

Adaptation Framework Thematic Brief: Fisheries & Aquaculture



Climate Change, Aquaculture and Fisheries

The impacts of climate change on aquaculture and fisheries vary significantly between regions. At a global scale, a decrease in maximum catch potential within the exclusive economic zones is projected for all greenhouse gas emission scenarios, ranging from minimum 2.8 percent (lowest emission pathway) to maximum 12.1 per cent (highest emission pathway) decrease by 2050. The tropics, especially the South Pacific, are expected to be most affected by climate change related decreases in fish stocks. For inland fisheries, climate change is likely to exacerbate existing stressors in many regions, however, in areas where increases in precipitation are expected these may benefit inland fish habitats. Aquaculture faces climate change impacts from extreme weather events, threatening infrastructure, and long-term impacts, including sea level rise, stock health and freshwater competition, that are likely to negatively affect aquatic production systems.

It is expected that saltwater fish stocks will shift, as species migrate to more favourable conditions, which could lead to competition over fishing areas. Increasing water temperature and resulting decrease in dissolved oxygen levels, as well as ocean acidification, will push fish and crustaceans beyond their biological ability to adapt within their original habitat. In freshwater systems, changes in water quality, quantity and the seasonality of flow regimes arising from shifting precipitation patterns will be felt sooner. It is expected that water bodies that are already under stress (for example from pollution, over-abstraction or over-fishing) will be more susceptible to damage from changes in temperature and precipitation regimes, while water bodies with fewer existing stressors will be more resilient to change. Inland water bodies around the equator may benefit from increased precipitation, which could lead to expansion and improved connectivity of fish habitat. However, taking advantage of positive impacts will require investments and adapted practices.

Aquaculture is vulnerable to climate change impacts including extreme weather events, causing production and infrastructure loss, as well as increased risk of disease, parasites and harmful algae blooms. In the long-term sea level rise and the availability of wild seed and competition over freshwater will affect marine and freshwater aquaculture. Often, countries with a large aquaculture sector are especially vulnerable due to their dependence on the sector for trade and as a food source. Additionally, unsustainable practices have strained aquaculture operations and degraded surrounding ecosystems in the past, adding to the sectors vulnerability. The aquaculture sectors in China, Viet Nam, Lao People's Democratic Republic, Bangladesh, Thailand, Uganda, Nigeria, Egypt, Madagascar, Belize, Honduras, Costa Rica, Ecuador, and Chile are considered to be particularly vulnerable.

Impacts will not be felt evenly, with countries that are dependent on trade and consumption of fish products more affected by fish migration due to climate change; with negative economic and social implications. Roughly 60 million people worked in the primary sectors of capture fisheries and aquaculture globally in 2016, of which over 80 per cent lived in Asia. With fishing and aquaculture farming as their primary livelihood and nutrition source, communities already living in poverty and food insecurity will be especially vulnerable to decreases in catch and aquatic production. Extreme weather events will affect small-scale fishing communities and aquaculture farmers most, as they often lack the resources to protect and replace damaged equipment. Thus, adaptation in the sector has to focus on resilient livelihoods and food security, ensuring that communities develop despite climate change impacts.

While a range of anthropogenic changes in oceans and freshwater bodies are well documented, projections of impacts on aquatic life vary in confidence due to the complex interplay of nutrients, temperature and light. Some impacts are currently unknown, for example, the consequences of changes in ocean circulation are not well understood but may be severe.

Adaptation and typical options available

Adaptation provides an important opportunity to mitigate the negative and take advantage of the positive effects described above, and the extent to which adaptation is integrated into fisheries management and governance will influence the severity of impacts in the sector. Through the transformation of aquatic production systems, it also provides the opportunity to improve on current conditions and improve food security among poor and marginalised groups. Adaptation for fisheries and aquaculture is highly context-specific, and influenced by the nature of local climatic, environmental and social systems.

Integrating a gender perspective in adaptation is critical, and it is clear that empowering women has positive outcomes in terms of capacity to adapt to climate change. Given the inequitable impacts of climate change, interventions need to be designed which specifically address the challenges faced by women, indigenous and marginalised groups, and poor people. Without this specific focus, there is a risk that adaptation can perpetuate and enhance existing inequalities.

