Concept Note

Toward Risk-Aware and Climate-resilienT communities (TRACT) - Strengthening climate services and impact-based multi-hazard early warning in Maldives

Maldives | UNEP

27 January 2020

GREEN CLIMATE FUND

Concept Note

Project/Programme Title:	**Toward Risk-Aware and Climate-resilienT communities (TRACT) - Strengthening climate services and impact-based multi-hazard early warning in Maldives**
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Accredited Entity(ies) (AE):	United Nations Environment Programme
Date of first submission/ version number:	*[2018-02-18] [V.1]*
Date of current submission/ version number	*[2020-01-28] [V.2]*

Notes

- The maximum number of pages should **not exceed 12 pages**, excluding annexes. Proposals exceeding the prescribed length will not be assessed within the indicative service standard time of 30 days.
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A. Project/Programme Summary (max. 1 page)			
A.1. Project or programme	☒ Project ☐ Programme	**A.2. Public or private sector**	☒ Public sector ☐ Private sector
A.3. Is the CN submitted in response to an RFP?	Yes ☐ No ☒ If yes, specify the RFP: _____	**A.4. Confidentiality[1]**	☐ Confidential ☒ Not confidential
A.5. Indicate the result areas for the project/programme	Mitigation: Reduced emissions from: ☐ Energy access and power generation ☐ Low emission transport ☐ Buildings, cities and industries and appliances ☐ Forestry and land use Adaptation: Increased resilience of: ☒ Most vulnerable people and communities ☐ Health and well-being, and food and water security ☐ Infrastructure and built environment ☐ Ecosystem and ecosystem services		
A.6. Estimated mitigation impact (tCO2eq over lifespan)	N/A	**A.7. Estimated adaptation impact (number of direct beneficiaries and % of population)**	Up to 541,000 direct beneficiaries (100% of the population of Maldives – M: 340,830, F: 200,170[2]) especially the 42% of the population living within 100 m of the coastline
A.8. Indicative total project cost (GCF + co-finance)	Amount: USD 25 million	**A.9. Indicative GCF funding requested**	Amount: USD 19 million
A.10. Mark the type of financial instrument requested for the GCF funding	☒ Grant ☐ Reimbursable grant ☐ Guarantees ☐ Equity ☐ Subordinated loan ☐ Senior Loan ☐ Other: specify_____		
A.11. Estimated duration of project/ programme:	Disbursement period: 5 years	**A.12. Estimated project/ Programme lifespan**	10 years
A.13. Is funding from the Project Preparation Facility requested?[3]	Yes ☒ No ☐ Other support received ☐ If so, by who:	**A.14. ESS category[4]**	☐ A or I-1 ☐ B or I-2 ☒ C or I-3
A.15. Is the CN aligned with your accreditation standard?	Yes ☒ No ☐	**A.16. Has the CN been shared with the NDA?**	Yes ☒ No ☐
A.17. AMA signed (if submitted by AE)	Yes ☒ No ☐ If no, specify the status of AMA negotiations and expected date of signing:	**A.18. Is the CN included in the Entity Work Programme?**	Yes ☒ No ☐
A.19. Project/Programme rationale, objectives and approach of	The small size, low elevation and heavy dependence on natural resources for its social and economic security make the Maldives highly vulnerable to climate change impacts		

[1] Concept notes (or sections of) not marked as confidential may be published in accordance with the Information Disclosure Policy (Decision B.12/35) and the Review of the Initial Proposal Approval Process (Decision B.17/18).
[2] The significant sex ratio imbalance is due to the working population being the largest population group and that the majority of foreign workers in Maldives are male (for every 100 female foreigners there were 1,017 male foreigners in 2014). National Bureau of Statistics, 2014. Maldives Population Projections 2014-2054.
[3] See here for access to project preparation support request template and guidelines
[4] Refer to the Fund's environmental and social safeguards (Decision B.07/02)

programme/project (max 100 words)	and climate-related hazards.[5] The country's vulnerability is further exacerbated by high population density and high rates of coastal development that are rapidly modifying protective natural barriers, such as coastal vegetation and coral reefs. Floods, droughts, cyclones, thunderstorms, storm surges, strong winds and tornadoes have all been identified as climate-related hazards to the Maldives. Extreme climate events are increasing in frequency and/or intensity as a result of climate change.[6] Such events have significant impacts on multiple sectors including human settlements, critical infrastructure, tourism, fisheries, human health, water resources, agriculture and food security. Limited financial resources, capacity, technology and adequate institutional structures constitute major challenges to providing end-to-end climate services. Improvement of climate data collection, management and forecasting remains a critical gap area.[7] This project will increase the resilience, risk awareness and enhance the livelihoods of the population of Maldives through a paradigm shift to evidence-based preparedness, response actions and decision making for climate risks. This will be achieved through strengthened climate services and impact-based multi-hazard early warning systems (MHEWS), which are crucial to building the climate resilience of Maldives and its vulnerable communities at "the last mile".

B. Project/Programme Information (max. 8 pages)

B.1. Context and baseline (max. 2 pages)

Maldives is an archipelago of 1,192 coral islands in the Indian Ocean, grouped into 26 atolls and spread over 860 km from latitude 7° 6' 35" N to 0° 42' 24" S, lying in a narrow band of 80 to 120 km from east to west.[8] About 200 of the islands are inhabited by its population of over 400,000; more than 80 of the islands are exclusively for tourists. The islands are small (96% are less than 1 km^2) and low-lying, with more than 80% having ground-level elevation of less than 1 metre above mean sea level.[9]

The Maldives has a warm and humid tropical monsoon climate with two main seasons: the wet season from May to November; and the dry season from January to March. Annual rainfall over the country varies between 1779 – 2218 mm per year, while average temperatures range from 25 °C to 31 °C. As a Small Island Developing State (SIDS), Maldives is particularly vulnerable to climate change.[10] Its location near to the equator predisposes the country to tropical storms, strong winds, storm surges, and heavy rainfall, in addition to swells generated by storms from the far south. Heavy rainfall, storm surge or swells cause flooding. The islands' small size and very low elevation expose coastal populations and built-up areas to these hazards, including sea level rise. Most at risk are half of the country's settlements, two-thirds of critical infrastructure, and almost all tourism establishments; all are located within 100 metres of the shoreline.[11]

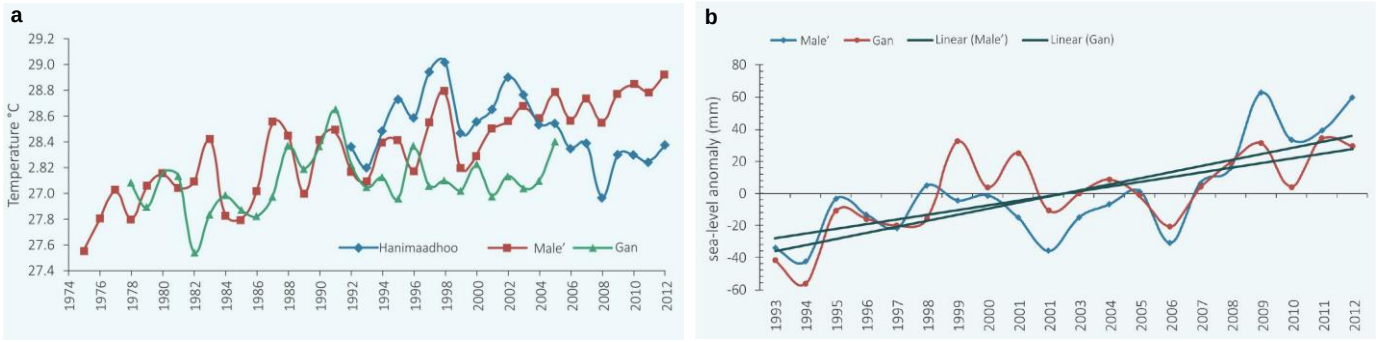
Communication and access to the islands from the capital city of Malé are costly due to the islands' geographical spread. This poses a challenge for communicating forecasts and disaster risks, and for mobilisation of emergency response assistance. Tourism remains the backbone of the country's economy. Fisheries and agriculture are the main livelihoods in rural areas, although agriculture is constrained by the availability of cultivable land and freshwater. Tuna is the primary fish export, with reef fish being the main source of live bait for tuna fishery. Coral reefs support the fisheries and tourism sectors and reduce the impact of strong waves on shore.

The Maldives Second National Communication (SNC) to the UNFCCC used data from the Maldives Meteorological Services (MMS) for the stations in the north (Hanimaadhoo), central (Malé) and south (Gan) to analyse current and future climate trends. Key findings in the current trends are a decrease in annual rainfall; decrease in the number of rainfall days per year; increase in the mean average temperature in the central and northern regions and a decrease in the south (Figure 1a); increase in sea level (Figure 1b); and an increase in sea surface temperature throughout the country.[12] The World Bank analysis of total annual precipitation from 1969-1998 for Malé and Gan reported a decreasing trend of around 2.7 mm/year and 7.6 mm/year respectively. Further analysis of seasonal average precipitation at Malé found that the

[5] Ministry of Environment and Energy, 2016. State of the Environment
[6] Union of Concerned Scientists, 2018. The Science Connecting Extreme Weather to Climate Change. Available from: https://www.ucsusa.org/resources/science-connecting-extreme-weather-climate-change
[7] Ministry of Environment and Energy, 2015. Maldives' Intended Nationally Determined Contribution (INDC)
[8] Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCC.
[9] Ministry of Environment and Energy, 2011. State of the Environment
[10] UN-OHRLLS, 2015. Small Island Developing States in Numbers. Climate Change Edition 2015
[11] World Bank, 2017. Maldives Country Snapshot. Available from: http://documents.worldbank.org/curated/en/737921507887264006/pdf/120417-WP-PUBLIC-CountrySnapshotMaldives-Final-merged.pdf
[12] Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCC

decreasing trend is observed only during the southwest monsoon season, with no significant trend during the northeast monsoon.[13]

Figure 1. (a) Annual mean temperature from 1975 – 2012.[14] (b) Regional sea level anomaly for the Maldives from 1993 – 2012.[4]



Current and future vulnerabilities and impacts

Climate projections

Precipitation: Warming over South Asia is likely to cause an increase in intense monsoon precipitation and a decrease in total rainfall days. Flash-floods and strong winds associated with tropical Cyclones are predicted to increase.[15] Downscaled global climate projections predict an increase in rainfall over northern and central regions and a decrease over the southern region until 2050; followed by an increase in rainfall over all regions for the years 2082 – 2100.[16] (Figure 2a)

Temperature: Higher CO_2 concentrations are expected to result in an increase in temperature across all regions, with mean temperature increases of 1.8 °C from the baseline (1981 - 2000) for the time period 2021 – 2050.[17] (Figure 2b)

Sea level change: Local sea level records are insufficient to provide sea level projections. Global models predict an increase in sea level of 0.40 – 0.48 m by 2100.[18] Sea level rise is expected to increase the frequency of flooding events and make coastal erosion more prevalent.[19]

Sea surface temperature (SST): There is an increasing trend in SST throughout the country (0.11 – 0.15 °C/decade). SRES scenarios predict that SST will rise by 0.76 – 1.37 °C in the 2030s, compared with the mean annual SST for 1961 – 1990. The rise in SST is projected to be greater in the south of the country compared to in the north.[20]

Geographical, topographic and socioeconomic factors make the Maldives highly vulnerable to natural disasters and extreme climate events.[21] A review of disaster events occurring between 1988 and 2007 reported that "80% of all disaster events is climate related" and that such events account for "45% of deaths and 79% of economic losses".[22] The 2006 UNDP Disaster Risk Profile for Maldives identified cyclones/thunderstorms, floods, droughts, storm surges and strong winds and tornadoes as climate-related hazards. 90% of islands are reported to flood annually.[23] Floods due to rain are the most frequent natural events in the Maldives; however, swells and tidal waves also cause flooding, which can lead to extensive damage to critical infrastructure, saltwater intrusion to groundwater aquifers and loss of livelihoods, etc. Strong winds and associated rough seas can significantly disrupt sea and air transport.[24]

[13] World Bank, 2020. Climate Change Knowledge Portal – Maldives. Available from: https://climateknowledgeportal.worldbank.org/country/maldives/climate-data-historical
[14] Ibid.
[15] Christensen et al. 2007. Regional climate projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC. Cambridge University Press.
[16] Ibid.
[17] Ibid.
[18] Ibid.
[19] https://www.preventionweb.net/files/60595_maldivesstrategicnationalactionplan.pdf
[20] Ibid.
[21] UNDP, 2006. Developing a Disaster Risk Profile for Maldives. Available from: http://www.mv.undp.org/content/dam/maldives/docs/Environment%20and%20Energy/disaster%20risk%20profile.pdf
[22] Republic of the Maldives, 2009. Draft Strategic National Action Plan for Disaster Risk Reduction and Climate Change Adaptation 2010-2020
[23] DRR in Maldives – Status Report 2019
[24] Ibid.

