

Climate Change Impacts on Fisheries and Aquaculture in Indonesia: Current Initiatives and Challenges for Adaptation and Mitigation

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Introduction

As one of the biggest archipelagic countries with more than 17,500 islands, 81,000 km coastline and 61 % (about 3.1 million km²) of water areas, Indonesia is more exposed to the adverse impacts of climate change. There are enormous threats and impacts of climate change to the coastal, ocean, marine and fisheries ecosystems and activities. The threats can be more disastrous for the ecosystems that provide habitat for high economic value and important fishes and protect from physical disturbances. Million of the Indonesia population relies to some degree on these ecosystems as source of foods and protein. Climate changes influence significantly global and regional scales of nature phenomenon such as increasing the number of tropical cyclones occurrence that triggered extreme high wave, increasing the incident of ENSO (Timmerman et al., 1999; Collins, 2000), and shifting of Asia-Australia monsoonal pattern. It then increases the vulnerability of marine and fisheries ecosystems through extreme climate events, such as El Niño and La Niña.

During 2010, changing in monsoonal patterns and La Niña event affected fisheries activities in Indonesia. It decreased capture fisheries production in some Indonesia regions. In Bali Strait, the average production of oily sardine (*Sardinella lemuru*) decreased significantly (as comparison: optimum production is 2,615 tonnes/month) that led by changing in these climate events. Oily sardine (*lemuru*) share significantly contribution (almost 90%) or capture fisheries production in Bali.

Extreme weather and high wave conditions in some regions of Indonesian waters (Indian Ocean, southern Java, Bali, Nusa Tenggara, eastern Sumatera and along the Java Sea) caused difficulties for fishermen to fish for several weeks. Small scale farmers in shrimp culture have similar adverse effects that caused through frequent extreme weather events such long rainy day, incresing temperature and anomaly weather. Sea level rise is becoming serious and greater risk to the aquaculture and its infrastructures in some coastal areas along the northern coast of Java.

To minimize and anticipate the adverse impacts of climate change on the marine and fisheries sector need both adaptation and mitigation actions. Adaptation activities include process of adjusting to changes in climate that influence human wellbeing and survival. It will be activities to reduce the negative impacts of climate changes and to look for opportunities to take advantage of the positive impact through a variety of responsive and planned efforts. Mitigation activities in the marine and fisheries include human intervention through science and technology to prevent or slow down climate change through the efforts of emissions reduction and/or absorption increases of the greenhouse gases (GHG) associated with this sector, such as maintenance and rehabilitation of mangrove forest and seaweed cultivation. This country report briefly describes current initiatives and challenges on adaptation and mitigation actions for marine, fisheries and aquaculture in Indonesia.

Current national climate change adaptation initiatives

Climate change adaptation in Indonesia is now become a key aspect in the national development agenda. There are several initiatives for promoting climate change adaptation that consist of immediate and medium and long terms. For immediate-term, the initiatives include:

1. To increase awareness and dissemination of climate change information;
2. To improve scientific study on climate change and its impact;
3. To review core policy impacted by directly and indirectly by climate change;

4. To integrate and mainstream of climate change adaptation into infrastructure plan, conflict management, and groundwater management and water management institution;
5. To modify standard criteria for design and planning, operating and maintenance infrastructure and facilities;
6. To link disaster risk reduction to climate change adaptation with community involvement;
7. To mainstream climate change adaptation into policies and program of various sectors;
8. To develop Climate Change Issue in High School and University curriculum;
9. To develop monitoring system on weather, climate and hydrology to strengthen the accuracy of weather and climate forecasting throughout Indonesia.

For long and medium term, the initiatives are more concern on (i) development of resilient and perspective infrastructure system and spatial plan and (ii) re-arrangement of the regional spatial plan, particularly coastal areas and highly sensitive ecosystem.

The National Council on Climate Change (*Dewan Nasional Perubahan Iklim or DNPI*), Indonesian national policy coordination entity on climate change, conduct several actions including development the National Adaptation Plan of Actions (NAPAs), vulnerability and projection maps and donor and stakeholder meetings on adaptation.

Current climate change adaptation initiatives on fisheries and aquaculture sectors

Adaptation initiatives on fisheries and aquaculture sectors have multi-functionality for human health, food security and ecological resilience. The importance of these multi-functionality are reflected on Indonesia Climate Change Sectoral Roadmap (ICCSR) on Marine and Fisheries Sector, including aquaculture that published by the Ministry of National Development Planning in 2010. The roadmap contains challenges on marine and fisheries sector in Indonesia such as management capture and culture fisheries, utilization of small islands and non-conventional marine resources, and law enforcement especially related to illegal fishing. The roadmap also outlines nine priority activities for adaptation that integrate to the Indonesian National Medium Term Development Plan as follow:

1. Implementation of inventories of data, information systems, and researches related to climate change.
2. The integration of adaptation and mitigation of climate change into planning and management of marine and fisheries.
3. Formulation and/or adjustment of regulation, policy, and institutional capacity in the marine and fisheries sector related to climate change in coastal, small islands and ocean areas.
4. Elevation adjustments and strengthening the structures of buildings and vital facilities in coastal zones related to climate change.
5. Adjustments of the integrated management of natural resources and ecosystems of coastal and small islands.
6. Adjustments of the management of strategic small islands related to climate change.
7. Strengthening the capacity of disaster mitigation on climatology and oceanography in the coastal, small islands, and ocean.
8. Adjustments of the integrated management of the potential resources of capture fisheries related to climate change.
9. Adjustments of the integrated management of the potential resources of aquaculture fishery in marine, brackish water, and freshwater related to climate change.