Some interventions which increase the resilience of fisheries and aquaculture have ecological co-benefits. Sustainable fishing and coastal aquaculture, for example, protect the ecosystem from overfishing or -farming, while providing a livelihood and food source for rural communities. Better aquaculture farm design and management can reduce the need for input such as aqua-chemicals and feed, which are a cause of pollution and eutrophication. Adapting fisheries and aquaculture to climate change provides a good opportunity to also reduce non-climatic pressure on aquatic ecosystems.

Adaptation measures for fisheries and aquaculture can be broadly grouped into the following categories¹:

Adaptive practices

Adapting fishing and aquaculture practices to the impacts of climate change can play an important role in resilience building, especially among small-scale fishers and farmers who are generally more vulnerable to climate change impacts. Diversifying livelihood and food sources can buffer periodic shortfalls in catch. Minor changes in aquaculture farming, such as species selection and use of hatchery seed can improve farm resilience, however, this needs to be weighed against factors such as market demand and hatchery supply. Medium to large aquaculture farms may be able to shift location, adapt equipment and management to more favourable conditions.

Climate Information and risk management

Climate information in the form of marine weather forecasts and early-warning systems, if well-tailored, significantly increase the resilience of fisherfolk and aquaculture farmers. Storm and bad weather warnings save equipment and lives of fishers fishing at sea and in large inland waterbodies. Equipment that is more stable or durable may be less prone to damage during extreme weather events. Insurance products (weather derivatives) can be an effective risk transfer mechanism and allow fishers and aquaculture farmers to better recover from such events.

Research and knowledge generation

Research into local effects, risk and opportunities of climate change on aquaculture and fisheries is needed for well-informed adaptation measures. Knowledge of the aquatic ecosystem and the social system is required to avoid maladaptation. Building understanding of climate change impacts on their livelihood source, is a first step towards enabling fisherfolk and aquaculture farmers to make informed adaptation decisions.

Policy/Institutional measures

In order for adaptation measures to be effective and move beyond site-specific interventions there is a need for climate change to be integrated into national and regional policy processes and plans. Identifying the barriers to scaling up different adaptation measures, many of which may not be specifically related to climate change, but revolve around social protection, for example, and working to overcome these barriers can create better enabling conditions for adaptation. Building institutional capacity in the fisheries and aquaculture sector to plan for and implement adaptation measures, such as adaptation and contingency plans, can benefit the entire sector. This may include the provision of equipment or budgets to local institutions. Social protection strategies, especially for vulnerable small-scale fisherfolk and aquaculture farmers, women and marginalised groups, can increase their resilience to the effects of climate change.

Strengthening local institutions so that they are better able to deal with climate risks, for example by integrating climate risk management frameworks into organisational strategies, or training staff to use and act on climate information is also key in any adaptation strategy.

¹ For a comprehensive list of adaptation options for fisheries and aquaculture please see the Adaptation Options database.

Experience from the ASAP I programme

The Adaptation for Smallholder Agriculture Programme I (ASAP I) programme was launched in 2012, providing co-financing resources to scale up and integrate climate change adaptation into IFAD's investments. The programme reached eight million vulnerable smallholders in 43 countries, increasing their capacity to cope with climate change impacts and ability to build more resilient livelihoods.

As part of ASAP, two projects address the fisheries and aquaculture sector specifically. In Djibouti, the "Programme to reduce vulnerability to climate change and poverty of coastal rural communities (PRAREV)¹" (2015-2021) targets mainly coastal ecosystem restoration, coral reef protection, knowledge generation through research and monitoring, environmental education of residents and coastal fishing infrastructure improvement to protect fisheries' value chain. In Viet Nam, the "Project for Adaptation to Climate Change in the Mekong Delta (AMD) in Ben Tre and Tra Vinh Provinces¹" (2014-2020) focuses on tackling decreased agricultural production including aquaculture threatened by increasing salinity. Activities in capacity-building, climate-informed planning, technology transfer and access to credit are part of this project. The projects are examples of the holistic approach to adaptation, which has been promoted under the ASAP.

NDC Priorities

The fisheries and aquaculture sector is included in the (Intended) Nationally Determined Contributions (INDC/NDC²) of 62 IFAD partner countries. On a global scale, there is clearly recognition of the need for adaptation in the sector. However, at the national level, NDCs vary significantly in their depth and scope.