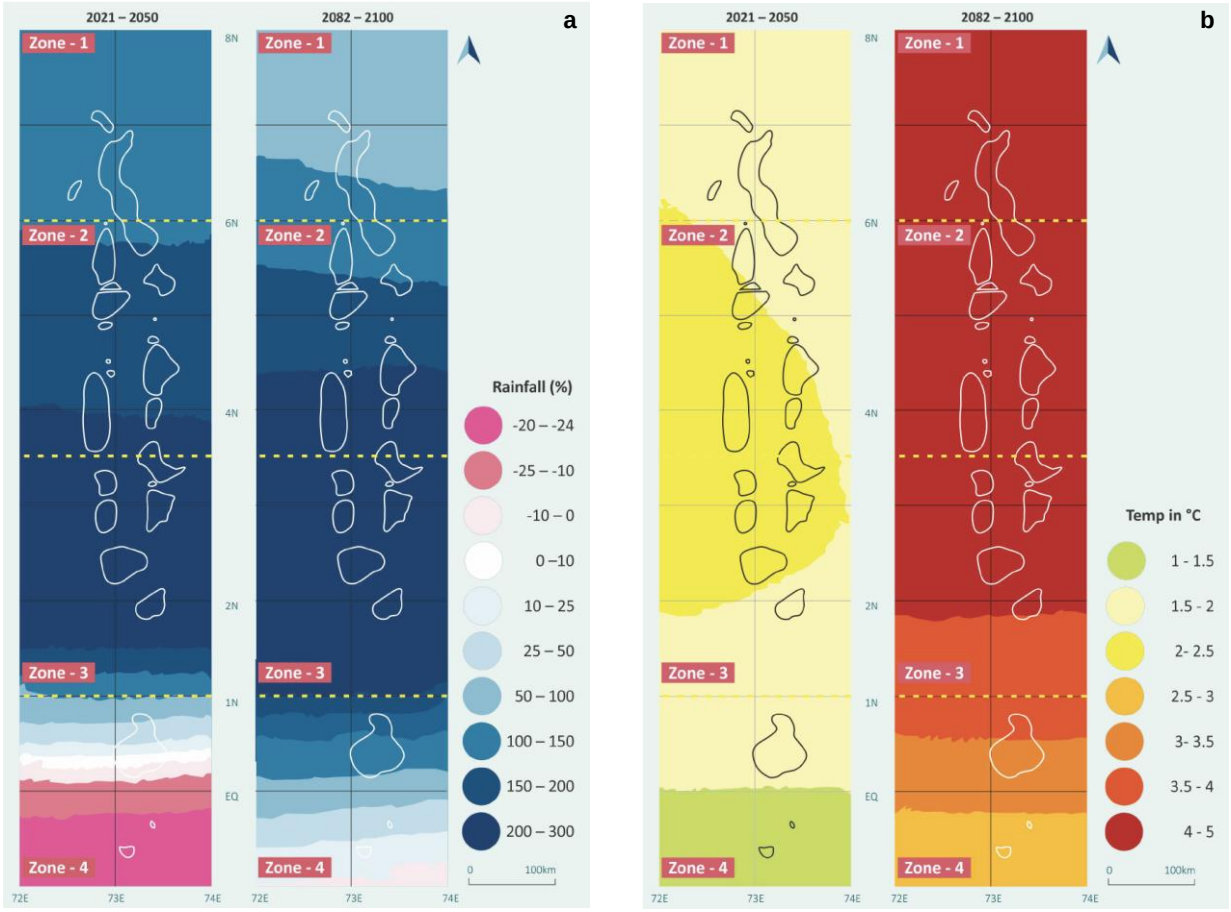


Figure 2. Changes in (a) monsoonal rainfall and (b) temperature from IPRC RegCM scenario for time slices (2021-2050) and (2082-2100) from baseline (1980-2000).[25]

Sector impacts

NAPA vulnerability assessments identified eight areas of vulnerability: land, beach and human settlements; critical infrastructure; water resources; coral reefs; agriculture and food security; human health; fisheries; and tourism.[26]

Given the small size of the islands, there is an inherent vulnerability to human development in the Maldives. Historically, **human settlements** were located near the coast due to their engagement with fishing; however, the expanding urban boundary is forcing the entire population to settle closer to the sea.[27] This includes the building of **critical infrastructure** (e.g. airports, roads, hospitals, communication infrastructure, etc.) close to the shoreline; for example, infrastructure of the four international airports are within 50 m of the coastline and more than 75% of communications infrastructure are within 100 m of the coastline.[28] Previous coastal hazard events (e.g. sea swells, storm surges and coastal inundation) have caused significant damage to critical infrastructures; one of the worst flooding events in 1987 cost an estimated USD 4.5 million in damages to the nation's only international airport.[29] The vulnerability and exposure level of all critical infrastructure was demonstrated during the 2004 Indian Ocean Tsunami; the transport sector was impacted with a loss of USD 20.3 million, whilst water, housing, health and education infrastructure had direct losses of USD 13.1, 64.8, 5.6 and 15.2 million respectively.[30, 31] Furthermore, poor land-use planning on the islands increases the vulnerability of coastal infrastructures.[32]

The predicted rise in temperatures, sea level and a possible decrease in rainfall would directly impact **freshwater resources**. For example, coastal inundation and associated saltwater intrusion would reduce fresh groundwater

[25] Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCC.
[26] Ministry of Environment, Energy and Water, 2006. National Adaptation Plan for Action
[27] Ibid.
[28] Ministry of Environment and Energy, 2015. Maldives Climate Change Policy Framework
[29] Ibid.
[30] World Bank – Asian Development Bank – UN System, 2005. Maldives Tsunami: Impact and Recovery. Joint Needs Assessment
[31] NAPA Project Priority 11, National Adaptation Program of Action, the Government of the Maldives, 2007
[32] Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCC.

availability.[33] The Maldives has very limited freshwater resources. [34] Water shortages are already a chronic problem, with islands running out of water between April and May. [35] Thus climate change is a significant concern to water security in Maldives.

The Maldives are highly reliant on **coral reefs**, both economically (through the tourism and fisheries industries) and as a natural defence to buffer beaches from wave action and other oceanic forces. Coral reefs are highly sensitive to increased sea temperature, which leads to increased bleaching and subsequent coral death. Loss of reef integrity will negatively impact the **tourism** and **fisheries** sectors, as well as reduce the ability of the Maldives to naturally protect itself against rising sea levels. [36, 37]

Agriculture is severely limited to due lack of cultivable land area (approximately 27 km^2 throughout the archipelago) and limited freshwater for irrigation. Consequently, the Maldives has a high import dependency (around 90% of food is imported[38]). **Food security** is thus threatened by climate change; both as a result of direct impacts on food production, and food transport disruption due to extreme climate events.[39]

High temperatures and extreme climate events are anticipated to have direct **health impacts** in the Maldives. As well as health impacts due to physical injury, the IPCC concluded that "heat-related mortality increases in countries with limited adaptive capacities and large exposed populations".[40] Indirect impacts include the increased prevalence of vector-borne diseases (dengue outbreaks are increased in frequency and appear to be associated with ENSO events) and water-borne diseases due to poor sanitation and groundwater contamination.[41]

The **tourism** sector is the single largest contributor to the Maldivian economy and accounts for over one third of GDP.[42] Major climate change impacts on the tourism industry include increasing temperatures, resulting in heat stress and increased prevalence of disease; sea level rise, resulting in loss of beach area and coastal infrastructure; increased frequency of extreme events, resulting in increased insurance costs; and increased SST, resulting in coral bleaching and marine resource degradation.[43]

Baseline climate information services and gaps

Agencies responsible for delivering climate services and EWS

Maldives Meteorological Service (MMS) - MMS is responsible for collecting, analysing and disseminating meteorological and seismic information to support sustainable socioeconomic development in the Maldives. MMS works with key government agencies to develop integrated policies and programmes for climate change adaptation and DRR by providing risk mapping, scenario building and modelling services. The MMS station at Hulhulé issues daily weather forecasts, aviation forecasts, weather warnings and marine forecasts. A tide gauge is installed for real-time tide monitoring, in collaboration with the University of Hawaii. [44]

National Disaster Management Authority (NDMA) - The NDMA is the main coordinating body for disaster management activities at the national level. It was established on 30 December 2018 by President Ibrahim Mohamed Solih as per the Disaster Management Act (2015). A key objective of NDMA is to "mainstream disaster risk reduction at the national level. This includes planning processes, establishing agreed standards, developing procedures and policies. This work is guided by the National Community-based Disaster Risk Reduction Framework." On its establishment, NDMA took on all staff, assets and ongoing work of the National Disaster Management Centre (NDMC). NDMC was established as a permanent institution in February 2006, with the mandate to "coordinate disaster response, relief, repair of damaged infrastructure and management of temporary shelters, and to formulate and implement disaster awareness programs".[45]

[33] Ibid.
[34] Ministry of Environment and Energy, 2015. Maldives' Intended Nationally Determined Contributions
[35] Maldives Independent, 2016. More than 20 islands already facing water shortages. Available from: https://maldivesindependent.com/environment/more-than-20-islands-already-facing-water-shortages-122792
[36] Ibid.
[37] Ibid.
[38] Shabau, I. 2006. Food fuel crisis and climate changes in the Maldives, A MMSll Island State Perspective. Ministry of Fisheries and Agriculture, Government of Maldives.
[39] Ibid.
[40] IPCC. 2007. Climate Change Synthesis Report.
[41] Ibid.
[42] Coface, 2019. Maldives – Major Macroeconomic Indicators. Available from: https://www.coface.com/Economic-Studies-and-Country-Risks/Maldives
[43] Ibid.
[44] http://www.meteorology.gov.mv/
[45] https://ndmc.gov.mv/about/

Environmental Protection Agency (EPA) - The EPA is a "regulatory entity, affiliated to the Ministry of Environment…EPA is responsible for regulatory activities for protection, conservation and management of environment and biodiversity, as well as waste management and pollution prevention".[46]

National Bureau of Statistics (NBS) - The NBS regularly collects and publishes socioeconomic statistical data for the Maldives. Plans are underway to integrate this data into the National Geographic Information System (NGIS).[47]

Methods of communicating early warning and climate information[48, 49, 50]

Maldives Meteorological Service (MMS) broadcasts daily weather and marine forecasts on radio, television and online. Standard Operating Procedures (SOPs) are applied to provide extreme weather warnings. MMS provides early warning information to NDMA and the Maldivian Coast Guard (MCG). NDMA issues online advisories with safety procedures that should be implemented by local councils.