Ministry of Marine Affairs and Fisheries (MMAF) has policy on adaptation actions that should be risk-based driven and has impacts to 3Ps (pro-growth, pro-job and pro-poor) with concern to adaptation capacity and community and ecosystem resiliencies (socially and economically). Several current initiatives for implementation this policy include (i) promoting and increasing local-based aquaculture production, (ii) developing variety/strain with highly tolerance to climate change impacts, (iii) promoting low-emission fish feeds and (iv) eco-friendly aquaculture.

These initiatives are in line with MMAF Strategic Plan 2005-2009, “Blue Revolution Policies”. The strategic plan promotes sustainable management on marine and fisheries resources by conducting optimal and sustainable utilization of marine and fisheries resources, managing the conservation area and protected aquatic organisms in sustainable way, developing small islands to become islands with high economy value, and realizing free IUU fishing and destructive marine activities.

MMAF is also a member of DNPI, which is chaired by President Yudhoyono, and has a membership of 17 Ministers and the Head of Meteorological, Climatology and Geophysics Agency. MMAF has been actively involved in mainstreaming and developing adaptation plan of actions on climate changes adverse impacts on marine and fisheries as well as aquaculture. The ministry nominated its decision makers and technical persons to serve at the Working Group of DNPI.

There are several projects under the MMAF that promote the policy to climate change adaptation and mitigation, such as Marine and Coastal Resource Management Project (MCRMP) and Coral Reef Rehabilitation and Management Program (COREMAP). MCRMP was funded by ADB to improve the local governments capacity and capability in managing coastal and marine resources. COREMAP was funded by the World Bank, ADB and AusAID to strengthen coral reefs ecosystem management.

MMAF actively involved in Indonesia's Technology Needs Assessment (TNA) on Climate Change Mitigation in 2010. This initiative is part of the low carbon economic development for seven priority sectors namely energy, transportation, industry, forestry, agriculture, ocean (marine and fisheries) and waste. It aims to assist in identifying and analysing priority technologies needed for adaptation and mitigation of climate change adverse impacts. There are eight priority technology on climate change mitigation for marine and fisheries (Appendix 1) which are formulated based on general criteria (Appendix 2) and specific criteria (Appendix 3).

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Appendix 1. Selected Technology/Measures of Climate Change Mitigation in Marine and Fisheries Sector

No.	Technology Priority Selection	Priority of Action Plan	Period of Action
1.	Seaweed	Development of potential areas for seaweed cultivation	2009-2015
		Seaweed culture management	2009-2015
		In-situ and laboratory measurements on carbon sink potential of seaweed culture	2010-2012
		Detailed mapping of potential areas for seaweed culture development	2010-2012
2.	Mangrove and coastal vegetation	Topic will be covered by the Forestry Sector TNA	-
3.	Coral reefs	Identification stage	2009-2015
		Coral replanting and transplantation	2009-2015
		Remote sensing for estimation of net primary production (NPP) and total carbon sink	2010-2011
		Modeling of carrying capacity for technology implementation	2010-2011
		In-situ and laboratory measurements on carbon sink potential	2011-2013
4.	Indonesian ocean observing system	Monitoring marine environment condition	2009-2015
		Establishment of ocean and coastal stations to observe Indonesian waters	2009-2015
		Operational Ocean Observing System	2010-2015
		Study on water mass transport in related to oceanic carbon budget	2012-2015
5.	Marine fisheries	Development of low energy fishing vessels with bio fuels and other energy alternative	2010-2015
		Implementation of technology and fishing supporting device that consume low energy	2009-2015
6.	Ocean and coastal renewable energy	Tidal current	2009-2015
		Wave	2009-2015
		Ocean thermal gradient	2015-onward
		Solar	2009-2015
		Wind power	2009-2015
7.	Sea grass	In-situ and laboratory measurements on carbon sink potential of sea grass beds	2012-2015
		Sea grass cultivation and rehabilitation	2014-onward
		Generation of non-conventional energy from sea grass	2014-onward
8.	Marine plankton	Satellite remote sensing technology for estimation of net primary production (NPP) and total carbon sink	2009-2011
		Numerical modeling of oceanography parameters for measuring ocean primary productivity	2009-2011
		In-situ and laboratory measurements to find out the absorption effectiveness	2011-2015
		Ecological modeling for marine plankton as carbon source or sink	2011-2015
		Identification of potential plankton species to absorbs carbon	2011-2015
		Phytoplankton culture in photo bioreactor	2011-2015

Appendix 2. General Criteria for Technology Selection

General criteria	Sub-criteria
a. Conformity with national regulation and policy	Food security (FS) Natural resource security (NR) Energy security (ES) Incentive for participation (IP)
b. Institutional and human development	Capacity building (production & know how) (CB)
c. Technology effectiveness	Mature degree of technology Advanced degree of technology Reliability of technology (RT) Applicability of technology Easiness of wider use of technology, including local contribution support of technology application (ET)
d. Environmental effectiveness	Greenhouse gas emissions reduction (GR) Improvement of local environmental quality (LE)
e. Economic efficiency and cost effectiveness	Capital and operational costs relative to alternatives (COC) Commercial availability (market) (CA)

Appendix 3. Specific Criteria for Technology Selection

Specific criteria	Sub-criteria
a. Development benefits	Security and legality GDP growth, income equity, job creation Coastal and small island community development Capacity building
b. Environmental protection	Sustainable fisheries and aquaculture Marine resources protection, conservation, rehabilitation
c. Market potential	Business scale development Added value of marine & fishery products Development & intensification Marketing (commercial readiness)