunity for future extension to regions/local communities/students; (v) social, economic (stakeholder use, level of negative impact, management), and environmental (naturalness, representativeness, uniqueness) significance reflected, for example, in protected areas and environmentally sensitive areas; (vi) sensitivity/vulnerability to climate change. Selected sites need not necessarily be resort house reefs thought using such sites maximizes convenience and reduces the likelihood of competition with other users.

(2.2) **Web enabling of coral reef monitoring data:** A web site will be developed to allow for data entry and management. Data management (entry/editing) screens will be developed for the monitoring protocols agreed for “*the Coral Reef Monitoring Framework*” and will be fully documented for training and management purposes. The web site developer will be supervised to ensure that its data exchange/interchange standards are compatible with those of the NGIS so as to maximise the potential for integrating the two systems. Efforts will be made to provide a platform for Coral Point Count with Excel (CPCe)¹⁵ of the United States National Coral Reef Institute and for key indicators from “Reef Check”, “BleachWatch”, reef resilience and other global initiatives. Funds will be provided to pay for necessary equipment/licenses and web fees to maintain the web site during the Project. The indicator will be “*Coral reef monitoring protocols reviewed and implemented*” with the target of “*1 time dataset for each resort for each agreed protocol on the web*”. These are the same as the PDO level indicator and target and the activity “*Coral reef monitoring protocols reviewed and implemented*”.

(2.3) **Remote sensing tools for climate change risk assessment:** The use of satellite derived sea surface temperature (SST) data for coral climate change risk assessment and planning will be piloted. The pilot will use and further develop, as necessary, the published approach^{xlv} developed under the World Bank/GEF Coral Reef Targeted Research and Capacity Building for Management Project¹⁶. The National Oceanographic and Atmospheric Administration (NOAA) SST weekly data set, collected since 1985 at a resolution of 4km², will be used to analyse thermal regimes across the Maldives archipelago and prioritise the potential resilience of coral areas, at the specified resolution, to bleaching. Suitable historic data and contemporary data collected during the Coral Reef Project using the “*the Coral Reef Monitoring Framework*” would be used to ground truth the study. Maps will be converted to ArcGIS format for use in a NGIS database and uploaded to Google Earth for public access. Training, materials and documentation to use the pilot system, including the processing of satellite imagery using Bilko for windows, converting outputs to ArcGIS format, and uploading outputs to Google Earth will be provided. The activity indicator for this sub-component is “a Bleaching risk assessment tool” and the target is a “1985-2010 coral bleaching resilience prioritisation map” (i.e. a map consolidating the information over this 25 year period across the Maldives)

¹⁵ <http://www.nova.edu/ocean/cpce/>

¹⁶ www.gefcoral.org

B.3 Component 3: Project Management

The objective of this component is to administrate the delivery of the other two components and meet the progress reporting requirements of the CCTF. Five key activities are proposed:-

(3.1) **Project Memorandum of Understanding (MoU)**: The CCTF PMU will develop and facilitate agreement to a memorandum of understanding (MoU) together with a certificate of contribution between the CCTF donors, the executing and implementing agency and the partnering private sector and civil society stakeholders. This MoU and its certificates will be public and detail the obligations of the contributing parties and recognise the contributions that they have made. The indicator will be the MoU and the target will be 5 MoU signed.

(3.2) **Project exit strategy**: The PMU will ensure that a Coral Reef Project Exit Strategy is developed at least 3 months before the scheduled end of the Coral Reef Project and ensure that there is, as a minimum, an integrated archived electronic legacy of “*the Coral Reef Monitoring Framework*”. Objective consideration should be given to financing and managing the continued operations of “*the Coral Reef Monitoring Framework*” after the end of the Coral Reef Project. A budget/financing plan for submission to Government should have been prepared and submitted at least 3 months before the end of the Project. The proposed indicator is a budget and the target is that it should be submitted.

