PROJECT CONTRIBUTION TO CLIMATE CHANGE ADAPTATION AND MITIGATION IN MARINE PROTECTED AREAS

1. **Basic Project information**. The Asian Development Bank (ADB) will support project implementation in national and district marine protected areas (MPAs) located in (i) Bintan, Batam, Lingga, and Natuna districts in Riau province; (ii) Central Tapanuli and North Nias districts in North Sumatra province; (iii) Mentawai district in West Sumatra province; (iv) Anambas national MPA in Anambas district, Riau province; (v) Pulau Pieh national MPA in Pariaman district, West Sumatra Province; and (vi) Gilimatra national MPA in North Lombok district, West Nusa Tenggara province (project area). Under the Project, 2.75 million hectares (ha) of MPAs will be managed with a combined coral reef, mangrove and seagrass areas of 52,000 ha,104,000 ha, 2918 ha respectively.

2. Climate change classification: Adaptation–high and Mitigation–low.

3. Coral Reef Rehabilitation Management Program—Coral Triangle Initiative Project (COREMAP—CTI) will provide relevant information, tools, policies, infrastructure, institutions and capacity building to address climate change impacts in MPAs through an ecosystem-based adaptation approach, and to maximize opportunities for mitigation through enhanced carbon sequestration.

I. Project Site Impacts

4. The primary impacts of climate change in Indonesia on coral reefs are natural hazards and coral bleaching due to climate change-related sea temperature rise. Based on the results of research the project locations in Riau (Bintan, Lingga, Natuna, Batam and Anambas Districts) are in shallow waters, and Indian Ocean location project areas (North and West Sumatra), and in the West Lesser Islands (NTB) are in deep waters. Riau waters, including shallow marine waters with a relatively higher temperature and lower density, and with temperature rise, will produce a larger volume of water and sea level rise will be higher (Indonesian western, about 3.1 to 9.3 mm per year). In contrast, the waters of North and West Sumatra (Indian Ocean), which have lower temperatures and higher density than the Java Sea, with increasing temperatures due to climate change, relatively lower sea level rise will occur (about 1.1 mm per year). Sea level rise and ocean acidification are presently not causing significant impacts to coastal islands and coral reef ecosystems but may be impacted in future if climate change-related impacts continue unabated. In Table 1, climate change-related impacts (e.g., temperature-induced coral bleaching and increase in sea surge) are described at ADB COREMAP—CTI sites.

Table 1: Climate Change-Related Impacts at ADB COREMAP—CTI Sites

Province	District/Municipality	Climate Change Potential Risk
North Sumatra	North Nias District	Moderate coral bleaching, more potential wave surge
	Central Tapanuli District	Moderate coral bleaching
West Sumatra	Mentawai Islands District	Moderate coral bleaching, more potential wave surge
	Padang-Pariaman District	Moderate coral bleaching
Riau Islands	Bintan District	Minor coral bleaching
	Lingga District	Minor coral bleaching
	Natuna District	Moderate coral bleaching, more potential wave surge
	Batam Municipality	Minor coral bleaching
	Anambas District	Moderate coral bleaching, more potential wave surge
West Lesser Islands (NTB)	North Lombok District	More serious coral bleaching

Sources: Professor Jamaluddin Jompa, Professor of Marine Science and Director of Coral Reef Studies, University of Hasanuddin, Makassar, Indonesia.

II. Climate Change Adaptation

5. Climate change, manifested through increased ocean temperatures, sea level rise, ocean acidification, altered ocean currents and weather patterns, and melting sea ice, has profound impacts on adequacy (appropriate size, spacing, shape), representation (covering the full range of biodiversity, rare and threatened species), resilience and connectivity (ensuring linkages between sites through currents, migratory species, larval dispersal) of MPAs. Some key impacts are outlined below:

(i) Changes in water temperature and oceanic circulation disrupt coastal upwelling systems and associated productivity; species shift; populations or species that move outside of an MPA may lose the valuable protection provided by that MPA.
(ii) Prolonged episodes of ocean warming cause bleaching and death of coral reefs
(iii) Saltwater intrusion in coastal areas affects estuarine and freshwater habitats, adversely affecting species and habitats that are sensitive to salinity shifts
(iv) Ocean acidification results in mass coral bleaching and reduced capacity of corals, crustaceans, shellfish, and plankton to form shells and skeletons, impeding their survival.