In comparison to the substantial procedures and regional cooperation in place to respond to tsunami events, services to respond to climate hazard events are relatively lacking. For example, despite floods due to rain being the most frequent natural event in Maldives, no criteria exist to declare flood disasters.[51] NDMA faces the following challenges to delivering climate services and early warning:

- Alerts are not specific and measurable;
- Alerts are too technical to be easily understood by the public and NDMA staff;
- Insufficient training of staff in forecast translation;
- Lack of public awareness of climate hazards and early warning;
- Limited staff capacity;
- Lack of a fail-safe end-to-end EWS; and
- Lack of synergised SOPs between MMS and one or more stakeholders.

The Community-Based Disaster Risk Reduction (CBDRR) framework was introduced in 2005 to reduce local risks. Since its introduction, around 45 islands have strengthened their resilience against natural hazards in Maldives. CBDRR approaches are a cost-effective means of reducing local vulnerabilities however, successful implementation faces the following challenges:

- Limited participation from local communities (for example, due to overriding traditional or cultural beliefs; or lack of willingness to adapt to change);
- Insufficient budget to run CBDRR activities;
- Lack of specific institutions and legal arrangements to implement CBDRR programmes;
- Lack of support from island councils and local government to integrate CBDRR into island development plans; and
- Limited capacity to use scientific risk and warning information in island communities.[52,53]

Technical capabilities with respect to forecasting and modelling

Maldives Meteorological Service (MMS) uses numerical weather prediction (NWP) model products from the European Centre for Medium-Range Weather Forecasts (ECMWF), Regional Integrated Multi-Hazard Early Warning System (RIMES), products provided under WMO Severe Weather Forecast Demonstration Project (SWFDP-South Asia), Indian Meteorological Department (IMD) website, and Indian National Centre for Ocean Information Services (INCOIS), etc. The main applications of NWP products are weather forecasting and nowcasting. Satellite-based products include satellite pictures for identification of cloud type and coverage; ASCAT winds for monitoring and forecasting sea state; TRMM data download and plot using GrADS for forecast verification.[54]

[46] http://en.epa.gov.mv/
[47] http://statisticMMSldives.gov.mv/
[48] https://www.wmo.int/pages/prog/amp/pwsp/documents/ReportStakehloderWorkshopMaldivesFinal.pdf
[49] https://www.jma.go.jp/jma/en/Activities/RIC_Workshop_2013/documents/pre/04.%20presentation%20(Maldives).pdf
[50] https://www.wmo.int/pages/prog/amp/pwsp/linkedfiles/EarlyWarningChallengesNDMC.pptx
[51] Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCCC
[52] Shadiya, F. 2018. Maldives National University. The Current Context of Multi-Hazard Early Warning Systems (MHEWS) for Coastal Resilience at National Level. Available from: http://cabaret.buildresilience.org/images/NPP-Maldives.pdf
[53] Republic of the Maldives, 2009. Draft Strategic National Action Plan for Disaster Risk Reduction and Climate Change Adaptation 2010-2020.
[54] Maldives Meteorological Service, 2018. Country Report – Maldives. Available from: https://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/documents/joint_meeting_program_presentation/CountryReport/Maldives.pdf

The 2006 Disaster Risk Profile of Maldives aims to provide a "comprehensive risk analysis of Maldives with description of various hazards, vulnerabilities and potential damage and loss scenarios".[55] In 2007, this study was complemented by multi-hazard assessments, known as "Detailed Island Risk Assessments".[56] The assessments included climate vulnerability assessments and comprehensive coverage of hazards to Maldives. However, the data is now out-of-date and may not represent the current situation of the islands; particularly due to rapid and large-scale development projects, which can wipe out significant proportions of natural barriers. New multi-hazard assessments need to be conducted; however, this is challenging due to limited human capacity; geographic isolation of the islands; and lack of available funding.[57] MMS acknowledges the benefits and need for impact-based forecasting; however, one of the key barriers to implementation is lack of detailed exposure and vulnerability information.[58] Furthermore, no proper mechanism exists to collect and record data on flooding and drought events. Hence, MMS cannot accurately determine the frequency or track trends in floods, droughts or prolonged dry periods.[59]

Infrastructure facilities for climate change research and observation in Maldives

The **Maldives Meteorological Service (MMS)** measures seismological and meteorological data. There are approximately 40 years of records on rainfall, wind speeds and direction, and temperature for two locations: Addu City and Malé.[60] In addition, there are about 25 years of records on tide levels. An overview of the Maldives observation network is provided in Table 1. In addition, the meteorological observatory on the international airport island of Hulhulé receives high-resolution satellite imagery at 30-minute intervals from the geostationary meteorological satellite FY-2E. In the event of an earthquake, Seiscomp3 software is used to locate and calculate the epicentre, magnitude and other parameters. Seiscomp3 communicates via satellite link to Jakarta, Indonesia, and also receives information from U.S. Geological Survey and JMA.[61]

Table 1: Overview of the Maldives observation network.[62, 63, 64]

Monitoring Stations	**Number *(Location)***
Meteorological Stations	5
Automatic Weather Stations (AWS)	36
Rainfall Observation Stations	2
Upper Air Observation Radiosonde	1 *(South)*
Doppler Weather Radar	1 *(Central)*
Tide gauge	3 *(North, Central, South)*
Seismological stations	2 *(North and South - Kaadedhdhoo and Hanimaadhoo)*
Ocean Monitoring Buoy	1 *(South – Addu City)*
Annual Coral reef monitoring stations (MEMP)	15 (20)

Maldives Climate Observatory Hanimadhoo (MCOH)[65] was established in 2004 and is operated through the joint collaboration of the Government of the Maldives, UNEP[66], and an international group of scientists led by Prof. Ramanathan (Scripps Institution of Oceanography, University of California). MCOH provides atmospheric composition

[55] http://www.mv.undp.org/content/dam/maldives/docs/Environment%20and%20Energy/disaster%20risk%20profile.pdf
[56] https://ndmc.gov.mv/assets/Uploads/DIRAM-Vol2-Methodological-Framework-V2.pdf
[57] Shadiya, F. 2018. The Current Context of Multi-Hazard Early Warning Systems (MHEWS) for Coastal Resilience at National Level in Maldives. Available from: http://cabaret.buildresilience.org/images/NPP-Maldives.pdf
[58] https://www.wmo.int/pages/prog/amp/pwsp/linkedfiles/IntroductiontoIBFDay1HK.pptx
[59] Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCCC.
[60] Ibid.
[61] https://www.jma.go.jp/jma/en/Activities/RIC_Workshop_2013/documents/pre/04.%20presentation%20(Maldives).pdf
[62] WMO, 2016. Stakeholders Workshop to initiate the implementation of impact-based forecasting and risk-based warnings. Available from: https://www.wmo.int/pages/prog/amp/pwsp/documents/26SpetMMSimpactwrokshop.pdf
[63] Ibid.
[64] Maldives Meteorological Service, 2017. The 5th Meeting of the Coordinating Group of the RA II WIGOS Satellite Project – MMS Presentation. Available from: https://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/documents/5th_meeting_program_presentation/CountryReport/Maldives.pdf
[65] Ministry of Environment and Energy, 2017. Pemphis – Environmental Newsletter. Available from: http://www.environment.gov.mv/v2/wp-content/files/pemphis/20170611-pemphis-57-jun2017.pdf
[66] MCOH was established in support of the Atmospheric Brown Cloud (ABC) Project, which was initiated by UNEP. Project Proposal document: https://pdfs.semanticscholar.org/d050/b208e52339b74139353cf402e06a77570d3d.pdf

measurements for the Indian Ocean, which is a receptor site for long range transport of pollutants (the atmospheric brown cloud) from South Asia, the Middle East and Africa.

National Geographic Information System (NGIS) was established under the Maldives Environmental Management Project (MEMP) and work is under way to populate the system with data. The initiative aims to strengthen the capacity for environmental management in the Maldives[67] through the development of policies and procedures, procurement of technical infrastructure, and human resource capacity development for effective implementation of the NGIS.

National Coral Reef Monitoring Program (NCRMP)[68] was initiated following the mass coral bleaching event in 1998 in order to monitor coral reef recovery and aid in future coral reef management efforts. The program systematically monitors 15 sites across the Maldives. The National Coral Reef Monitoring Framework was later established and is supported by a web-enabled coral database[69], which reports data from more than 32 organisations.

Limited availability and quality of data is a major barrier to provision of climate services. Key constraints include lack of infrastructure and/or institutional arrangements for data collection, analysis and management; inconsistent data formats; and lack of means for data quality control.[70] Lack of data has negative knock-on effects for climate modelling and forecasting capacity. An assessment of EWS in the Maldives recommended the following additions to infrastructural capacity: two tidal gauges at Kaddhoo (central) and Kaadedhdhoo (south) to monitor tide variations in the southern region; wave monitoring systems in the northern, central and southern regions to evaluate sea conditions during rough weather conditions; additional GPS buoy systems (e.g. in the northern region) to monitor wave time variations, water levels and tsunamis.[71] Furthermore, MMS lacks trained staff in multiple areas including system software, forecasting, observation, calibration and O&M.[72]

Problem statement

The small size, low elevation and heavy dependence on natural resources for its social and economic security make the Maldives highly vulnerable to climate change impacts and climate-related hazards.[73] The country's vulnerability is further exacerbated by extremely high population density and high rates of development,[74] which are rapidly modifying protective natural barriers, such as coastal vegetation and coral reefs. Floods, droughts, cyclones/thunderstorms, storm surges, strong winds and tornadoes have all been identified as climate-related hazards to the Maldives. Extreme climate events are increasing in frequency and/or intensity as a result of climate change.[75] Such events have significant impacts on multiple sectors including human settlements, critical infrastructure, tourism, fisheries, human health, water resources, agriculture and food security.[76]

The Government of Maldives acknowledges that "climate change not only poses a development challenge, but an existential threat"[77] and as such, it is making continuous efforts to strengthen adaptive capacity. However, limited financial resources, capacity, technology and adequate institutional structures constitute major challenges to providing comprehensive climate information services and impact-based multi-hazard early warning systems (MHEWS) across the entire country. These constraints include gaps in geographical coverage and insufficient capacity of observation and monitoring equipment; lack of institutional and individual capacity to productively use climate information and respond to climate-related hazards; weak coordination between institutions responsible for delivering climate services; and communication break-down between providers of climate information and vulnerable end-users. The vulnerabilities and challenges outlined above impede the Maldives from effectively safeguarding its population and assets from climate-related hazards and extreme climate events.