(3.3) **Technical supervision (International Technical Advisor)**: International technical supervision is proposed so as to supervise and ensure delivery of a technically consistent Project particularly with respect to the web enabling of the protocols. The indicator is proposed as quarterly progress reports on the delivery of the international technical advisor terms of reference. The target is four quarterly reports. (3.4) **Procurement and Financial**: The CCTF PMU will prepare the terms of reference, issue the invitations, supervise the tender evaluations, administer the delivery of goods and services and ensure payment on effective delivery according to the specified procurement requirements and according to the Coral Reef Project schedule. The indicator is procurement exercises completed and the target is 10 exercises within 3 months of Project start-up.

B.4 Cumulative costs table

The cumulative costs table is presented below by component. A breakdown by activities is presented in section V.C.

Project Cost By Component	US \$ million
1. Managing coral reefs for climate change	0.43
2. Collecting and managing information on coral reefs	0.98
3. Project management	0.13
Total Baseline Cost	1.54
Physical Contingencies	
Price Contingencies	
Total Project Costs	

B.5 Lessons learned and reflected in Project design

The Coral Reef Project design primarily builds on the lessons to be applied from five initiatives. The initiatives and lessons to be applied are:

No	Initiative	Lessons to be applied
1	On going coral reef monitoring by MRC ^{xlvi}	Capacity needs to be built so that those that depend on the resources monitor them and are involved in their management. Government does not have the resources to do necessary monitoring and management and should concentrate such assets as it has on delivering a standards setting, compliance audit and advisory role in support of delegated monitoring and management.
2	The National coral reef monitoring programme developed under MEMP in 2009 ^{xlvi} ;	The Programme framework, reflected substantially in this Coral Reef Project, identified the need for funding of delivery. This Coral Reef Project provides this funding which would not, otherwise, be available.
3	The coral reef monitoring components of the MEMP M&E Plan developed in 2010 ^{xlvi} ;	The M&E Plan is a Project specific instrument and does not build capacity for recurrent monitoring. The limited monitoring for evaluation under MEMP will end when the MEMP ends. MEMP does not have the funds to implement the Coral Reef Project.
4	The Darwin Initiative Project “Managing coral reef fisheries for biodiversity, ecosystem and economic benefits” ^{xlix} .	The Coral Reef Project will build on the systems developed under the Darwin Project and the networks it uses. However, it will do so for a larger set of protocols and will provide tools for managing the data.
5	Resort monitoring initiatives	A number of Resort Operators laudably undertake some environmental monitoring in support of their corporate social responsibilities (CSR). However, monitoring is not co-ordinated across the sector and monitoring data are not readily available. The Coral Reef Project will help to resolve both constraints and help strengthen CSR initiatives.

The recent government initiative to downsize the public sector, together with the dispersed geography of the archipelago re-enforces the fact that there is a lack of public sector capacity to provide comprehensive monitoring data in support of “*the Coral Reef Monitoring Framework*”.

The Coral Reef Project addresses this constraint in three ways. The first way is to enhance such capacity, as exists, using improved information management systems through web enabling these systems. This allows government, and resort sector stakeholders, to maximise