6. Recent estimates suggest that live coral area varied from 21 to 51% in project sites (see RRP Supplementary Document 15, Description of Project Area).

7. The long-term, place-based nature of MPAs provides a distinct advantage in addressing the impacts of climate change. By reducing non-climate stressors, providing protection to those coastal and marine resources most at risk, and reducing risk, MPAs can foster the resilience and health of marine ecosystems in order to improve their ability to resist and recover from the impacts of climate change in the ocean and directly contribute to public health, safety, and economic welfare of coastal communities. MPAs and networks of MPAs are valuable tools that, with proper management, can help buffer impacts, create climate change resistant species, and

sustain ecologically, culturally, historically, socially, and economically valuable coastal and marine resources throughout Indonesia's waters and beyond.

8. Over the last ten years, design principles have been developed to ensure that MPA networks are resilient to the threat of climate change. (West and Salm, 2003; Grimsditch and Salm, 2006; McLeod and Salm, 2006; Green et al. 2007, 2009; Hinchley et. al. 2007; TNC 2009). These principles include:

(i) addressing uncertainty by spreading the risk through representation and replication of major habitats; protecting critical habitats, particularly those demonstrating strong resilience;
(ii) understanding and incorporating patterns of biological connectivity; and
(iii) reducing other threats (particularly overfishing and destructive fishing and runoff from poor land-use practices)

9. The project aims to strengthen resilience of MPAs to climate change by spreading the risk through protecting critical habitats that may be naturally more resistant or resilient to increasing sea temperatures and coral bleaching. In particular, the MPA network design will include coral reefs exposed to a diverse range of oceanographic influences, such as areas of seasonal upwelling, strong currents, sheltered and exposed reefs and areas of high temperature variability such as reef flats. Such areas include:

(i) habitats that regularly experience high temperature variability,
(ii) areas that experience upwelling and strong currents,
(iii) areas that are shaded by coastal vegetation or cliffs, and
(iv) areas of high diversity and coral cover.

10. The project plans to follow four steps for improving resilience of MPAs.

(i) Step 1: Identify species and habitats with crucial ecosystem roles or those of special conservation concern.
(ii) Step 2: Identify the traits of those species/habitats identified in Step 1 that are vulnerable to projected climate change impacts.
(iii) Step 3: Determine whether the impacts of climate change on the traits identified in Step 2 can be mitigated by or adapted through MPAs or MPA networks.
(iv) Step 4: If impacts on the traits identified in Step 2 can be reduced by MPAs or by MPA networks, the project will estimate the timescale over which their subject is expected to respond to climate change and trigger a re-evaluation of the boundaries of the MPA, or design the MPA or MPA network to be robust to these changes.

III. Climate Change Mitigation

11. MPAs also serve as an important carbon sink. Over half (55%) of the biological carbon stored globally is stored by living marine organisms. MPAs that protect habitats, such as salt marshes, mangroves, and algae and sea-grass beds, all of which store carbon, help mitigate climate change. In countries such as USA, many MPAs are demonstrating greening techniques, clean energy technologies, and other innovations. All these opportunities may be pursued in the project area.

12. The project aims to take the following steps towards enhancing greenhouse gas mitigation opportunities.

(i) Step 1: Identify habitats and species that function as potential carbon sinks
(ii) Step 2: Describe the carbon flux system, including carbon sources and the sinks identified in Step 1
(iii) Step 3: Determine whether the carbon flux system is vulnerable to impacts from climate change that can be mitigated by MPAs or MPA networks
(iv) Step 4: If impacts on the system from climate change that are identified in Step 3 can be mitigated by MPAs or by MPA networks, the project will estimate the trends and timescale over which the impacts are expected and trigger a re-evaluation of the boundaries of the MPA, or design the MPA or MPA network to be robust to these changes