Root causes and barriers[78]

The main barriers to the provision of comprehensive climate information services and impact based MHEWS by Maldives is a result of compounding financial, technological, institutional and capacity-related factors related to its specific situation as a Small Island Developing State (SIDS), including:

[67] http://www.asprs.org/wp-content/uploads/2013/08/Shafee.pdf
[68] https://www.mrc.gov.mv/en/programmes-and-collaborations/coral-reef-research-programme/
[69] https://coraldatabase.gov.mv/
[70] Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCC.
[71] https://www.preventionweb.net/files/14228_14228AssessmentofEWSinMaldivesfinal.pdf
[72] MMS Country Report 2013
[73] http://www.environment.gov.mv/v2/download/210/
[74] Shadiya, F. 2018. Maldives National University. The Current Context of Multi-Hazard Early Warning Systems (MHEWS) for Coastal Resilience at National Level. Available from: http://cabaret.buildresilience.org/images/NPP-Maldives.pdf
[75] https://www.ucsusa.org/our-work/global-warming/science-and-impacts/climate-attribution-science
[76] Ministry of Environment, Energy and Water, 2006. National Adaptation Plan for Action
[77] Ibid.
[78] Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCC

- Insufficient institutional, legislative and regulatory frameworks for climate services (e.g. clarification of the mandates, roles and responsibilities of relevant government agencies and partners; and legislation ensuring adequate budget allocation);
- Limited climatological measurements due to insufficient capacity and inadequate resources [79] for hydrometeorological observations and monitoring (including lack of necessary infrastructure for data collection; lack of trained MMS staff;[80] lack of appropriate methods for data collection and analysis) resulting in a lack of high-quality data for climate modelling and forecasting;
- Limited awareness, knowledge and understanding of climate information and its applications (e.g. lack of information and technical knowledge to integrate climate change factors into planning; [81] communication breakdown between climate service providers, stakeholders and end-users; and lack of higher education in meteorology and disaster management[82]); and
- Limited capacity to implement climate change adaptation and disaster risk reduction strategies at community level (e.g. limited funding available for community-based disaster risk reduction programmes; lack of engagement and participation of communities in climate adaptation planning and implementation processes).[83]

Proposed solutions

The proposed GCF project will support the Government of Maldives in strengthening the Maldives Meteorological Service (MMS) for the provision of enhanced climate information services and the establishment of an impact-based multi-hazard early warning system (MHEWS). This will significantly enhance the resilience and improve the livelihood of the vulnerable island populations. The project also aims to improve awareness of climate risks and climate hazard events; and facilitate enhanced capacity to prepare for and respond to climate risks at the community and national levels, thereby contributing to improved well-being, public health and socio-economic security.

The project will be achieved through the following components:

- **Strengthening of Climate Services and MHEWS** through the establishment of an inter-ministerial and multi-stakeholder coordination platform for climate services and early warning; development of a national policy and financial framework for comprehensive climate services; enhancement of data collection and management including establishment of a user interface platform.
- **Modernising of the Maldives Meteorological Service (MMS)** through an expanded and upgraded hydrometeorological observation and monitoring network with expanded coverage of islands and ocean areas and strengthened climate modelling and impact-based forecasting capacity to inform a range of sectors (including tourism, fisheries, agriculture, etc.).
- **Establishment of an impact-based multi-hazard early warning system (MHEWS)** including coordinated protocols and enhanced capacity for dissemination and communication of climate risk information and early warning messages; establishment of a web-based portal/decision support system (DSS) for climate-sensitive sectors; enhanced public awareness of climate risks and training of users on the use of climate information.
- **Enhanced climate risk management capacities at "the last mile"** through outreach and awareness raising activities; and implementation of community-based early warning schemes and community-based disaster risk reduction (CBDRR) approaches to promote adaptive livelihood strategies.

Through coordinated, inclusive and productive participation between MMS and relevant stakeholders, this project has the opportunity to meet the needs of all climate-sensitive sectors and communities in the Maldives, including the most vulnerable groups such as women, children, elderly and disabled people.

Contribution to national needs and priorities

GCF Readiness Support for NDA Strengthening and Country Programming (2017-present)

[79] Ministry of Environment and Energy, 2015. Maldives' Intended Nationally Determined Contribution (INDC)
[80] MMS Country Report 2013
[81] Republic of the Maldives, 2009. Draft Strategic National Action Plan for Disaster Risk Reduction and Climate Change Adaptation 2010-2020
[82] Shadiya, F. 2018. Maldives National University. The Current Context of Multi-Hazard Early Warning Systems (MHEWS) for Coastal Resilience at National Level. Available from: http://cabaret.buildresilience.org/images/NPP-Maldives.pdf
[83] Ibid.

The ongoing GCF Readiness project in Maldives, which was approved in July 2017, identified "*Enhancing weather and climate monitoring in the Maldives and developing human resource capacity at Maldives Meteorological Service*" as a priority project for Maldives.

National Climate Change Policy Framework (NCCPF), 2015

The NCCPF is an essential policy document that recognises climate change as a central player in sustainable development. The framework was developed by the Ministry of Environment and Energy through extensive consultation with representatives of the general public, government institutions, the private sector, non-governmental organisations and other relevant stakeholders. Implementation of NCCPF is intended to be a "major step towards adapting and mitigating the current and future effects of climate change." [84]

Disaster Management Act, 2015[85]

The Disaster Management Act refers to the "responsibility of the State to protect its people, their health and well-being, their property, and the natural and built-up environment they live in from natural and man-made disasters, and hazards."

Maldives' Intended Nationally Determined Contribution (INDC), 2015

The INDC recognises the need for Maldives to build capacity to ensure a sustainable and climate-resilient future. Maldives places significant priority on adaptation actions, including those related to "Early warning and Systematic Observation" as follows:

- "Expand and strengthen the meteorological network and weather related early warning system to cover all the communities of the Maldives.
- Improve climate forecasting using climate modelling to provide information to support decision making sectors affected by weather and climate variability.
- Develop appropriate early warning systems and risk management tools."[86]

National Climate Change Research Strategy (NCCRS), 2012

NCCRS was established in 2012 with support from the Least Developed Countries Fund (LDCF). The NCCRS focuses on building knowledge, enabling research and linking decision makers and facilitating change. The Strategy highlighted that most relevant research undertaken so far focuses on climate science, with a limited number of studies on geological and geomorphological aspects, and coral reef monitoring. Studies focusing on socioeconomic impacts, adaptation and mitigation are severely limited.[87]

Maldives: Strategic National Action Plan (SNAP) for DRR and Climate Change Adaptation, 2009

The Maldives SNAP process was established in 2009 with the assistance of UNDRR (formerly UNISDR) to undertake the development of a Strategic National Action Plan for Disaster Risk Reduction and Climate Change Adaptation. SNAP aims to "build resilience of the nation and the island communities to disasters by sustaining progress made, by consolidating learned best practices, and by incorporating risk reduction into the strategy for decentralization. Harmonized with the policies, plans, and sustainable development strategy, it will identify a consolidated set of programs/projects that can be undertaken with the Government budget and those that may be considered for donor assistance." The SNAP emphasises the need to develop a comprehensive risk management approach for synergy between climate change adaptation and disaster risk reduction actions, ensuring that both are incorporated as "core policy and programmatic objectives in national development plans".[88]

Maldives National Strategy for Sustainable Development (NSDS), 2009

The NSDS sets out an approach for improved policy making through identification of national sustainable development goals that may be integrated into policies and strategic measures for climate change adaptation and disaster risk reduction.[89]

[84] Ministry of Environment and Energy, 2015. Maldives Climate Change Policy Framework
[85] National Disaster Management Authority, 2015. Disaster Management Act
[86] Ministry of Environment and Energy, 2015. Maldives' Intended Nationally Determined Contributions.
[87] Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCC
[88] Republic of the Maldives, 2009. Draft Strategic National Action Plan for Disaster Risk Reduction and Climate Change Adaptation 2010-2020
[89] Ibid.

Third National Environment Action Plan (NEAP-3), 2009

NEAP-3 sets out the agenda for environmental protection and management in the Maldives for the five-year period 2009 – 2013 by providing the basis for environmental planning, budgeting, performance measurement and accountability. Successful implementation of NEAP-3 was expected to achieve resilient islands, rich ecosystems, healthy communities, safe water, environmental stewardship, and a carbon-neutral nation.[90]

National Adaptation Program of Action (NAPA), 2007

The NAPA was prepared with support from the Global Environmental Facility (GEF) and United Nations Development Program (UNDP). The goal of the NAPA is to establish a framework for climate change adaptation that enhances the resilience of the natural, human and social systems and ensures their sustainability in response to the predicted climate hazards.[91]

National Community Based Disaster Risk Reduction (CBDRR) Framework, 2005

The CBDRR aims to actively engage vulnerable communities in the "identification, analysis, treatment, monitoring and evaluation of disaster risks…to reduce their vulnerabilities and enhance their capacities to prevent and withstand damaging effects of hazards".[92] The CBDRR framework is a very effective, low cost approach to reduce local risks. However, successful implementation of CBDRR across the country is limited for a number of reasons including lack of specific institutions and legal arrangements; very limited technical capacity to support projects; lack of budget to run CBDRR activities; and lack of full participation from local communities.[93]

Furthermore, the project is fully aligned with the Sustainable Development Goals (SDGs), the Paris Agreement, the SAMOA pathway and the Sendai Framework:

- SDG 13 on urgent action to combat climate change and its impacts and related target 13.1 to "*Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries*", which is the focus of this project.
- The Paris Agreement, which in Article 7, Sub-paragraph 7(c) calls for "*strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making*".
- The SAMOA pathway adopted by the Third International Conference on Small Island Developing States 2014 contains a comprehensive set of priorities for addressing the unique vulnerabilities of SIDS.[94] This project will address the needs highlighted in the SAMOA pathway for: *technical assistance for early warning systems; risk assessment and data; observation equipment; disaster risk management; data sharing and networking to strengthen and enable beneficial and durable national, sub-regional, regional and global cooperation; improved baseline monitoring of island systems; and strengthened capacity for acquiring and managing climate data/information to raise awareness and share environmental data to increase resilience to the impacts of climate change.* Resolution A/74/L.3 on the High-Level Midterm Review of the SAMOA Pathway was adopted by the UN General Assembly in October 2019.[95] Paragraph 31 (i); specially requests: "[T]he United Nations Environment Programme to further strengthen support to small island developing States, including through dedicated programmes".
- The Sendai Framework for Disaster Risk Reduction 2015–2030, which in paragraph 33 b) stresses that it is important "*To invest in, develop, maintain and strengthen people-centred multi-hazard, multisectoral forecasting and early warning systems, disaster risk and emergency communications mechanisms, social technologies and hazard-monitoring telecommunications systems; develop such systems through a participatory process; tailor them to the needs of users, including social and cultural requirements, in particular gender; promote the application of simple and low-cost early warning equipment and facilities; and broaden release channels for natural disaster early warning information*". Furthermore, the Sendai Framework's Seven Global Targets calls for efforts to "*substantially increase the availability and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030*."

[90] Ministry of Housing, Transport and Environment, 2009. Third National Environment Action Plan
[91] Ministry of Environment, Energy and Water, 2006. National Adaptation Plan for Action
[92] National Disaster Management Centre, 2014. National Community Based Disaster Risk Reduction Framework. Available from: http://ndmc.gov.mv/assets/Uploads/National-CBDRR-Framework.pdf
[93] Shadiya, F. 2018. Maldives National University. The Current Context of Multi-Hazard Early Warning Systems (MHEWS) for Coastal Resilience at National Level. Available from: http://cabaret.buildresilience.org/images/NPP-Maldives.pdf
[94] https://sustainabledevelopment.un.org/samoapathway.html
[95] United Nations, 2019. A/74/L.3

The main institutions involved in implementing the global frameworks in the Maldives are the National Disaster Management Authority, Maldives Meteorological Service, Environment Ministry, Tourism Ministry and Local Government Authority. The biggest challenge to implementation is lack of coordination between the institutions. Furthermore, although multiple strategic documents exist, lack of monitoring frameworks and evaluation procedures make it difficult to assess if climate change projects are being targeted to the most vulnerable islands.[96]

B.2. Project/Programme description (max. 3 pages)

In response to the vulnerabilities, challenges and climate change impacts outlined in the previous section, the Project aims to effect a paradigm shift away from the current "business as usual", characterised by lack of awareness, understanding and poorly coordinated use of inadequate climate data and risk information, towards a new paradigm of *evidence-based preparedness, response actions and decision making to climate risks*. The transformative **Impact** of the Project will be ***increased resilience, risk awareness and enhanced livelihoods of communities in Maldives to climate hazards and extreme climate events*** through i) reduced expected losses of lives and economic assets due to the impact of extreme climate-related disasters and ii) an increase in the number of males and females benefiting from the adoption of diversified, climate-resilient livelihoods. The Theory of Change (Annex 1) diagram shows how the Project interventions will lead to the short-term Outputs and longer-term project Components, which in turn will contribute to achieving the selected GCF fund-level Outcomes, the Intermediate States and ultimately the Impact.