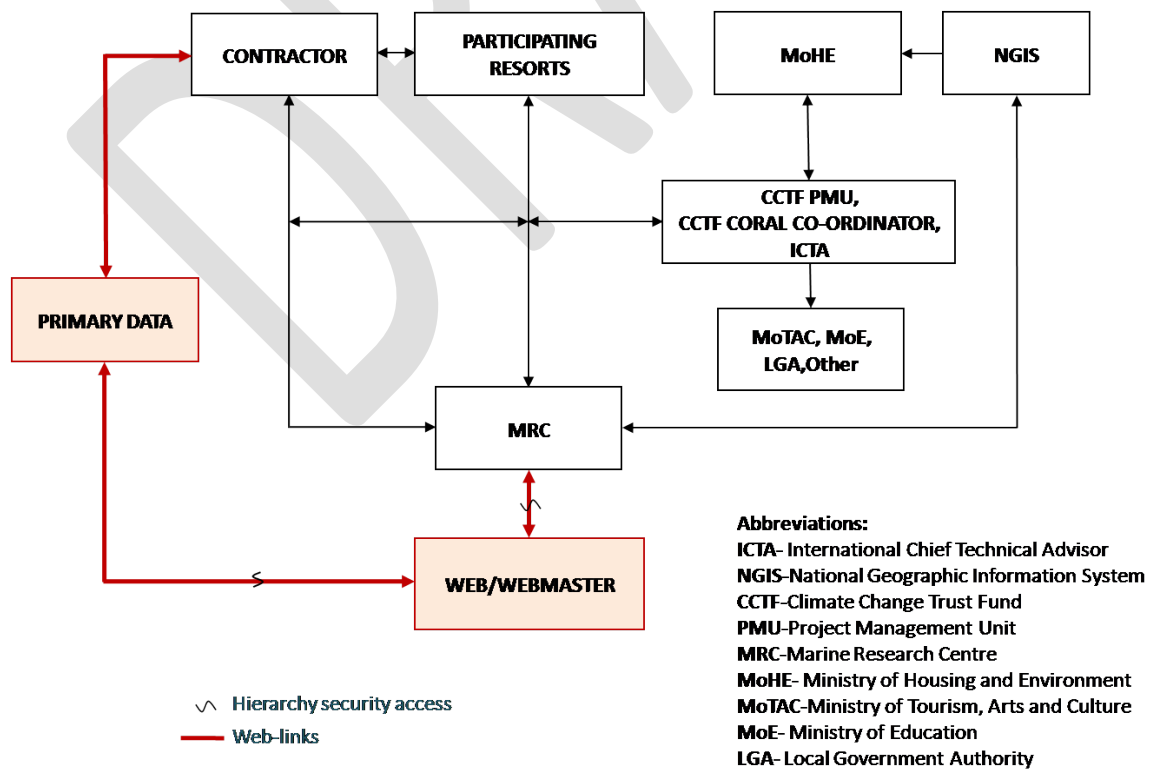
effective use of available resources. The second way is to involve civil society stakeholders who depend on coral reef resources, particularly resort operators, who provide snorkelling and diving services to clients, to share the burden of monitoring. In some cases these stakeholders are already doing the monitoring but the monitoring is not co-ordinated and the data are not readily available. Mainstreaming “*the Coral Reef Monitoring Framework*” so that civil society stakeholders use it helps to achieve this. This not only accords with recommendations from the Reefs at Risk Revisited report but also accords with Principle 2 of the Convention on Biological Diversity that “Management should be decentralized to the lowest appropriate level”¹. Enabling Resorts to collect data reduces the burden on government to collect such data and so allows for the allocation of any resources that are, so released, to a standards setting, compliance audit and advisory role.

III. Implementation

A. Institutional and Implementation Arrangements

Figure 1 below illustrates the organisational arrangements for the Coral Reef Project. The Project Executing Agency is the Ministry of Housing and Environment. The Implementing Agency is the Marine Research Centre of the Ministry of Fisheries and Agriculture. The Project will be supported administratively by the CCTF PMU which will undertake procurement and reporting and liaise with the contractors on contractual matters. A full-time Coral Reef Co-ordination Officer will provide technical support and liaise between the MoHE, MRC and other stakeholders such as Ministry of Tourism, Arts and Culture (MoTAC), Ministry of Education (MoE) and the Local Government Authority. S/he will be supported by a part-time senior international technical advisor.

Figure 1: Organisational chart



MRC will be the focal point for the web site and provide technical quality assurance for the contractors. At least three MRC staff will be assigned 75% of the time to the Project. They will have a standards setting and testing and an audit and compliance role. The Project will build on, liaise with, and support delivery of, the on-going Darwin Initiative Project and other relevant initiatives. The participating resorts will provide and manage their primary data through the web site assisted by the contractors. The priority will be to use Maldivian consultants to build monitoring capacity. Technical analyses, and software development, will, in principle, be assigned to international consultants.