Adaptation priorities in the NDCs relating to the fisheries and aquaculture sector focus on the protection and restoration of coastal, wetland, lake and riverine ecosystems. An oft-cited measure is the protection and regrowth of mangrove forests. Improving and strengthening the resilience of fisheries and aquaculture production systems, value-chains and infrastructure is another commonly stated priority, for example by upgrading safety measures or replacing unsafe vessels. The sustainable use of aquatic resources and their importance for local food security is included in many NDCs, mainly promoting sustainable fishing practices. In the Asia and Pacific region in particular, the need for disaster risk management, including early-warning systems, is frequently cited. Social protection measures, which include extreme weather insurance of fishing and aquaculture equipment, as well as livelihood diversification of communities living from aquatic resources is less often found in NDCs. In most of Africa, a need for further research on the impacts of climate change on the sector has been included in NDCs.

Table 1 provides an overview of INDC/NDC priorities for adaptation in the fishery and aquaculture sector by IFAD region of operation. A full list of adaptation priorities by IFAD partner country can be found in the NDC adaptation priorities database.

² In the following, NDCs is used to refer to both, NDCs and INDCs.

Table 1: NDC priorities for adaptation in the fisheries and aquaculture sector

NDC priority	Asia and the Pacific	Latin America and the Caribbean	Near East, North Africa and Europe	East and Southern Africa	West and Central Africa	Total
Number of countries	14	11	9	11	17	62
Sustainable resource exploitation	2	5	2	7	6	22
Enhance food security	3	3	2	5	1	14
Ecosystem and biodiversity restoration, protection and conservation -coastal, riverine, wetlands, lakes	11	8	4	7	7	37
Disaster risk management incl. early-warning systems	9	0	3	2	1	15
Social protection (insurance, livelihood diversification)	2	0	3	3	4	12
Improve production & value-chains, physical protection of fishing and aquaculture infrastructure	6	2	6	9	11	34
Research on national CC impacts related to marine ecosystems, fisheries and aquaculture	0	1	2	2	4	9

Accessing the Green Climate Fund (GCF)

The GCF invests in adaptation and mitigation projects and programmes in developing countries, with the objective of limiting or reducing greenhouse gas emissions and supporting vulnerable people to adapt to climate change. Key to GCF access is ensuring that projects have a strong climate rationale – the justification for how the project addresses specific climate impacts and vulnerabilities. While there are lots of other GCF assessment criteria, in this brief we summarise how to craft a strong climate rationale. A strong climate rationale must first set out the need for adaptation, and then clearly describe the rationale for planned adaptation interventions and why they have been selected.

Step 1: Adaptation Evidence

The project team must describe the project context, namely expected climate change impacts, risks and vulnerabilities. Expected climate impacts should be based on scientific evidence, and thus the project team needs to demonstrate clear use of climate data in the assessment of impacts and vulnerabilities. Demonstrating clear risks from climate change, including, where possible estimates of economic damage and number of people affected, is key if a project is to qualify for GCF funding.

Assessment Criteria – project should answer:

- What are the climate risks, vulnerabilities, and impacts related to climate variability and change relevant to the project context?
- What aspects of climate vulnerability will be targeted?
- Which climate-related risks might prevent project objectives being achieved?
- What is likely business-as-usual development and what are climate change related vulnerabilities?

Step 2: Prioritization of Interventions

The second step is to identify and describe adaptation measures for the project that are clearly linked to the previously identified climate risks and vulnerabilities. Adaptation measures should be consistent with national priorities for adaptation and sustainable development. The Adaptation Options System provides a foundation for identifying and prioritising appropriate adaptation options for the project. Transparency of decision-making around project interventions, including assumptions and uncertainty behind the choice of options strengthens a climate rationale. A theory of change should describe how the adaptation interventions are expected to contribute to the project objective.

Assessment Criteria:

- What options are available to address identified climate related vulnerabilities and are the proposed adaptation options realistic?
- Are the options robust and within an appropriate envelope of uncertainty?
- What type of adaptation is being pursued: reducing adaptation deficit, incremental, or transformational adaptation?
- With the investment, what are the specific adaptation activities to be implemented to increase the climate change resilience of the business-as-usual activity or baseline?
- Project states intent to address outlined vulnerabilities and risks through the proposed interventions. (Could take out?)
- Does this project respond to national adaptation and sustainable development priorities?

Tools available to support project design

Various tools are available to help integrate adaptation into project design. In this note three main tools are highlighted, with a selection of additional data sources and tools provided under the resources section. Together, these tools provide support to IFAD staff to identify the relevant climate risks during project design, and integrate appropriate adaptation measures. They also provide the evidence base needed for the climate finance contribution from adaptation projects to be reported.