The transformative impact of the Project will be achieved through strengthened climate services and establishment of an impact-based multi-hazard early warning system (MHEWS) according to WMO and UNDRR standards, using the Global Framework for Climate Services (GFCS) as the overarching framework. The proposed Project will strengthen the National Framework for Climate Services (NFCS); modernise Maldives Meteorological Services (MMS); enhance dissemination and communication of multi-hazard climate risk information and early warning; and enhance climate risk management capacities at "the last mile". This will include the following interventions:

Component 1: Strengthened climate information services supported by institutions, coordination, financial frameworks and enhanced risk knowledge

Output 1.1 – National Framework for Climate Services based on the Global Framework for Climate Services (GFCS)

- **Institutional strengthening of the Maldives Meteorological Service (MMS)**, including through harmonisation of standard operating procedures (SOPs) to develop synergised SOPs involving MMS and one or more stakeholders; establishment of a Quality Management System (QMS) with the aim of attaining WMO quality management certification by the end of the project; and establishment of a resource management framework to determine how monitoring, evaluation and learning will be tracked and managed.
- **Implementation of a comprehensive programme for increasing and strengthening the human resource capacity of the MMS** to enhance technical capacity for data collection, analysis and research in relevant scientific areas such as climatology and oceanography.
- **Enhancement of the capability and capacity of MMS for providing coherent climate services through the strengthening of strategic partnerships** with regional and international institutions. For example, enhanced operational linkage with the Regional Integrated Multi-Hazard Early Warning System (RIMES) and Global Disaster Alerting Coordination System (GDACS) to incorporate new technologies, methodologies and practices for climate applications and adaptation; and South-South cooperation with Hydro-meteorological services in other countries.
- **Establishment of an inter-ministerial, multi-stakeholder coordination mechanism** for climate services and early warning to inform and support policy and decision-makers in different sectors to coordinate and use climate information and services and facilitate the unblocking of barriers to uptake and investments in climate information and early warning services.
- **Establishment of a User Interface Platform for climate information** to strengthen interactions between the MMS (as producers) and the users of climate services to co-design and co-produce user-driven products and services for sectors such as fisheries, health, disaster management, tourism and others, and downscaled information products for communities taking into account gender and age dimensions. Through the use of decision support systems (DSSs), it will also strengthen the capacity of users to apply climate information in evidence-based decision making and livelihood strategies in ways that will enable them to derive maximum

[96] Transparency Maldives, 2013. An Assessment of Climate Finance Governance

benefits and impacts including through adaptation actions across sectors such as agriculture, water resources, and health.

- **Establishment of a financial framework and long-term business model**, including a procurement management plan, outlining a value-chain and linkages approach to climate services delivery; investment mechanisms and decision support tools on how to access and integrate different sources of investment; a strategic partnerships management plan to enhance cooperation between the public and private sectors; and establishment of a climate applications support mechanism with appropriate financial instruments to sustain climate applications.

Output 1.2 – Enhanced data collection and management, risk assessment and hazard mapping

- **Enhanced data collection and archiving capacity** to facilitate the identification and analysis of significant climate-related hazards (such as swell waves, thunderstorms and high winds etc.) for the preparation of dynamic multi-hazard maps with identified evacuation shelters/sites. Criteria for classification of hazard events will also be harmonised.
- **Establishment of institutional arrangements for data sharing** among stakeholders with understanding of the provision of mutual benefits. For example, strengthening of the Monsoon Forum to facilitate more meaningful stakeholder involvement in the provision and uptake of climate services and applications in capacity development.
- **Systematic GIS mapping and vulnerability data collection** through partnership with the Maldives Land Survey Department and the National Disaster Management Authority (NDMA).
- **Integration of vulnerability data** into hazard mapping, local risk management plans (including a specific plan for special-needs populations) and the MHEWS.
- **Establishment of a common process to present climate information at the national level**, drawing on existing national assessments and other research material.[97] This clear and transparent information sharing about climate impacts will underpin effective adaptation, support capacity development in government entities and scientific and educational communities, and assist Maldives in complying with their regional and international reporting obligations on climate-related agreements and frameworks.

Component 2: Modernisation of the Maldives Meteorological Service (MMS) for enhanced observations, monitoring, modelling and impact-based forecasting

Output 2.1 – Expanded and upgraded hydrometeorological observation network and monitoring capacity

- **Enhancement of the Maldives' hydrometeorological observation and monitoring network** as part of the National Framework for Climate Services (see Output 1.1) using innovative and cost-effective technologies. This will include development of a strategy and sustainability plan for Operations and Maintenance (O&M) and enhancement in capacity of existing infrastructure (e.g. installation of an uninterruptable power supply for continuity of operations; upgrade of computing power; system upgrade for real-time data collection, display and processing; upgrade of NWP/LAM including higher resolution and data assimilation).
- **Establishment of an Internet of Things (IoT)**, wireless communications and data analytics infrastructure as part of the observation networks and operational forecasting systems.
- **Establishment of an ocean observation and monitoring system** for sea surface temperature (SST), current, wind speed and direction, and wave and swell height, direction, and period, including chlorophyll content, to generate data for improving ocean state and fishery forecasting. This will involve deployment of wave rider buoys, voluntary observing vessels, development of a data acquisition and management system, and O&M training.
- **Implementation of a robust programme of MMS staff training**, capacity building and modernisation of the MMS organisational structure to fit new processes and improved human/social infrastructure.

Output 2.2 – Strengthened climate modelling and impact-based forecasting

- **Establishment of a fully integrated observing and high-resolution forecasting system**. This will include the development of a database to catalogue climate events using hazard/impact matrices and vulnerability information to initiate a system for cataloguing hazards and impacts through (via consultation with WMO/DRR).

[97] The Country Level Impacts of Climate Change (CLICC) project is piloting a common process for countries to present the impacts of climate change at the national level that could be useful.

- **Enhancement of downscaled climate modelling, long-lead weather forecasting and high-resolution ocean state and fishery forecasting** through model development, data assimilation, GIS-based data visualisation platform development, sector-specific decision-support tool development, system (model and tool) transfer and development of SOPs.
- **Development of impact-based monitoring tools, capabilities and networks** to verify impact-based forecasts and warnings, including systematic evaluation of significant climate hazard events and establishment of an interactive feedback mechanism with stakeholders to analyse the efficacy of impact-based forecasts and consequences for the end-user.

Component 3: Enhanced dissemination and communication of multi-hazard climate risk information and early warning

Output 3.1 – Dissemination and communication of climate risk information and early warning messages

- **Development and implementation of coordinated and integrated protocols and associated capacity to communicate timely risk information, early warning alerts and early action messages across the islands.** This will include the development of emergency information and communication protocols and infrastructure, use of SMS, social media and other channels, interactive feedback loops between the MMS, institutional users and end-users and establishing partnerships with the private sector to expand information dissemination channels and feedback mechanisms (e.g., SMS, mobile app). Local governments and civil society organisations will play a key role in the dissemination of climate data and information, and alerts to the communities.
- **Establishment of a web-based portal/decision support system (DSS) displaying real-time multi-hazard information with exposure and vulnerability data**. The system will include the capability of encoding information in Common Alert Protocol (CAP) format to enable the exchange of multi-hazard emergency alerts and public warnings over multiple types of networks. The integration with weather forecast development and dissemination systems will support the seamless integration of forecasting and warning processes.
- **Development and implementation of sector-specific communication plans and products** for MHEWS in fisheries, agriculture, water, tourism, sea transport, health and disaster management services amongst others.
- **Enhancement of MMS capacity in the co-generation and dissemination of high-resolution ocean state forecasts and advisories**, relevant for fishery, navigation, tourism, disaster management, and marine environment sectors.
- **Co-production of sector-specific advisories for the dissemination of downscaled climate outlook and long-lead weather forecasts** to inform planning and decision making in climate-sensitive sectors (e.g. to inform rainwater harvesting, aid crop planning and management, enhance public health surveillance, manage disaster risks, etc.)
- **Co-production of sector-specific advisories for the dissemination of high-resolution ocean state forecasts** and location-specific potential fishing zone advisories relevant for fishery, navigation, tourism, disaster management and marine environment sectors.

Output 3.2 – Knowledge management, awareness raising and education on climate risks

- **Enhancement of the National Climate Outlook Forum (NCOF)** as a platform for providing climate information at relevant timescales through a regular and sustained multi-stakeholder dialogue process between MMS and users at the national and local levels. This will further downscale the Regional Climate Outlook Forums (RCOF) and the seasonal/monsoon forums convened by RIMES, in which Maldives participates.
- **Development of Information, Education and Communications (IEC) materials** on climate risks and services and dissemination through all means (door-to-door, social media, print media, TV, radio, etc.).
- **Enhancement of public awareness of climate risks** through inter-agency and multisectoral collaboration in training and information dissemination via workshops, seminars, advocacy campaigns and incorporation of climate change and disaster risk reduction (DRR)-related topics into the school curricula. Strengthened partnerships between MMS and Higher Education Institutes and regional institutions focusing on disaster management research will be critical in this endeavour.[98]
- **Conduct training of users at national, sub-national and local levels on the use of climate information** (historical, trends, new generation forecast products, and projections) in sectoral planning and decision making,

[98] Shadiya, F. 2018. Maldives National University. The Current Context of Multi-Hazard Early Warning Systems (MHEWS) for Coastal Resilience at National Level. Available from: http://cabaret.buildresilience.org/images/NPP-Maldives.pdf

including the design of facilities. This will include training on translation of forecasts into potential impacts; tailored impact management advisories for responding to climate hazard warnings; and engagement with end-users to validate understanding and establish protocols/mechanisms to support end-users and facilitate sustained climate application uptake.

Component 4: Enhanced climate risk management capacities at the last mile

Output 4.1 – Community-based tools, instruments and strategies to prepare for and respond to climate risks and hazards

- **Strengthening of community capacity to implement mitigation and preparedness actions in the window between a forecast and the potential event**. This would include outreach and awareness raising activities, the establishment of an enabling environment for early action, access to and understanding of hazard risk maps and evacuation procedures.
- **Development and implementation of Forecast-based Financing (FbF)** as an innovative mechanism whereby early actions are pre-planned based on in-depth forecast information and risk analysis, and are funded and implemented before a climate shock to minimise climate-related losses and damages and the need for humanitarian assistance in the aftermath of climate-related disasters.[99]
- **Implementation of community-based early warning schemes and community-based disaster risk reduction (CBDRR) approaches** at the local level through engagement with civil society and community organisations to participate in CBDRR projects in collaboration with government institutions[100] considering the needs of women, children, disabled people and other vulnerable groups and learning lessons for upscaling and replicability. The selected communities will be at relatively high risk, have short lead times for extreme events, have technical constraints for the national systems to effectively service them (e.g. due to their remote locations).
- **Engagement and training of selected communities in the design, implementation and operation of early warning systems and centres**, including enhancing their understanding of their climate-related hazards and exposure, establishing an impact-based monitoring and warning service, integrating traditional knowledge, establishing appropriate dissemination and communication channels and building community response capabilities to secure their lives, assets and livelihoods during climate-related hazards.
- **Promotion of adaptive livelihood strategies amongst communities vulnerable to climate hazards**, including through sustaining water availability and enhancement of water resource storage capacity, and enhancement of food security through increased food storage capacity and development of a management plan for distribution of staple foods during climate hazard events.