Stakeholder Group	Institution	Staff Position	Nature of engagement	Key Responsibilities
Project executing agency	Project Management Unit (PMU)	Project Manager	Part-time	Procurement
		Coral Reef Coordinator	Full time	Project delivery
		International technical advisor	Part time	Project delivery
Project implementing agency	MRC	3 (named)	75% time, Government	Quality assurance and quality control
Partners	MoTC	Liaison Officer (named)	Part time Government	Liaison, capacity building
	MoE/EPA	Liaison Officer (named), staff	Part time Government	Liaison, capacity building, monitoring activities
	Resorts	Liaison Officer Monitors (named)	As agreed in MoU	Monitoring activities
Consultants	Technical consultant firms/individuals	Technical Consultants	Activities based	Terms of reference

The website will be managed on behalf of MRC and the stakeholders by a webmaster who will be the web developer and who will be required to provide an extended service and warranty of one year from acceptance of the web site. A follow-up webmaster will be determined in the Project exit strategy. Since the web is accessible to all other participants these are not shown in the figure. Access to data on the website will be determined by a hierarchic security protocol. The NGIS will be the workface for detailed analysis populated by data extracted from the web enabled database and returned to the web for presentational purposes.

B. Monitoring and Evaluation of Results

The PMU is responsible for providing technical and financial reports to the World Bank as per the following schedule:

<i>Reports</i>	<i>Purpose and Broad Contents</i>	<i>Timeframe (August 2011 – December 2012)</i>
1. Inception report	Revision of PIP	End Sept. 2011
2. Quarterly technical and financial reports	Progress reporting against results framework	End Dec. 2011 End Mar. 2012 End June 2012 End Sept. 2012
3. Evaluation report		End Nov. 2012
4. Project completion report		December 2012

Objectively verifiable indicators of Project delivery are presented in the Results Framework in Section V.A below.

C. Sustainability

The Project is designed for sustainability in that it aims to delegate the responsibility for monitoring, and ultimately managing, the use of resources to the user. This reduces the recurrent cost to government of providing this service and allows government to use such resources as are available to provide a standards setting and audit service. A budget is included in the Project for exploring sustainability options/an exit strategy for the end of the Project. It is assumed that the on-going costs of maintaining the NGIS and web site will be provided by government. Policy advocacy initiatives under the Project may deliver agreement to generate revenues by charging for use of the Web Site and requiring relevant users to use it so as to deliver some cost recovery. This will include new users should there be uptake of the coral reef framework across the country.

IV. Project summary

A Cost-Benefit Assessment/Justification

Three scenarios are described to demonstrate cost-effectiveness of the project approach.

A.1 Business as usual

MRC is the current national focal point for coral reef monitoring. MRC has limited capacity and can only deliver a limited coral reef monitoring framework. There is no indication that this situation will change. Current monitoring by Government is not providing a framework at sufficient resolution, in time and space, that can inform evidence based decision making for climate change resilience and adaptation. The last coral reef monitoring survey by Government was in November 2010 and only examined 3 sites. The next, which is heavily

subsidised by MEMP and the Darwin Initiative Project, is due in the next month at the time of writing of this report and will cover limited sites. It is unlikely to be repeated using government funds. The last time that all the 15 sites forming the basic national coral reef monitoring framework were monitored was in 2009. This may seem relatively recent but it is unlikely to be repeated in the foreseeable future due to government downsizing. Whilst the results have been used to inform the MRC 2010 publication^{li} and the 2011 international status report on coral reefs^{liii} these publications do not reflect a comprehensive dataset or data other than from government.

Coral reef monitoring data collected by private sector contractors, for the many tourist and government infrastructure developments required under the EIA process, are collected and meta data can be obtained but primary data are not always provided or easily accessible^{liii}. There are a number of private sector monitoring initiatives by resort operators. These initiatives are not co-ordinated and the data are not readily available. Investment in these activities is substantial but difficult to quantify and could not be matched by government. Under the business as usual scenario where information is not used and/or is not readily available any investment has a limited return.