How to Do: Fisheries, Aquaculture and Climate Change

IFAD's How to Do note on Fisheries, Aquaculture and Climate Change includes guidance how to include climate change adaptation and mitigation in the design and implementation of Fisheries projects. This includes questions to ask to ensure that the project is taking into account the potential effects of climate change on the project, as well as a checklist for how to design a climate-sensitive project, and examples of adaptation measures for the sector.

Adaptation Options Prioritisation System

A database of adaptation options, and system for the assessment and prioritisation of adaptation options have been developed as part of IFAD's Adaptation Framework. The prioritisation comprises two main elements. First, the adaptation options in the database are filtered based on project sector, and the climate risks identified during the climate screening process. A multi-criteria analysis is then carried out on the shortlist of adaptation options to assist IFAD staff in choosing measures to integrate into the project using the following criteria:

- Technical feasibility
- Cost-benefit ratio
- How well the option addresses risks in the project context
- Complementarity to other IFAD themes
- Flexibility (i.e avoids lock-in)
- Mitigation co-benefits
- Transformative potential
- Accessibility for small-holder farmers

The Adaptation Options System uses a simple scoring system based on the eight criteria above. The first four criteria require a minimum score of 2; options which score lower than 2 on any of these criteria do not meet the minimum requirements and are not deemed to be suitable. Adaptation options which are scored the highest are most suitable for a project. The guidance below sets out how users of the system should score assign scores to the adaptation options for each of the criteria in the multi-criteria assessment.

Technical feasibility

The technical feasibility criterion is important in assessing which adaptation options are practical, given the skills, experience and capacity of the organisations tasked with implementing the project. If there is no prior experience with an adaptation option then the barrier to implementation may be too high, and there is an increased risk that it fails to meet its objectives.

1: Executing Agency has no experience implementing this type of adaptation option and there are no project partners with this experience.

2: Executing Agency does not have direct experience with this adaptation option, but partners are available who can provide technical expertise and experience with this type of option.

3: Executing Agency has previously implemented this type of adaptation option, and there is technical expertise within the organisation itself.

Economic case

The economic case includes a cost-benefit analysis and other instruments to establish the business case for public investment. The benefits must exceed the costs: the ratio of benefits to costs is greater than 1 in a cost-benefit analysis. Comparing the costs and benefits of different options allows for a comparison of the efficiency of different options, but requires costs and benefits to be calculated over the lifetime of the option and therefore requires a discount rate to be applied. The choice of discount rate for the analysis has an important bearing on the overall ratio of benefits to costs. Cost-benefit analysis for adaptation should also make some allowance for benefits that are hard to value in a traditional assessment, such as the benefits arising from improved environmental goods and services.

1: The benefits are less than the costs (BCR < 1) over the lifetime of the option, even with indirect benefits included

2: The benefit-cost ratio is in the range of 1-2. Benefits of implementing the option are higher than the estimated costs over the lifetime of the option although the benefits are not large and may be distributed unevenly among beneficiaries.

3: The benefit-cost ratio is greater than 2. Benefits of implementing the option are significantly higher than the estimated costs over the lifetime of the option and should be readily achieved.

Addresses climate risks

The extent to which an adaptation option increases resilience to the climate risks facing the project is a key consideration in prioritising options. All other things being equal, an option which increases resilience to several of the identified risks (e.g. livelihood diversification) should be prioritised over options that only address a single risk (e.g. increased flood protection). In the final consideration of which options to include in the project, care should be taken to select a package of options which address the different risks identified in the climate screening process.

1: Adaptation option is not relevant or may not be effective for the risks identified for the project.

2: Adaptation option effectively addresses at least one of the identified risks.

3: Adaptation option is relevant for all of the major climate risks identified for the project.

Accessibility for project beneficiaries

Adaptation options for IFAD projects should be appropriate for the project beneficiaries. This means ensuring that the adaptation option is affordable for target groups such as rural smallholders, youth or indigenous populations, or will not exacerbate existing gender inequalities (for example an insurance product that is only accessible to heads of the household, who may be predominately men).

1: Adaptation option is inaccessible for the main project beneficiaries (e.g. unaffordable, requiring regular complex maintenance), or exacerbates existing inequalities.

2: Adaptation option is accessible for the majority of the project's target beneficiaries.