Project Governance and Implementation Arrangements

At the request of the Government of Maldives, UN Environment Programme (UNEP) will serve as the Accredited Entity for the project. As per its GCF Entity Work Programme, UNEP offers more than 20 years of experience working on climate change. It brings a comprehensive approach to climate change mitigation and adaptation that is grounded in both natural and economic science and is tied to the environmental and development concerns of countries. UNEP has longstanding expertise in environmental and climate change information management and early warning as well as the implementation of projects that promote adaptation to climate change at global, regional and national levels. Through the implementation of these projects, UNEP develops innovative solutions for national governments and local communities to adapt to the current and predicted effects of climate change in an environmentally sound manner. This experience is globally recognised and includes community-based and natural resource management projects. The agency will draw upon this experience during the implementation of the project.

Key national entities for implementing specific project outputs and activities for this project will include:

- Maldives Meteorological Service (MMS)
- National Disaster Management Authority (NDMA)
- Ministry of Fisheries and Agriculture
- Ministry of Environment
- Ministry of Health

[99] WFP, 2019. Forecast-based Financing Factsheet
[100] http://cabaret.buildresilience.org/images/NPP-Maldives.pdf

- Ministry of Transport and Civil Aviation
- Ministry of Tourism
- Ministry of Education

Technical Assistance Providers:

- World Meteorological Organisation (WMO)
- Regional Integrated Multi-Hazard Early Warning System (RIMES)
- Others TBC

A Project Steering Committee (PSC) will be established comprising the NDA, key stakeholders from the Government of Maldives and community representatives. The mandate of the PSC will include i) overseeing project implementation; and ii) reviewing annual workplans and project reports. The PSC will meet at least twice a year – with *ad hoc* meetings held as and when necessary – to discuss the project's performance indicators and provide strategic guidance.

The PSC will be supported by the Project Management Unit (PMU), which will coordinate activities between the Accredited Entity (UNEP), Executing Entity/ies (TBC) and other relevant national entities and Technical Assistance Providers to oversee the implementation of the project's activities.

B.3. Expected project results aligned with the GCF investment criteria (max. 3 pages)

This project will increase the resilience, risk awareness and enhance livelihoods of the population of Maldives through a paradigm shift to *evidence-based preparedness, response actions and decision making to climate risks*. This will be achieved through strengthened climate services and impact-based multi-hazard early warning systems (MHEWS), which are crucial to building the climate resilience of Maldives and its vulnerable communities. As climate-related hazards such as floods, cyclones, storm surges and droughts increase, the project will reach "the last mile" by providing communities with actionable climate information products and targeted early warning alerts. This will eventually lead to a reduction in the number of people affected by climate-related hazards. The project is fully aligned with the GCF investment criteria as follows:

Impact Potential

The project will contribute to the achievement of Fund-level impacts stated in the GCF Performance Measurement Framework through *increased resilience and enhanced livelihoods of the most vulnerable people, communities and regions*.

The project intends to establish end-to-end climate information services and impact-based multi-hazard early warning systems (MHEWS) to ensure that the entire population of Maldives receives timely and actionable warnings based on accurate climate information. The proposed interventions aim to reach up to 541,000 beneficiaries (63% male and 37% female).[101] This is the estimated entire population of Maldives,[102] all of whom are at risk from climate-related hazards. The project will especially benefit the 42% of the population living within 100 m of the coastline whom are most at risk of sea-level rise.[103] The most vulnerable groups include women, children, elderly people, people with disabilities and remote communities at "the last mile". The project will include targeted interventions to ensure that people in the most vulnerable communities will benefit from the adoption of diversified, climate-resilient livelihoods.

The project aims to reduce human and economic losses due to the impact of climate hazards and extreme climate events, and enhance adaptive capacity at national, sub-national and community level. Sector-specific advisories delivering actionable climate information and impact-based forecasts, including for agriculture, fisheries and tourist operators, will increase sectoral resilience, reducing the risks from climate-related hazards and thus reducing losses and damages to infrastructure, crops and other assets.

Strengthening the MMS with infrastructure, tools and institutional efficacy through QMS certification will have a demonstrable impact on its service provision. Technical support for the design of impact-based MHEWS, impact-based forecasting models, and risk information and dissemination mechanisms and procedures will facilitate MMS in the development of an integrated observation, forecasting and communication system tailored to the needs of climate-vulnerable sectors and communities in Maldives. It will enable them to provide more reliable impact-based forecasts and targeted, actionable climate information products. Moreover, it will equip them to function as hazard monitoring and warning services as part of a people-centred impact-based MHEWS and thus enable the preparedness and response

[101] The significant sex ratio imbalance is due to the working population being the largest group and that the majority of foreign workers in Maldives are male (for every 100 female foreigners there were 1,017 male foreigners in 2014). National Bureau of Statistics, 2014. Maldives Population Projections 2014-2054.
[102] Based on the 2020 estimate. UN Department of Economic and Social Affairs: Population Division, 2019.
[103] Maldives Ministry of Environment, Energy and Water, 2006. National Adaptation Programme of Action.

mechanisms at national and community level. In addition, the project will enhance the capacities of a range of stakeholders and decision-makers to access and use these climate information products and services, which will lead to more effective adaptation decisions, preparedness and response actions, resulting in more resilient and sustainable development in Maldives.

Paradigm Shift Potential

The project will catalyse a paradigm shift to evidence-based preparedness, response actions and decision making for resilience to climate hazards and extreme climate events. Shifting from business-as-usual phenomenon-based "what weather will be" information to impact-based "what weather will do" information, the project will scale up the use of climate information and innovative approaches across government entities and relevant stakeholders as follows:

- **Innovation:** Project interventions are expected to achieve transformative impacts through the implementation of early warning services designed as integrated impact-based multi-hazard early warning systems (MHEWS), which will be critical for use in multi-hazard contexts whereby hazardous events may occur simultaneously and/or cumulatively over time with potential inter-related effects. Innovative approaches such as the introduction of cost-effective new technologies will reduce costs and increase the accuracy of observations. The development of innovative modern communication systems, including Internet of Things (IoT) infrastructure and wireless communications where feasible, will close the loop between information providers and end-users and ensure that climate information services and actionable early warning alerts reach all end-users expeditiously, including highly vulnerable end-users at "the last mile". Furthermore, the implementation of Forecast-based Financing (FbF) mechanisms will provide an innovative means to ensure that early actions are pre-planned based on credible forecasts, and are financed and implemented prior to a climate shock.
- **Potential for scaling up and replication:** Supporting Maldives' achievement of WMO standards for MHEWS and QMS certification will have a transformative impact on its capacity to manage climate and weather risks, along with an improved understanding of long-term climate change impacts. This will have high potential for being scaled up across the region, facilitated through existing regional cooperation mechanisms such as the seasonal/monsoonal forums convened by RIMES. The proposed decision-support tools are expert systems that translate science-based forecast information into potential impacts and impact management advisories for agriculture, health, fisheries, tourism and disaster management sectors. These tools are highly scalable; institutional users, once trained, could easily scale the tool to cover more areas in the country. In addition, community-based MHEWS and community-based disaster risk reduction approaches (CBDRR) will have high potential for being scaled-up across the country as they will be based on tailored climate information products and decision support schemes to address the needs of specific end-users at sector and community level. Moreover, lessons learned from implementation of this project will be capitalised to inform future interventions in MHEWS, particularly in similarly vulnerable SIDS.
- **Potential for knowledge and learning:** Knowledge management and learning are key elements in this project. Amongst others, the establishment of community-based early warning schemes and CBDRR approaches, which drawn upon both traditional and modern scientific climate knowledge, will enable vulnerable communities to base their adaptation decisions, preparedness and responses to climate-related hazards on reliable and timely information and knowledge. Significant behavioural changes resulting from these learning processes will, in time, safeguard lives, livelihoods and assets. Furthermore, the National Climate Outlook Forum (NCOF) to be supported under this project will provide an ideal platform for knowledge sharing and learning between MMS as the climate information provider and users across different sectors at the national and local levels. Application experiences, including good practices and lessons learned, will be shared in Regional Climate Outlook Forums (RCOFs) and seasonal/monsoonal forums.
- **Contribution to the creation of an enabling environment:** Project interventions have been designed to address and eliminate institutional, technological, infrastructural and social barriers to sustainable and climate resilient development in Maldives. Forging long-term partnerships between MMS, other government entities, civil society organisations, Higher Education institutions, tourist enterprises, fisheries businesses and other stakeholders will create an enabling environment for sustainable and impactful climate information services. This will be achieved through the establishment of a National Framework for Climate Services and User Interface Platform, enhancement of the National Climate Outlook Forum, and donor coordination amongst others. The project takes a capacity building approach of multi-stakeholder inclusion, including: decision-support system (DSS) development; co-production of sector-specific advisories; engagement and training of communities in the design and implementation of early warning systems; and back-up operational support from RIMES until systems, tools and production application are fully integrated into MMS and institutional and end-user environments. This approach will create an enabling environment for project activities and outcomes to continue beyond the project timeframe. An enabling environment for long-term sustainability will be further facilitated through the integration

and climate services and MHEWS in key policies, strategies, plans and budgets, which will provide a foundation for uptake of climate information in decision making, enable allocation and mobilisation of required resources and support sustainable service provision in the long-term beyond the project duration.

- **Contribution to regulatory framework and policies:** The project will enable Maldives to formalise the mandates, roles and responsibilities of existing government agencies in addressing long-term climate change and extreme events and provide a structure to mainstream climate knowledge into the functions of all ministries. The integration of climate information services in key decision making, planning and operational processes of Government entities in Maldives will bring systemic change facilitated by the National Framework for Climate Services.
- **Overall contribution to climate-resilient development pathways:** The development and dissemination of highly tailored and targeted climate information products will be transformational in building the long-term resilience of key economic sectors (such as tourism and fisheries) to climate risks. Delivered through a suite of outreach, learning and knowledge management activities, information products will catalyse improved, more efficient and more informed approaches and response actions to climate hazards and prevent maladaptation. There will be transformation in building long-term resilience of economic sectors to climate risk but also in the immediate reduction of losses to assets and livelihoods caused by climate-related hazards. Furthermore, enhanced climate information, including vulnerability and risk assessments, will enable resilience planning for critical infrastructure impacted by climate change and climate-related hazards, through embedding tailored and actionable climate risk information into their planning, design, construction and management frameworks.