A.2 No delegation (Government does it all)

Government does not currently have the staff, or the budget, to deliver a comprehensive monitoring and management framework for coral reefs in the Maldives. Indeed with the current Government policy to downsize the civil service the capacity is reducing and even its audit and compliance role is severely limited. The recurrent budget for monitoring of coral reefs by MRC is \$US 3,500 for the current year (2011) which is down on the budget for 2010. This is enough for about 3 days boat hire when a minimum of 15 days are required to monitor the current government national coral reef monitoring sites annually. It is indicated that at least five full-time staff would be required to monitor the 15 sites on an annual basis and this does not allow for an audit and compliance role for other coral reef monitoring activities. Recruitment of staff is not going to happen during a period of downsizing. The Project should not address these constraints directly since there is no guarantee that funds and resources will be forthcoming to sustain the investment after the Coral Reef Project ends.

A.3 Project model

In the Project model Government provides the information platform, has a supervisory role, sets standards, audits compliance, and provides key technical services support. The long-term recurrent costs to government for providing the information platform should be offset by charging stakeholders for use of the system but government will have to continue to provide some level of core recurrent funding to secure the interests of society as a whole. In the proposed Coral Reef Project model the monitoring and the management of much of the data will be undertaken by resort stakeholders, using the web enabled data management system. These stakeholders will provide in-kind support in terms of time and travel. Government will need to continue to employ core staff necessary to deliver the supervisory role but this time would be made available from the time previously allocated to coral reef monitoring.

B. Technical

B.1 Monitoring Protocols

The Monitoring Protocols to be used have, to a significant extent, already been developed under the MEMP^{liv, lv}. They reflect international norms and/or systems developed in the Maldives. There is an activity providing for the peer reviewed evaluation and revision of the Protocols.

B.2 Web enabled database

A key activity of the Project is a web enabled database supporting the entry and management of data by remote users. It should be noted that the internet is widely available in the Maldives. It is proposed that the web enabled database would use hypertext pre-processor (PHP) with structured query language (MySQL). Some additional features could be based on Java script, Ajax and Jason. This decision not to use ArcIMS (the web interface system for ArcGIS) reflects the lack of control over the roll-out of the NGIS and some technical concerns with respect to linking the web enabling to ESRI products. The web enabled database would be developed in a way that ensures compatibility with ArcGIS. Resources are allocated to providing quality assurance oversight for this compatibility and developing software that can extract compatible data from the database, download it into ArcGIS, and upload meta data (data about data contents) back into a web site for presentational purposes.

B.3 NGIS

The NGIS is being developed under a separate contract under MEMP, to whom technical reference can be made^{lvi}. Since the Coral Reef Project has little control over the delivery of this product the web enabled database will be designed to operate independently of, but capable of integrating with, the NGIS.

C. Fiduciary (with Procurement Plan)

Financial Management: The Project will be implemented by a Project Management Unit that implements the Bank-supported Maldives Environment Management Project (MEMP) in the Ministry of Housing and Environment, who will also handle the financial management arrangements under the Coral Reef Project. Coral Reef Project activities to be undertaken as part of the Climate Change Trust Fund will be demarcated from the MEMP-related activities of the CCTF PMU. The implementation arrangements are designed to ensure transparency and efficient fiduciary arrangements and will be adequate to account and report for project resources and expenditures.

The funds for the Project will be handled by the CCTF PMU and all expenditures will be recorded in its Books of accounts. While all major payments under the Project will be centralized and made by the CCTF PMU. The Operations Manual of CCTF outlines the financial and operational controls for this Project including for the various components and activities. The auditing arrangements that are in place for the Maldives Environment Management Project will also be used to conduct the audits of the Coral Reef Project. More specifically, an internal audit will be conducted under the Coral Reef Project to evaluate the effectiveness of project business processes and its functioning. It will also look at technical

and operational performance. An annual external audit will be conducted by an independent firm of chartered accountants, acceptable to IDA, under agreed Terms of Reference that are in the Operations Manual. The Finance Management Officer attached to MEMP will be responsible for the financial management to be carried out under the Coral Reef Project on a part-time basis. He will be assisted by a full time Financial Management Assistant who is identified among the staff of MOHE and will be hired before the Project becomes effective. Disbursements will be based on quarterly interim financial reports (IFRs) that will also forecast the cash requirements for six months. There will be training of the FM Assistant who will assist the FM officer as a means of strengthening and mainstreaming FM capacity in MOHE through on-the-job learning.