3: Adaptation option is accessible to project beneficiaries and specifically benefits women or other marginalised groups.

Flexibility

Flexible and agile strategies for dealing with the uncertainty inherent in predictions of climate change ensure that adaptation options and strategies are developed in response to pressing needs and opportunities. This includes allowing for changes in approach as new information becomes available, or certain impacts start to pose a major risk. Flexibility in adaptation options is a function of the timeframe being considered, the design of the option, and the approach to managing change in the options being considered.

1: The adaptation option has a long life-time (>10 years) and its design does not allow for any adjustment. For example, a flood defence designed to cope with an additional 1m of flooding, and which would have to be completely replaced if greater protection was required.

2: The adaptation option being considered has a short lifetime (<10 years) meaning that considerations of flexibility are not as relevant.

3: The adaptation option is low or no regrets or is part of an adaptive management approach. Low regrets mean the option has benefits across a wide range of conditions. Thresholds and trigger points identified in adaptation strategies support adjustments in response to new information, risks or opportunities.

Mitigation co-benefits

Where possible we should prioritise those options which also have emissions reductions potential. For example, the reforestation to stabilise slopes prone to landslides has clear mitigation benefits, while a reduction in the use of fertilizer resulting from the implementation of low or no-till agricultural practices would decrease the emissions used in food production.

1: No mitigation co-benefits or adaptation significantly increases greenhouse gas emissions.

2: Adaptation option leads to emissions reductions, either at present or in the future.

3: Adaptation option involves reforestation, restoration of carbon sinks, or the substitution of fossil fuels for renewable energy sources.

Transformative potential

An adaptation option may enable fundamental change in the target system so that it becomes more resilient to climate change. Key attributes of transformative adaptation are that it addresses underlying barriers to change, and that it operates at scale; for example enabling access to insurance products amongst smallholders may create knock-on effects in risk-taking and ability to invest in productive assets and thus create transformative change in livelihoods and significantly increase resilience to climate change at a large scale.

1: Adaptation option is limited to small increases in the resilience of target group, but does not involve changes in wider systems.

2: Adaptation option operates at scale or enables wider implementation of the option, for instance with a declining marginal cost.

3: Adaptation option enables change in the system in question which significantly increases opportunities for target beneficiaries to adapt to climate change.

Complementarity to IFAD themes

Where possible the adaptation options selected should complement the other IFAD cross-cutting themes (Gender, Youth and Nutrition). For example, a drought-resistant crop variety may be introduced which is nutritionally superior to existing varieties.

1: No complementarity

2: Complements at least one other cross-cutting theme that is directly relevant to adaptation outcomes.

3: Complements more than one other cross-cutting theme to support systemic resilience.

Resources

IFAD Guidance

- How to do: Climate Change Risk Assessments in Value Chain Projects
- How to do: Measuring Climate Resilience
- IFAD Climate Finance Tracking guidelines
- How to do: Fisheries, Aquaculture and Climate Change

- Guidelines for Integrating Climate Change Adaptation into Fisheries and Aquaculture Projects
- Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests – Implications for IFAD

Adaptation Framework:

- Adaptation Options prioritisation system
- Access climate finance from the Green Climate Fund
- NDC Priorities database

Useful reports

- FAO (2019) Proceedings of FishAdapt: the Global Conference on Climate Change Adaptation for Fisheries and Aquaculture, Bangkok, 8-10 August, 2016. *FAO Fisheries and Aquaculture Proceedings No. 61*
- FAO (2018) Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. Fisheries and Aquaculture Technical Paper No. 627
- UNDP & FAO (2018) Promoting gender-responsive adaptation in the agriculture sectors: Entry points within National Adaptation Plans. Briefing Note
- FAO (2017) Adaptation Strategies of the Aquaculture Sector to Impacts of Climate Change, FAO Fisheries and Aquaculture Circular No. 1142
- FAO (2016) Fisheries, Aquaculture and Climate Change. The role of fisheries and aquaculture in the implementation of the Paris agreement
- CCAFS (2015) Supporting women farmers in a changing climate: five policy lessons, Policy Brief 10

Data & Tools

Climate data portals:

[World Bank Climate Portal](#)

[KNMI Climate Explorer](#)

[Climate Information Portal](#)

[COPERNICUS Climate Change Service](#)

[CCAFS Downscaled Climate Data Portal](#)

Climate hazards data:

[ThinkHazard](#)

[Global Flood Risk Analyzer](#)