Sustainable Development Potential

The project will contribute to sustainable development through long-term social, economic and environmental benefits from avoided human and economic losses and healthier ecosystems. The project is fully aligned with the Sustainable Development Goals (SDGs), the Paris Agreement, the Sendai Framework and the SAMOA Pathway. Through the proposed interventions, the project will contribute to the Maldives' progress towards many of the SDGs in the areas of disaster risk reduction, ecosystem protection, climate change adaptation, health and sustainable economic development. Furthermore, the proposed interventions will achieve numerous environmental, social and economic co-benefits, as outlined below:

- **Environmental co-benefits:** Environmental management will significantly benefit from the increased availability of climate data, which will improve the quality of long-lead weather forecasts and impact-based early warnings. For example, sea surface temperature monitoring will enable MMS to issue alerts when coral reefs are stressed by high temperatures – coral is known to recover better if human activity is suspended. Improved management of coral reef and marine ecosystems will enhance the ability of Maldives to naturally protect itself against rising sea levels.
- **Social co-benefits including health impacts:** The proposed interventions will enable communities to adopt sustainable and climate-resilient livelihood strategies. Social co-benefits include improved public safety in response to impact-based early warnings; better healthcare services for water- and vector-borne diseases facilitated by capacity to predict outbreaks; and improved general well-being with better access to food and freshwater. Furthermore, the project aims to educate the population at all levels on the use of climate information and disaster risk reduction approaches.
- **Economic co-benefits:** Economic co-benefits arise from avoided economic losses due to better preparedness to climate-induced hazards through the use of improved forecast and warning information, and from climate risk-informed programmes and activities. Economic gains are also expected from improved management of resources due to the use of forecasts of fishery zones and favourable climate / weather conditions. These benefits translate into increased national capacity to invest in climate-resilient development.
- **Gender-responsive development impact:** The project will promote gender-responsive development in accordance with GCF policies and guidelines through the following processes: ensuring that expect advice on gender is used in planning and designing frameworks, policies and legislation and in the delivery of workshops, training exercises and capacity development activities; keeping gender disaggregated records of project-funded activities and striving for 50/50 participation; and using best-practice consultation techniques when co-designing communication methods and information products with communities to ensure that outputs take into account gender inequality in education, literacy and the capacity to receive information and warnings.

Needs of the Recipient

The small size, low elevation and heavy dependence on natural resources for social and economic security make the Maldives one of the most vulnerable countries in the world to climate hazards and extreme climate events. With over 80%

of the total land area less than one metre above mean sea level, Maldives is extremely vulnerable to sea level rise.[104,105] Cyclones and storms, floods, droughts, high waves and tornadoes have all been identified as major hazards.[106] Most disaster events affecting the country are climate-related; between 1988 and 2007, such events accounted for 45% of deaths and 79% of economic losses.[107] Without adequate adaptation measures, Maldives is predicted to experience annual economic losses of over 12% of GDP by the end of the century.[108]

Responding to the needs of communities and stakeholders is central to this project, which will incorporate strong user engagement for the co-design of climate information products and services. The project will strengthen inclusive planning to ensure representation from vulnerable groups. For example, community-based early warning systems and disaster risk reduction approaches will include interventions tailored to the needs of women, youth, people with disabilities and the elderly.

The project will develop the capacities of user institutions and end-users in the agriculture, water, fisheries, tourism, sea transport, public health, and disaster management sectors on climate risk management and adaptative planning. These sectors are all climate-sensitive, with tourism, agriculture and fisheries being of significant economic importance: tourism is the main contributor to the national economy, whilst agriculture and fisheries are the main sources of livelihood for the country's rural population, which accounts for 60% of the total population and inhabits islands outside of Malé.[109] The project will also contribute to addressing gaps in data availability, and user capacity and confidence in using existing and new technologies to build climate resilience, as identified in the country's Second National Communication to the UNFCCC. Lack of financial resources to implement priority adaptation actions is also a major constraint. The 2010 National Economic, Environment and Development Studies (NEEDS) Report estimated that USD$441 million would be required over the next four decades for adaptation actions in Maldives.[110] GCF support for the proposed project is strategic, in terms of creating an enabling environment for adaptation in seven climate-sensitive sectors.

Country Ownership

Strong country ownership of the project has been facilitated through extensive stakeholder engagement during the project planning and development phase. The project has been developed through comprehensive consultation and planning processes with all relevant stakeholders including Maldives Meteorological Service (MMS), National Disaster Management Authority (NDMA), Ministry of Tourism, Ministry of Education, Health Protection Agency, Environmental Protection Agency, Regional Integrated Warning System for Africa and Asia (RIMES), World Meteorological Organisation (WMO), Maldives Police Service, Maldives Red Crescent, Communication Authority of Maldives (TAM) and private sector representatives. From its outset, the project has focused on identifying and incorporating Maldives' national needs and priorities into project activities to foster country ownership. For example, a Stakeholder Workshop was held in September 2016 to provide guidance and assistance to MMS and national stakeholders on the implementation of a pilot project on impact-based forecasting for Maldives.[111] To ensure continued ownership and to enable the project to benefit from stakeholder expertise throughout the project, stakeholders will be involved throughout the implementation phase. For example, the National Climate Outlook Forum will provide a platform for regular multi-stakeholder dialogue; and civil society and community organisations will be engaged to develop and implement community-based early warning schemes and disaster risk reduction approaches.

The project will provide an enabling environment for implementing adaptation measures identified in the country's Second National Communication to UNFCCC (2016). The project is aligned with the priority adaptation strategies of the National Adaptation Program of Action (2007), particularly on new technologies to increase local food production, safe rainwater harvesting, integrated reef fishery management, infrastructure design, implementation of the Safer Island Strategy, and capacity for healthcare delivery. The project is also aligned with the Strategic National Action Plan for Disaster Risk Reduction and Climate Change Adaptation (2010-2020), in the areas of end-to-end early warning and climate risk management for empowered and capable communities, and connecting island communities to technology, knowledge and resources for increased resilience. Additionally, proposed activities are in line with priorities identified in the Maldives Nationally Determined Contribution (NDC), as well as the Maldives Climate Change Policy Framework (MCCPF) and relevant sectoral plans. Furthermore, the project interventions will strengthen existing country systems for climate

[104] Maldives Ministry of Environment and Energy, 2017. State of the Environment 2016.
[105] UNDRR, 2019. Disaster Risk Reduction in Republic of Maldives: Status Report 2019.
[106] UNDP, 2006. Developing a Disaster Risk Profile for Maldives.
[107] The Republic of the Maldives, 2010. Strategic National Action Plan for Disaster Risk Reduction and Climate Change Adaptation 2010-2020.
[108] Asian Development Bank, 2014. Assessing the Costs and Climate Change and Adaptation in South Asia.
[109] https://www.britannica.com/place/Maldives
[110] Maldives Ministry of Housing and Environment, 2010. National Economic Environment Development Studies.
[111] https://www.wmo.int/pages/prog/amp/pwsp/Stakeholders_Workshop_Maldives_IBF_2016.htm

services through institutional capacity building; enhanced coordination mechanisms and partnerships; and establishment of a dedicated National Framework for Climate Services.

Efficiency and Effectiveness

The project will achieve efficiency and effectiveness through the development of a National Framework for Climate Services (NFCS) based on the WMO Global Framework for Climate Services. The NFCS will build on existing national strategies, plans and networks in Maldives to mainstream the use of science-based climate information and impact-based forecasting into long-term policy, planning and practice. Investing in climate services yields benefits that greatly outweigh the costs, contributing to both the economic and social well-being of countries. [112,113] It is a highly cost-effective alternative to reactive approaches to climate-related hazards that focus on ad-hoc recovery and investment in hard infrastructure and risk expensive maladaptation. The project will significantly enhance the risk knowledge and response capabilities of climate-sensitive sectors and vulnerable communities, as well as contributing to the capacity building of MMS. Enhanced risk knowledge will enable end-users to proactively respond based on timely and accurate information and reduce the cost of damage to assets and livelihoods. Key elements of the value proposition of this project include:

- High expected benefit-cost ratio (BCR) on investments in upgrading and modernising MMS that can only be achieved with a sizeable and multi-year investment such as the proposed project. This is corroborated amongst others by a 2015 economic assessment report by WMO[114] that indicated that improvements in early warning systems and preparedness make it possible to limit losses from hydrometeorological disasters, which would not be possible without the informed use of constantly improving meteorological, hydrological, social, behavioural and related information. Furthermore, a 2018 review by USAID found that improvements in National Meteorological and Hydrological Services to reduce loss from disasters has BCRs between 4:1 and 36:1.[115] Cost-benefit analysis (CBA) of cyclone early warning systems in Samoa found that every USD 1 invested yields USD 6 in benefits.[116]
- Efficacy of tailored, flexible and community-based early warning systems proposed under this project. From related efforts such as UNEP's Climate Change Early Warning Project (CLIM-WARN),[117] it can be concluded that "to be effective, early warning systems must themselves incorporate aspects of resilient systems: diversity, flexibility, local relevance, learning, acceptance of change, consideration of justice and equity" and that "the success of early warning is not based solely on technical or meteorological systems, but is dependent on social systems." Results from UNEP's CLIM-WARN project offers important lessons and identifies best practices.
- Mobilisation of private investment in climate information and multi-hazard early warning systems (MHEWS) will be enhanced through the establishment of policy and regulatory frameworks and investment mechanisms that create an enabling environment for private sector involvement and partnerships. Moreover, institutional arrangements for data sharing amongst stakeholders, including with the private sector, will support effective and sustainable markets for MHEWS and enable the private sector to add value and market services to end users.

B.4. Engagement among the NDA, AE, and/or other relevant stakeholders in the country (max ½ page)

At the invitation of the Government of Maldives, WMO convened a Stakeholder Workshop in Male, Maldives (26-28 September 2016) to provide guidance and assistance to Maldives Meteorological Service (MMS) and national stakeholders on the implementation of a pilot project on impact-based forecasting for Maldives. In addition to staff, including the senior staff from MMS, the stakeholders who attended the workshop represented a variety of important user communities for the products and services of MMS, including the disaster community, media, health, academia, agriculture, health, security and tourism. As the first activity of the workshop, a number of presentations were made by MMS and the Stakeholders on the current status of operational warning systems for meteorological, hydrological and geophysical hazards (tsunamis, heavy rain, swell waves and tidal waves), the challenges posed by those systems, and the disaster reduction activities.

Based on the outcomes of the aforementioned WMO Stakeholder Workshop, a first draft project concept was prepared in early 2018 with the assistance of RIMES. The project concept was developed with inputs from institutions that are participating in the Monsoon Forum. Stakeholders of the proposed project are also key stakeholders of the Monsoon Forum, which MMS convenes.

[112] USAID, 2018. Climate Information Services Market Assessment and Business Model Review.
[113] Fakhuddin, B. and Schick, L. 2019. Progress in Disaster Science. Benefits of economic assessment of cyclone early warning systems – A study on Cyclone Evan in Samoa.
[114] WMO, 2015. Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services.
[115] USAID, 2018. Climate Information Services Market Assessment and Business Model Review.
[116] Fakhuddin, B. and Schick, L. 2019. Progress in Disaster Science. Benefits of economic assessment of cyclone early warning systems – A study on Cyclone Evan in Samoa.
[117] https://wedocs.unep.org/bitstream/handle/20.500.11822/7429/Early_Warning_as_a_Human_Right_1.pdf?sequence=5&isAllowed=y

In his letter dated 9 May 2019, the NDA of Maldives requested UNEP for its support, "in taking on the role as Accredited Entity for this project. In this regard, we would highly appreciate your assistance in bringing the proposal to GCF standards, in close cooperation with relevant national authorities and RIMES for a successful GCF project. The national focal point for the project will be the Maldives Meteorological Service (MMS)".