Procurement: The CCTF PMU will handle the procurement arrangements under the Coral Reef Project. The Procurement Officer attached to MEMP will be responsible for procurement under the Coral Reef Project on a part time basis. S/he will be assisted by a full time Procurement Assistant who is identified among the staff of MoHE. Both officials will follow up, as necessary, on all procurement activities and liaise with the Tender Evaluation Board of the GoM for all contracts costing more than MVR 1.5 million as per the government requirements. All procedures and documents to be used for procurement activities are in the Operations Manual and have been appraised and will be reviewed, updated and agreed with the Bank, as and when necessary.

D. Environment and Social Due Diligence

The project triggers the following safeguard policies of the World Bank: Environmental Assessment (OP 4.01) and Natural habitats (OP 4.04). The Environmental and Social Due Diligence (ESDD) study is to be undertaken by the Government of Maldives through a consultant for the proposed project to identify, assess, and manage environmental and social concerns by following the basic principles of avoidance, minimization and mitigation of negative impacts. The negative environmental impacts associated with this project are expected to be limited. The key impact is possible damage to corals, their habitat and to the associated organisms from activities/events associated with field monitoring such as boat anchoring, oil leakages from boats, transect marking and physical monitoring. Safety issues may stem from malfunctioning of equipment, inadequate equipment, diving related accidents, etc. No social safeguards issues are anticipated in this project.

The ESDD study will identify existing international best practices for environmental sports diving prevalent in Maldives, including health and safety. It will specify a budget for providing basic training in these practices by certified trainers to participating Project field partners including, where necessary, contractors and, where agreed by government, public servants. The ESSD indicators will be taken from those specified in the relevant environmental sports diver standards.

The proposed MoU for Resort partners and the contracts for consultants providing field services will specify an arbitration arrangement in the event that a complaint is made that damage has been caused to natural assets during monitoring or that health and safety has been compromised. Periodic internal monitoring of the implementation of the ESDD will be undertaken by the CCTF PMU and the MRC through both desk review and field visits using a simple set of performance indicators selected by the ESSD from the study. An independent external audit will be done after the first 12 months of the project duration.

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment (OP/BP 4.01)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Natural Habitats (OP/BP 4.04)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Pest Management (OP 4.09)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Physical Cultural Resources (OP/BP 4.11)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Involuntary Resettlement (OP/BP 4.12)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Indigenous Peoples (OP/BP 4.10)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Forests (OP/BP 4.36)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Safety of Dams (OP/BP 4.37)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Projects in Disputed Areas (OP/BP 7.60)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Projects on International Waterways (OP/BP 7.50)	<input type="checkbox"/>	<input checked="" type="checkbox"/>

E. Readiness

No significant readiness issues are envisaged. Procurement of staff for the CCTF PMU and for the CCTF coral reef co-ordinator is underway. The three staff assigned to the coral reef unit in MRC are capable, keen, in position and are not leaving under the government downsizing programme. The Darwin Initiative Project, which is also under MRC, has built a good relationship with a number of resorts and will continue through, and beyond, the currently projected life of the Coral Reef Project.

Concerns over the roll-out of the NGIS are addressed by supporting the development of a stand-alone web enabled database system that has data compatibility, for key data, with the NGIS/ArcGIS.

V. Technical annexes

A. Results Framework

PDO: “Developing and piloting a web enabled coral reef monitoring framework for evidence based management of the coral reef ecosystem”.						
PDO Level Results Indicators	Unit of Measure	Baseline	Target Values	Frequency	Data Source/ Methodology	Responsibility for Data Collection
Indicator One: <i>Real pilot data are available¹⁷ for decision-making in the web enabled geo-database</i>	Records	0	1 time dataset for each resort for each agreed protocol on the web.	Mid-term and end of project	Project progress reports/Web site	PMU (audit by MRC)

Intermediate Result (Component 1): Managing coral reefs for climate change						
Intermediate Results Indicators	Unit of Measure	Baseline	Target Values	Frequency	Data Source/ Methodology	Responsibility for Data Collection
Lessons to be applied workshops	Number	0	4	End of project	Project progress reports	PMU
Decision support systems 1.Data detection proximity tool 2. Decisions tracking tool	System	0	2	Mid-term and end of project	Web site	PMU
Policy framework (5 policy areas)	Policy briefs and consultations	0	5	End of project	Policy briefs/ consultation	PMU

¹⁷ The term “available” would be replaced with “used” in a Project extension.

Intermediate Result (Component 2): Collecting and managing information on coral reefs						
Intermediate Results Indicators	Unit of Measure	Baseline	Target Values	Frequency	Data Source/ Methodology	Responsibility for Data Collection
Coral reef monitoring protocols reviewed and implemented	Records	0	1 time dataset for each resort for each agreed protocol on the web.	End of project	Project progress reports/Web site	PMU Audit by MRC External evaluation
Web enabling of coral reef monitoring data	Records	0	1 time dataset for each resort for each agreed protocol on the web	End of project	Project progress reports/Web site	PMU External evaluation
Remote sensing tools for climate change risk assessment	Bleaching risk assessment tool	0	1985-2010 coral bleaching resilience prioritisation map.	End of project	Project progress reports/Web site	PMU External evaluation

Intermediate Result (Component 3): Effective Project Management						
Intermediate Results Indicators	Unit of Measure	Baseline	Target Values	Frequency	Data Source/ Methodology	Responsibility for Data Collection
Project Memoranda of Understanding (MoU)	Number	0	5 MoU signed	Mid-term and end of project	MoU	PMU
Project exit strategy	Budget	0	Budget submitted	Mid-term and end of project	Budget/ submission letter	PMU, external evaluation
Technical supervision (International Technical Advisor)	Activities report	0	4	Quarterly	Reports against ToR	PMU
Procurement	Number	0	15	Quarterly	Project progress reports	PMU
Reporting	Reports	0	7	Quarterly	Project progress reports	PMU

B. COMMENTS

Marine Research Centre sent out a request, on 22nd May, to relevant government agencies, for comments on version 4 of this document to be received by 02nd June 2011. This document has addressed comments received from Marine Research Centre and Department of Meteorology. Ministry of Tourism, Arts and Culture (MoTAC) acknowledged the request for comments but made no comments.

Finance – 30-MRC-ADM/30/2011/1

MOFA – (Memo) 30-MRC-ADM/30/2011/94

MoHE – 30-MRC-ADM/138/2011/12

MoTAC – 30-MRC-ADM/88/2011/14 (reply 88-DS/30-MRC/2011/02)

EPA – 30-MRC-ADM/203/2011/4

Meteorology – 30-MRC-ADM/93/2011/1 (reply MET-93-CDMN/30-MRC/2011/2)

Disaster Management – 30-MRC-ADM/MISL004/2011/1

SAARC Coastal Zone Management - 30-MRC-ADM/PRIV/2011/7

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ⁱⁱⁱ Naseer, A., Hatcher, B.G., (2004). Inventory of the Maldives' coral reefs using morphometrics generated from Landsat ETM+ imagery. *Coral Reefs* (2004) 23:161-168.

^{iv} Zahir, H., N. Quinn, and N. Cariglia (2010). Assessment of Maldivian Coral Reefs in 2009 after Natural Disasters 2010. Marine Research Centre. Ministry of Fisheries and Agriculture, Male', Republic of Maldives. www.mrc.gov.mv/files/publications/Zahir_etal_2010.pdf

^v http://www.planning.gov.mv/publications/census2006_island_level_tables/population/population/PP_01.htm

^{vi} <http://hdrstats.undp.org/en/countries/profiles/MDV.html>

^{vii} MMA (2010). Annual Economic Review, 2009, Maldives Monetary Authority, p.20.

<http://www.mma.gov.mv/aer/aer09.pdf>

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