C. Indicative Financing/Cost Information (max. 3 pages)

C.1. Financing by components (max ½ page)

Component/Output	Indicative cost (USD)	GCF financing		Co-financing[118]		
		Amount (USD)	Financial Instrument	Amount (USD)	Financial Instrument	Name of Institutions
1 – Strengthened climate information services supported by institutions, coordination, financial frameworks and enhanced risk knowledge	2.9 million	1.9 million	Grant	1 million	TBC	TBC
2 – Modernisation of the Maldives Meteorological Service (MMS) for enhanced observations, monitoring, modelling and impact-based forecasting	12.5 million	9.5 million	Grant	3 million	TBC	TBC / Country for O&M
3 – Enhanced dissemination and communication of multi-hazard climate risk information and early warning	3.85 million	2.85 million	Grant	1 million	TBC	TBC / Country for O&M
4 – Enhanced climate risk management capacities at the last mile	5.75 million	4.75 million	Grant	1 million	TBC	TBC / Country for O&M
Indicative total cost (USD)	25 million	19 million		6 million		

C.2. Justification of GCF funding request (max. 1 page)

Greater urgency, speed and transformative action is critical to helping highly vulnerable SIDS, such as Maldives, to enhance their resilience to the increasing threat of climate hazards and extreme climate events and shift towards climate-resilient sustainable development pathways. The relative cost of responding to and recovering from extreme climate events is much greater in SIDS due to their reliance on imported goods and the logistical challenge of reaching dispersed and isolated populations. SIDS often need to divert their scarce resources towards immediate, short-term re-building needs rather than investing in long-term sustainable development and climate resilience. The result is a vicious cycle of increased vulnerability to future climate change impacts.[119]

[118] Co-finance will be further clarified, and new sources identified during the Full Proposal formulation.
[119] Tortora, P. and Soares, R.A. 2016. World Bank. Climate and disaster resilience financing in Small Island Developing States.

The economy of Maldives is highly reliant on tourism and fisheries. Tourism, on the one hand, remains the major income earner for the country, and contributed significantly in lifting the country out from its Least Developed Country status in 2011. Decline in tourism revenue in 2016 is one of the causes of the wide fiscal deficit during the year.[120] Considering its public debt of 61.9% of GDP (2016),[121] shocks to tourism would have serious impacts to the country's economy. Fishing, on the other hand, is the primary industry for rural Maldivians. Fish is the country's main export and is therefore also a key source of foreign exchange. Tourism and fisheries, however, are sectors that are at high risk to climate variability and change, as they are very much dependent on climatic seasonality and the country's coastal and marine environments. Climate risk reduction and adaptation is thus paramount.

Maldives recognises that addressing the impacts of climate change is a national priority and is committed to investing significant effort and resources into climate adaptation measures.[122] However, external finance is essential for the Government of Maldives to supplement its own limited expenditure capacity to successfully prepare for and respond to the intensifying and increasing threats of climate change.[123] The requested GCF grant resources will help to remove financial, technical and institutional barriers to supporting investment in climate information and multi-hazard early warning services (MHEWS). The proposed project will deliver transformative impact through *increased resilience, risk awareness and enhanced livelihoods of communities in Maldives to climate hazards and extreme climate events* and ambitious outcomes in close alignment with the mandate, scope and objectives of the GCF.

High public debt, with high risk of external debt distress,[124] constrains public financing for adaptation. Maximum concessionality through a grant would be very much desired over loan or other debt instruments, considering the country's high public debt. Private sector financing may be difficult to obtain, as the proposed project involves provision of improved climate products and services, which are considered as public goods.

However, public and private sector economic benefits, anticipated from the project due to better management of resources and risks from application of climate services and impact-based multi-hazard early warnings, could translate to investments in climate-resilient development. Demonstration of avoided economic losses could create incentives for the Government of Maldives to develop favourable policies and increase its funding for climate information and early warning services. Improved climate products and services could also form the basis for establishing an insurance market as the private sector and households see their benefits. It should be noted though that such investments could be realised **only after demonstration** of such economic benefits from use of improved climate products and services. Therefore, this initial investment could catalyse further investments locally beyond the project duration as it demonstrates risk reduction to government and private sector operations.

C.3. Sustainability and replicability of the project (exit strategy) (max. 1 page)

This project is designed to address existing root causes and barriers to sustainable climate information services and MHEWS in Maldives. In particular, the following are key elements of the exit strategy to ensure sustainability beyond the project's lifespan:

- Sustainability and replicability of the project will be facilitated and supported through **strategic partnerships**, its **alignment with key frameworks and strategies**, and its focus on **meeting identified user priorities**. The project is aligned with the National Framework for Climate Services (based on WMO Framework), designed to facilitate the delivery of best practice climate services. The project's long-term investment strategy and business plan will also be closely aligned with national priorities and policies. Furthermore, an enabling environment for long-term sustainability will be facilitated by ensuring that proposed interventions are based on meeting the needs of climate services users and institutions. This priority was well established during the WMO convened a Stakeholder Workshop in Malé, Maldives (26-28 September 2016). Proposed interventions are based on needs and demands from institutions that participate in the MMS-convened Monsoon Forum. Model and tool development and climate application demonstrations will involve key personnel from MMS and participating institutions, such as Ministry of Tourism, Ministry of Fisheries and Agriculture, Environmental Protection Agency, Health Protection Agency, National Disaster Management Authority, and their line agencies, including Atoll and Island Councils at the pilot sites.

[120] World Bank, 2017. Country Snapshot – Maldives. Available from: http://documents.worldbank.org/curated/en/737921507887264006/pdf/120417-WP-PUBLIC-CountrySnapshotMaldives-Final-merged.pdf
[121] World Bank, 2017. Country Snapshot – Maldives. Available from: http://documents.worldbank.org/curated/en/737921507887264006/pdf/120417-WP-PUBLIC-CountrySnapshotMaldives-Final-merged.pdf
[122] Maldives Ministry of Environment and Energy, 2016. Second National Communication of Maldives to the UNFCCC.
[123] Stockholm Environment Institute, 2017. Working Paper. Climate finance for the Indian Ocean and African Small Island Developing States.
[124] World Bank, 2017. Country Snapshot – Maldives. Available from: http://documents.worldbank.org/curated/en/737921507887264006/pdf/120417-WP-PUBLIC-CountrySnapshotMaldives-Final-merged.pdf

- The project will **build on current strengths and capacities** of Maldives Meteorological Service (MMS) through integration of new hydrometeorological equipment and tools into the existing MMS, and incorporation of the impact-based MHEWS into the national emergency management framework and budgets. The project will strengthen the National Framework for Climate Services, National Climate Outlook Forum and associated institutional coordination mechanisms to promote effective governance, coordination and management of climate services in Maldives. The Monsoon Forum will be used as platform for monitoring and reporting of project milestones, and for evaluation of effectiveness of climate services and applications in developing adaptive capacity. The establishment of a User Interface Platform will incorporate key stakeholders and institutions at the local and national level to define the roles of different stakeholders and to facilitate ownership of processes, products, and outcomes. An inter-ministerial, multi-stakeholder coordination mechanism will incorporate feedback and review mechanisms to ensure that MMS is providing relevant services that are tailored, targeted and actionable by end-users at all levels.
- The project will adopt a **broad multi-stakeholder approach** through MMS collaboration with key stakeholders, NGOs, private sector actors, communities and others representing both producers and users of climate information and early warnings. Through capacity development activities, awareness raising and outreach, their capacity will be enhanced, and sustainability of results facilitated. Engagement with and support for end-users will be undertaken through a demonstrative approach to guide climate service providers to undertake capacity building processes with end-users. Stakeholder participation, capacity building, highly scalable tools, demonstration approach, and technical assistance from partners such as RIMES are among the strategies for project sustainability and replicability.
- A key element of this project's sustainability and exit strategy is the development of a **financially sustainable business model for climate services** in Maldives. The project will utilise a value-chain approach to devise a sustainable business model and long-term investment strategy to address existing root causes and barriers to delivering effective end-to-end climate information and early warning services in Maldives. The establishment of integrated investment mechanisms, climate applications support, and identification of capitalisation opportunities will ensure that MMS has the means to sustain and ensure the continued operation of its services. Climate application outcomes will be documented, with benefits quantified, to generate evidence for convincing policy and decision-makers to invest in climate adaptation and scale the impacts of the project. Moreover, the project will provide a foundation for greater involvement of the private sector in the delivery of climate information products and services, risk transfer schemes and risk reduction.
- Sustainability of the project will be facilitated by a strategy for **Operation and Maintenance (O&M)** of MMS's network, equipment and tools, funding modalities, and capacity building efforts both during and post implementation of the project. Key elements of this strategy will be financing of goods and services, preventative maintenance of systems and equipment, management objective to improve equipment performance and training and capacity development. MMS is committed to providing proper Operations and Maintenance (O&M) to their expanded hydrometeorological monitoring networks and newly created MHEWSs during and after the end of the project. Partners such as RIMES are committed to providing continued technical support (for example, on modelling or tool improvements, updates and/or maintenance) beyond the project duration. The project will help MMS and other relevant authorities to develop and implement long-term sustainable strategies for O&M and will support them in designing and disseminating a suite of tailored climate information products that in the long-term may catalyse modest levels of additional resources for MMS through sector demand. Proper O&M will provide early detection of equipment problems and may lower repair and replacement costs.
- A **Procurement Plan** will be developed to outline a coordinated and integrated schedule for the procurement of goods and services according to the project requirements. The Plan will enhance the management of goods and services by ensuring that procurement activities are aligned with the budget and that suitable contracts are executed. Ownership of observing systems that will be established under the project shall be transferred to MMS. MMS shall collaborate with the Maldivian Coast Guard, Maldives Ports Limited, Ministry of Tourism, and Ministry of Fisheries and Agriculture under an Agreement framework, for operation, maintenance, and security of ocean observing systems. Such arrangement has been shown to work in Seychelles. Amongst others, the proposed project budget has provision for spare sensors to allow MMS time to integrate maintenance costs into its operational budget. The design, procurement, establishment of observation systems, forecasting models, information and communication infrastructure, DSS/tools and platforms, protocols and procedures are all based on a comprehensive assessment of current capacities and requirements, as well as identified needs and resource capacity to operate, maintain and sustain the system, to maximize their long-term benefits. Cost-effective systems suitable for the country will be prioritized for implementation.
- **Replication potential** is a major focus of the proposed project. Through the consultation of stakeholders and documentation of lessons learned, and emerging understanding of best practices, synthesised project results will

assist in the implementation of pilot adaptation measures and propose additional strategies that can build off project activities in the immediate project vicinities and beyond. Specific attention to documenting and disseminating learning helps replications and mainstreaming and will be a mandatory part of the project.

D. Supporting documents submitted (OPTIONAL)

- ☐ Map indicating the location of the project/programme
- ☒ Diagram of the theory of change
- ☐ Economic and financial model with key assumptions and potential stressed scenarios
- ☐ Pre-feasibility study
- ☐ Evaluation report of previous project
- ☒ Results of environmental and social risk screening

Self-awareness check boxes

Are you aware that the full Funding Proposal and Annexes will require these documents? Yes ☒ No ☐

- Feasibility Study
- Environmental and social impact assessment or environmental and social management framework
- Stakeholder consultations at national and project level implementation including with indigenous people if relevant
- Gender assessment and action plan
- Operations and maintenance plan if relevant
- Loan or grant operation manual as appropriate
- Co-financing commitment letters

Are you aware that a funding proposal from an accredited entity without a signed AMA will be reviewed but not sent to the Board for consideration? Yes ☒ No ☐